A Preliminary Study on the Effect of Trenching on the Understory Vegetation under a Continuous Cano py

by

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連續林冠下에서 trenching이 下層植生에 미치는 影響에 關한 豫備調査

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INTROUDCTION

It was observed that there was no understory vegetation under a continuous canopy of Korean white pine, *Pinus koraiensis*(Sieb. et Zucc.), and larch, *Larix kaempferi*(Sarg.), stands in Kwangwon Do. This study was to determine which of the two reputed site factors, that is, light or soil moisture, among others was responsible for this lack of vegetation through a series of trenched quadrats.

Along this line, there has been a number of similar experiments. Outstanding ones were of Toumey and Kienholz(1931) at the Yale Forest, and of Korstian and Coile (1938) in the North Carolina Piedmont Plateau. They have confirmed that soil moisture rather than light had inhibitory effect responsible for the lack of understory vegetation under dense canopy.

DESCRIPTION OF THE STUDY AREA

This study was conducted at the Chunchon Agricultural College Forest located in Dongsan Myun, Chunsong Gun, Kangwon Do: more specifically it is situated at 37°50′ N in latitude and 127°50 E in longitude. The forest was artifically established in 1930 and were thinned in 1955 and in 1964. The study sites were located in the Ka and Na Subcompartments of Compartment No. 8; and these subcompartments along with Da have been designated as seed orchard of Korean white pine for the Forest. Stock volume after the 1964 thinning was 210 m^3/ha in average for each subcompartment. The annual growth rate has been estimated to be 4 percent, and the stand density to be 0.9. The sites in which plots were established were pure in stand composition.

The mean annual precipitation based on the 1957-1964 records for Chunchon Area was 1379mm, but over 80 percent of that amount had fallen during the six monts, from April to September. The mean annual temperature was 10°C. The lowest mean monthly temperature in 1964 was −7.1°C in February, and the highest was 25.9°C in August. The highest maximum temperature was 29.3°C recorded in August and the lowest minimum temperature was -11.0°C in February.

The growing season, estimated as the period between the last frost in spring and the first frost in fall, was about six and a half months, from mid-April or early May to mid-October.

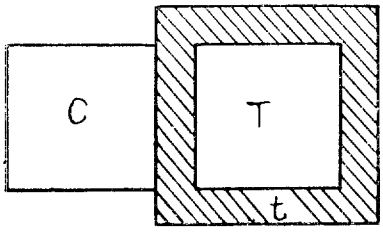
The soil was sandy loam to loamy sand and this has been formed by metamorphosed or weathered granite-gneiss; and the soil has been considered to be well suited for forest growth. The selected sites were southerly to southwesterly in aspect with slope gradient of 25 degree ranging from 18 to 29 degrees. Litter cover was 1−2cm thick and humus layer 3−5 cm thick. The A horizon was dark brown and reached down to a depth of about 25 cm, and C horizon

was located below the depth of 50–60 cm. In most cases zonation was distinct. Numerous stones of first-size were encountered in the mineral soil during trenching, and this was particularly noticeable at the plot No. 1. Otherwise all the other soil conditions in all the plots were homogenous.

THE LAYOUT OF PLOTS AND PROCEDURE

Five plots were established in small openings created by thinning done in 1964, and there were no understory vegetation to speak of. The surrounding trees were either dominant with an average height of 13 m and an average dbh of 16 cm.

Each plot had consisted of a pair of quadrats of which the dimension was 2×2m; and the pair consisted of a controlled quadrat and a trenched one. The pairs were so layed out that each were either adjacent or a very short distance apart. In trenching treatment, a continous trench was dug down to a depth of 1m around and outside of the 2×2 m sqare with a width of 50 to 60 cm as the drawing below:



C: the controlled quadrat
T: the trenched quadrat
t: the trench

In trenching all the roots encountered were cut to eliminate the possibility of soil moisture within the treated quadrat being taken away by the surrounding trees. Upon completion of digging, soil dug out was put back into the trench and the surface was made as natural as possible by covering with litter (as similar as possible to the original litter conditions). All the quadrats were marked by piles driven at their four corners.

