

A Basic Study on Container-type Planting Ground for Perpendicular Greening

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This study is to find the effective way to green perpendicular wall spaces as soon as possible and to get basic data for activating the perpendicular greening on high story building through the experiment of container-type planting ground in which lightened artificial soil mixed with rock wool was put. Comparative studies of the sizes of containers and soil were carried out but separate management was not performed. Four plants(*Euonymus fortunei* var. *radicans*, *Lonicera japonica*, *Parthenocissus quinquefolia*, *Parthenocissus tricuspidata*) which have the capability to cover and screen perpendicular spaces were used in the experiment. In result, a container must be equipped with over 15cm depth soil mixed with less than 30% of rock wool.

Key Words : Perpendicular Greening, Containers planting, Rock wool, *Euonymus fortunei* var. *Radicans*, *Lonicera japonica*, *Parthenocissus quinquefolia*, *Parthenocissus tricuspidata*

1. Introduction

Despite the spread of perpendicular greening in Korea, most greening method is very passive to wait for the climbers to cover the walls. It is difficult to pass the limit of wall greening in a high rising city. Therefore the greening method by containers installed on the wall can be an effective way to cover high story building walls. The conditions of a container have to be light, strong against wind and light and durable during the winter months. Hence a planting ground must be filled with lightened artificial soil which is able to keep warm and moisture rather than regular soil.

In this study soil mixed with rock wool was used for the experiment. Rock wool is a fiber blown by pressure air when it flows out from the bottom electric furnace after melting the compound that limestone is blended with andesite, basalt and mixture of nickel-manganese slag at 1,500~1,600°C. The following are the catabolic characters of rock wool.

1. noncrystalline(no ion active)
2. low CEC(cation exchange capacity) and phosphorus absorption coefficient
3. capacity for retaining fertilizer and manure.

Rock wool products consist of fiber that the diameter is 3~10 μ m and very small gaps are equally distributed in it. Therefore Solid fraction & Air Filled Porosity are 3~4% and 95% each. The diffusion of nutritious liquid is very fast when it is moistened. Since rock wool is not only so light but germfree, it is easily treated and its structure is stable.

The capacity of keeping moisture in regular soil is strong when its ph is high but that in rock wool is strong when its ph is low. Regular or lightened soil except rock wool eliminates water at pH1.5. Hence rock wool is suitable for long term plants growing without watering. The capacity of rock wool to hold water can keep plants growing in the container where it become dry easily. Therefore rock wool is introduced as a material which is able to enhance the capacity of retaining moisture of soil in the container.

The purpose of this study is to get basic data for activating the perpendicular greening on high story building through the experiment of container-type planting ground.

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2. Method and Material of Experiment

This study is to find a method to rapidly cover a building with plants planted in container. Therefore comparative studies of the size of container and soil were carried out and separate management was not performed.

2.1. Experiment environment and method

24 containers of two sizes with three kinds of soil are installed on the retaining wall at the south of DICT(Daewoo Institute of Construction Technology). 4 kinds of 5 ground covers were planted in each container. The experiment could be objectively fulfilled since there was no obstacles to affect sunlight and wind flow. The plants were planted Oct. 2002. and measured for 2 months. After the measurement, the upper parts of plants except evergreen were removed. In spring, the plants were measured 2 times a month to check frost damage from Mar. 2003 to July 2004.

2.2. Experiment materials and their qualities

Containers have two different widths and heights. One is 500mm(length)×100mm(width)×200mm(height) and the other is 500mm×150mm×300mm. The material of container is stainless steel and non-woven fabric is attached to the inside of it to increase adiabatic ability. The depths of soil is 150mm, 250mm each. A drainage pipe is installed at the bottom(Fig. 1).

Midsized granule rock wool is mixed with soil to increase the quantity of moisture. Mixing rates are 50%, 30% and 10% of rock wool with soil mixed Cera-soil with regular soil(1:1)¹⁾. In the experiment

of container planting, soil depth to develop light container must be 25cm and 15cm each and rock wool to make efficiently managed container has to be mixed in percentage of 50%, 30% and 10% each.

The introduced plants are *Parthenocissus tricuspidata*, *Parthenocissus quinquefolia*, which can grow in the central part of Korean peninsula, *Lonicera japonica*, which shows flowers and *Euonymus fortunei* var. *radicans*, which is able to cover the wall during the winter time.