All the plots had been established on April 17 and 18, 1965: four plots(designated as Plot No. 1, Plot No. 3, Plot No. 4, and Plot No. 5) under the canopy of Korean white pine, and the remaining one (Plot No. 2) in a larch grove. But the treatment at Plot No. 3 was litter removal, hence the result of the study in this plot has been excluded in this paper. Besides, a trenched quadrat was designated as T so that the trenched quadrat of Plot No. 1 could be expressed as Plot No. 1-T and so forth.

The first iventory of understory vegetation was taken on October 16, 1965 (a growing season later) and the second on September 22, 1966 (two growing season later). On the latter date, the understory vegetation grown in Plots No. 2 and No. 5 were clipped of aerial parts for weighing. Measurement for point density computation was also taken on the same day.

RESULTS AND DISCUSSION

Plot No. 1

After two growing seasons since trenching, this plot has shown the difference between the controlled and trenched quadrats in abundance of vegetation. However, the appearance of 30 individuals belonging to 7 species in 1966 in the trench edquadrat was noteworthy since there had been none in 1965. Although the detailed list of vegetation is as Tables I and II, its rough outline is given below (the figures in front and following a dash are the number of species and the number of individuals respectively):

	controlled quadrat	trenched quadrat
Annual grasses	1—1	1—9
Perennial grasses	2—4	3—1
Vines	1—1	1—1
Shrubs	1—1	1—13
Trees	0—0	1—1
Total	5—7	7—30

There have been 15 species in both quadrats in one time or other, but only one species, *Vitis nipponica*, was found in common.

This sparse appearance may be due to its soil texture and structure, its most prominent feature being the stoniness(largest number of stones as well as largest sizes encountered among all trenches). And this had probably witheld some of its effect of holding soil moisture within the quadrat.

As an indicator of light intensity under a continous canopy, a point density was taken up instead of a direct light measurement. Since the trenched and controlled quadrats were 7.6m apart, point density was taken at the center of each quadrat; and they were 36.992 and 34.597 m^2/ha respectively.

Whether this high point density plus a high stone content in soil had contributed for the low abundance in both quadrats are yet to be studied.

Plot No. 4

The trench around the upper three sides of the treated quadrat was half-washed down by runoff produced by heavy downpours in 1965 while the controlled remained intact. This resulting gullies may have added its soil moisture content or helped evaporation, and this also needs to be investigated.

The understory vegetation surveyed was listed in Tables III and IV, and the rough breakdown for that in 1966 is as follows:

	controlled quadrat	trenched quadrat
Annual grasses	1—17	3—122
Perennial grasses	4—33	6— 15
Vines	0— 0	1— 13
Shrubs	2— 4	3— 25
Trees	0— 0	0— 0
Total	7—54	14—176

Trenching had brought about an increase in numbers of species and individuals. However, it should be noted that the numbers of species and individuals of annual grasses, vines and shrubs in the trenched quadrat, were much more than those in the controlled, though the number of individuals of perennial grasses was less. Whether the effect of competition due to overcrowding has been most sensitively felt by perennial grasses is yet to be determined.

The species most common in both quadrats was an annual grass, *Impatiens textori*, which prefers wet sites. But the number of individuals varied greatly, e.g., 109 in the trenched and 17 in the controlled quadrat; and this is another further indication of a higher soil moisture content in the former's soil. On the other hand, the invasion of this species into the controlled quadrat may mean a gradual increase of soil moisture as the result of 1964 thinning. Out of 42 species emerged in both quadrats in 1965 and 1966, 10 were found in common.

Darker leaves, taller stems(not measured), and much better vigor were noted in the vegetation grown at the trenched quadrat.

The point density for this plot was 25.376m^2/ha, which was the lowest among all point density figures in the pine stand sites.

Plot No. 5

This plot had shown the largest difference in numbers of individuals found in both quadrats. The detailed results of its surveys are presented in Tables V and VI, and its rough grouping for 1966 is as follows:

	controlled quadrat	trenched quadrat
Annual grasses	2— 5	4— 36
Perennial grasses	6—18	4—306
Vines	1—18	1— 18
Shrubs	2—11	1— 4
Trees	1— 1	2 - 5
Total	12—53	12—369

The trenched quadrat shows larger numbers of individuals in all the groups except shrubs. Here the identical numbers of species and individuals in the vine group and in the total do not represent that they are identical species, however. In perennial grasses, the smaller number of species should be noted while the number of individuals is so much greater in the trenched quadrat.

As in the case of the trenched quadrat in Plot No. 4, the number of species in the trenched quadrat in 1966 had decreased to 12 from 16 found in 1965. This may also be reflecting an effect of competition due to high population density.

The most striking feature in this plot was the overwhelming abundance of *Polygonatum japonicum*, a perennial commonly found in shady sites, in the trenched quadrat, and this species occupied more than 80 percent of total number of individuals. This might be another indication of an increased soil moisture content being responsible for this abundance under an unchanged low light intensity. The species found in both quadrats in largest number was a vine *Vitis kaemferi*.

The total number of species found in both quadrats was 35 among which 9 were common. The vegetation observed on September 22, 1966 had shown that leaves were darker and larger and stems taller in the trenched quadrat but the vigor was not so good as in all other trenched quadrats. As in all the plots, the controlled quadrat became to support rather a large number of vegetation since its establishment. Plot. No. 5 confirmed the trend of a gradual increase of soil moisture following the 1964 thinning.

The point density for this plot was 31.664 m^2/ha, which is quite high.

All the aerial parts of vegetation in both quadrats were clipped off and their fresh and air-day weights were measured. The fresh weight in the control was 350 grams and its air-day weight 115 grams, while in the trenched the former was 1120 grams and the latter 230 grams. This indicates that the vegetation in the trenched quadrat was more succulent because the partial reduction of water content in the clipped sample plants due to air drying was 890 grams or about 80 percent of the fresh weight, while in the controlled its reduction was 235 grams or 67 percent of its fresh weight.

Plot No. 2

As mentioned earlier, this plot was established in a larch grove, and all the other conditions and treatment were same as in the previous plots.

The point density was 17.774m^2/ha, by far the lowest. The both had supported about the same number of individuals, but the trenched had much fewer number of species as may be seen in the following table:

	controlled quadrat	trenched quadrat
Annual grasses	2— 46	3—201
Perennial grasses	25—856	13—201
Vines	3— 30	4— 62
Shrubs	5— 73	5— 53
Trees	5— 10	2— 6
Total	40—1005	27—1006

The practically same number of individuals is deceiving; not only the species distribution differs but also the size of individuals in general varies greatly as the weight measurements as below shows:

	controlled quadrat	trenched quadrat
Fresh weight	1125 gr.	3300 gr.
Air-dry weight	400 〃	725 〃

The fresh weight of all the aerial parts clipped off the trenched quadrat was nearly 3 times whereas the air-dry weight was nearly 2 times those of the controlled. Darker and larger leaves and taller and bigger stems and better vigor were witnessed in the common species found in the both quadrats.

Here, a much larger number of individuals in annual grasses and a much smaller number of individuals in perennial grasses were also found as in the plot No. 4 (see Tables VI and VII). Three perennials, *Asplenium incisum*, *Carex lanceolata* and *Isodon inflexus*, were found in both quarats and were in great number among others. Out of 109 species in both buadrats, 33 species were found commonly in the both one time or another.

SUMMARY AND CONCLUSIONS

The foregoing results can be condensed as the table below:

plot	No. of Spp. (No. of Ind.) 1965	1966	point density
			m^2/ha
No. 1-C	3(3)	5(7)	34.597
No. 1-T	0(0)	7(30)	36.992
No. 4-C	8(26)	7(54)	
No. 4-T*	17(100)	14(176)	25.376
No. 5-C	9(30)	12(53)	
No. 5-T	16(96)	12(369)	31.664
No. 2-C	38(565)	27(1006)	
No. 2-T	33(761)	40(1005)	17.774

*Half-washed in 1965

The above table suggests that:

(1) After two growing seasons, the nusmber of individuals in the trenched quadrats were greater than those in the controlled quadrats. And so were the number of species.

(2) The number of individuals had increased in two growing seasons in all the quadrats, and so has the number of species except Plot Nos. 5-T, 4-C, and 2-C.

(3) Point density may be associated with the increase in the number of individuals, e.g., the lower the point density, the greater the numbers of individuals and species may become.

(4) The vegetation in the trenched quadrat was larger, darker and thriftier in all instances than in the controlled.

Therefore, the following can be concluded:

1. Trenching has increased the number of individuals as well as the number of species regardless of stand composition in two growing seasons.