2.3. Measurement method and analysis

Measured items are height, root length, number of branch and leaf, length of node(distance between gnarls), number of node(the number of gnarls) and dry rate. After a final measurement, roots and upper parts are separated from each other and root length and wet-dry weight were measured to check dry rate. The leaves over 0.5cm were checked as an individual. The longest stem from the ground was measured. The numbers of node&length of node were measured at third gnarl from the bottom. As soon as plants were washed, roots and upper parts are separated. Being dehydrated, they were dried to check the dry weight.

SPSS Ver. 10.0 for window(SPSS Institute Inc., 2000) was used for experiment results analysis and the significant($p < 0.05$) of difference among the mean value of plants was approved in accordance with Anova test, Duncan Multiple Comparison(5%).

3. Result and Consideration

3.1. *Euonymus fortunei* var. *radicans*

There was no the significant($p < 0.05$) of these plants

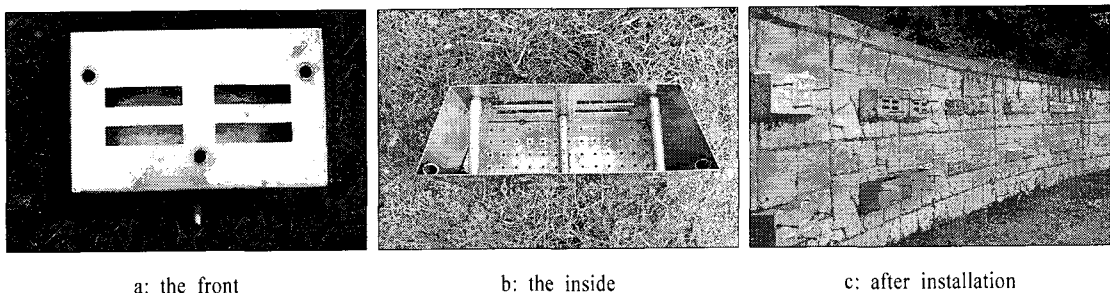


Fig. 1. container appearance.

1) The containers are made of stainless steel which is easily treated and durable but are not industrial products.

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because the growth made a little difference among them. But the growth in soil mixed with 30% of rock wool was better. Height of root & length of node had the significant($p<0.05$) and the best growth was in PLA. Although there was no significant($p<0.05$), the growth at 25cm soil depth was good about leaf number, height of root(root diameter) and root dry rate(Table 1).

3.2. *Lonicera japonica*

The upper parts of these plants were withered to death except the containers, PLB, PLC and PSC. So height of root and dry rate was measured to get the statistical significant($p<0.05$).

The plants shed their leaves after may. The growth

in 25cm depth soil mixed with 10% and 30% of rock wool and in 15cm depth soil mixed with 10% of rock wool was better. The mixed soil used in the containers had less moisture.

Although the longest height of root appeared at PLA, dry rate of both under and upper parts was excellent in PLC. It means that plant growth was good in the soil mixed with a little rock wool. The growth in 25cm soil depth was great(Table 2).

3.3. *Parthenocissus quinquefolia*

This plants had the significant($p<0.05$) except the length of node. Height of root and number of branch were excellent in PLB and PLC. Number of node and number of leaves were good in PLC and dry rate was

Table 1. The growth result of *Euonymus fortunei* var. *radicans*

Experiment planter type	Height(cm)	Root length(cm)	No. of branch(no)	Length of node(cm)	No. of node(no)	No. of leaves(no)	Root dry rate(%)	Crown dry rate(%)
PLA ^Z	18.7 a ^y	22.8 a	3.0 a	4.6 a	8.6 a	22.0 a	19.7 a	14.5 a
PLB	20.1 a	22.3 a	3.6 a	2.6 b	10.4 a	26.8 a	22.0 a	15.2 a
PLC	18.0 a	13.9 b	3.8 a	2.1 b	9.0 a	18.4 a	22.6 a	13.3 a
PSA	20.0 a	12.5 b	2.4 a	2.7 b	11.2 a	17.6 a	20.4 a	15.7 a
PSB	24.0 a	13.2 b	3.8 a	2.9 b	11.4 a	17.0 a	16.4 a	14.2 a
PSC	17.5 a	14.3 b	3.0 a	2.2 b	8.2 a	18.0 a	19.0 a	14.2 a

^y: Mean values with the same letter within are not significantly different at $p=0.05$ level in Duncan's multiple range test.
^Z : P : Planter , L: Depth of soil 25cm. S: Depth of soil 15cm, A: Mixed soil of wool rock 50%, B: Mixed soil of wool rock 30%, C: Mixed soil of wool rock 10%

Table 2. The growth result of *Lonicera japonica*

Experiment planter type	Root length(cm)	Root dry rate(%)	Crown dry rate(%)	mortality(%)
PLA ^Z	27.5 a ^y	7.7 bc	6.6 c	100
PLB	22.9 ab	15.0 ab	13.7 b	0
PLC	25.0 ab	16.4 a	18.4 a	0
PSA	18.0 ab	15.4 ab	8.1 c	100
PSB	18.6 ab	4.9 c	5.2 c	100
PSC	15.7 b	22.1 a	9.3 c	60

^{y, Z} : See Table 1.

Table 3. The growth result of *Parthenocissus quinquefolia*

Experiment planter type	Height(cm)	Root length(cm)	No. of branch(no)	Length of node(cm)	No. of node(no)	No. of leaves(no)	Root dry rate(%)	Crown dry rate(%)
PLA ^Z	37.3 ab ^y	22.3 ab	4.6 ab	8.4 a	8.4 b	31.0 ab	38.6 a	24.5 a
PLB	39.1 ab	29.8 a	7.0 a	8.8 a	7.4 b	37.0 ab	29.9 ab	21.2 ab
PLC	56.4 a	28.2 ab	6.2 ab	8.9 a	13.4 a	40.0 a	32.3 ab	23.1 ab
PSA	32.0 b	16.0 b	3.8 b	7.1 a	6.8 b	17.5 b	31.9 ab	17.3 ab
PSB	30.0 b	25.9 ab	5.2 ab	7.9 a	6.2 b	24.0 ab	25.3 b	15.7 b
PSC	24.3 b	25.3 ab	4.6 ab	9.1 a	4.4 b	21.4 ab	27.9 ab	20.8 ab

^{y, Z} : See Table 1.

Table 4. The growth result of *Parthenocissus tricuspidata*

Experiment planter type	Height(cm)	Root length(cm)	No. of branch(no)	Length of node(cm)	No. of node(no)	No. of leaves(no)	Root dry rate(%)	Crown dry rate(%)
PLA ^z	38.6 a ^y	30.4 a	9.2 a	5.7 ab	15.0 a	75.2 a	27.9 ab	16.7 a
PLB	35.9 a	21.9 ab	5.4 ab	6.0 a	19.0 a	66.8 a	19.6 b	13.2 a
PLC	33.9 a	23.6 ab	2.6 b	5.8 ab	16.0 a	52.4 a	26.7 ab	17.3 a
PSA	22.6 a	21.9 ab	10.2 a	5.3 ab	15.2 a	70.8 a	32.8 a	21.3 a
PSB	29.0 a	19.0 ab	7.0 ab	5.1 ab	19.4 a	42.0 a	21.4 ab	13.1 a
PSC	25.8 a	15.0 b	9.2 a	3.5 b	17.6 a	51.4 a	24.3 ab	17.3 a

^{y, z} : See Table 1.

fine in PLA followed by PLC. This means *Parthenocissus quinquefolia* generally grows well (Table 3).

3.4. *Parthenocissus tricuspidata*

This plant growth was generally excellent but there was no different among experiment results. Height of root and number of branch were fine in PLA. The root mature was the best in PSA (Table 4).

4. Conclusion

Generally, the growth in the container with 25cm depth of soil was thriving but result didn't have the significant ($p < 0.05$). The plants planted in soil with high rate of rock wool didn't grow well because of much moisture. But the growth of plants in the soil mixed with less than 30% of rock wool was excellent.

Using rock wool, it is possible to plant plants without irrigation. It can be used at the dry area and bad-growth surroundings in particular.

In result the container must be equipped with over 15cm depth soil mixed with less than 30% of rock wool. Especially, the container for *Lonicera japonica* must be made not to be so wet because it damps off in the wet soil.

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