2. The effect of thinning in 1964 in increasing soil moisture has been apparent.

3. The effect of trenching may have been accelerated by lower point density.

4. There may be competition among species within a quadrat.

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Table I, Change in Abundance of Vegetation in Plot No. 1-C

Botanical Name (Korean Name)	1965	1966
Scrophularia buergeriana(현삼)	1	—
Quercus dentata var. fallax(청떡갈나무)	1	—
Carpesium divaricatum(긴담배풀)	1	—
Asplenium incisum(꼬리고사리)	—	3
Lespedeza crytobotrya(참싸리)	—	1
Viola nipponica(아욱제비꽃)	—	1
Youngia japonica(박조가리나물)	—	1
Co cculus trilobus(댕댕이덩굴)	—	1
Total in species	3	5
Total in individuals	3	7

Table II, Change in Abundance of Vegetation in Plot No.1-T

Botanical Name (Korean Name)	1965	1966
Aralia elata var.canescens(두릅나무)	—	13
Persicaria posumbu(장대여뀌)	—	9
Astilbe chinensis var.typica(노루오줌)	—	3
Tradescantia canaliculata(자주달개비)	—	2
Actinidia arguta(다래나무)	—	1
Quercus acutissima(상수리나무)	—	1
Viola nipponica(아욱제비꽃)	—	1
Total in species	0	7
Total in individuals	0	30

Table III, Change in Abundance of Vegetation in Plot No. 4-C

Botanical Name (Korean Name)	1965	1966
Aster spp. (취)	—	18
Impatiens textori(물봉숭)	—	17
Petasites japonicus(머위)	—	8
Viola ovato-oblonga(긴잎제비꽃)	3	6
Smilax sieboldii(청미래)	—	2
Securinega suffeuticosa(광대싸리)	—	2
Ligularia stenocephala(곰취)	—	1
Urtica thunbergiana(쐐기풀)	13	—
Vicia pseudo-orobus(큰등갈퀴덩굴)	3	—
Dioscorea japonica(마)	2	—
Agrimonia pilosa var. japonica(짚신나물)	2	—
Smilax nipponica(밀나물)	1	—
Persicaria fauriei(가시여뀌)	1	—
Morus bombycis(산뽕나무)	1	—
Total in species	8	7
Total in individuals	27	54

Table IV, Change in Abundance of Vegetation in Plot No. 4-T

Botanical Name (Korean Name)	1965	1966
Impatiens textori(물봉숭)	31	109
Vitis kaempferi(산머루)	8	13
Persicaria fauriei(가시여뀌)	—	12
Cocculus trilobus(댕댕이덩굴)	—	8
Securinega suffeuticosa(광대싸리)	—	9
Corylus heterophylla var. japonica (개암나무)	5	8
Petasites japonicus(머위)	—	6
Festuca ovina var. vaginata (키다리김의털)	—	3
Disporum sessile(윤판나무)	—	3
Tradescantia canaliculata(자주달개비)	—	1
Pleuropteropyrum polymorphum (승애)	—	1
Persicaria senticosa(며느리밑씻개)	—	1
Fragaria neglecta(땅딸기)	—	1
Urtica thunbergiana(쐐기풀)	18	—
Smilax nipponica(밀나물)	6	—
Amphicarpa trisperma(서리콩)	6	—
Paraixeris denticulata(이고들빼기)	4	—
Agrimonia pilosa var. japonica (짚신나물)	4	—
Vicia chosenensis(참갈퀴덩굴)	4	—
Vicia pseudo-orobus(큰등갈퀴덩굴)	3	—
Arundinella hirta var. triphyllus(새)	3	—

Diosco rea japonica(마)	2	—
Morus bombycis(산뽕나무)	2	—
Commelina communis(달개비)	1	—
Spuriopimpinella bracycarpa(참나물)	1	—
Viola variegata var. chinensis (알룩제비꽃)	1	—
Duchesnea wallichiana(뱀딸기)	1	—
Unknown(不識別種)	—	1
Total in species	17	14
Total in individuals	100	179

Talbe V, Change in Abundance of Vegetation in Plot No. 5-C

Botanical Name (Korean Name)	1965	1966
Vitis kaempferi(산머루)	15	18
Cocculus trilobus(댕댕이덩굴)	—	8
Thalictrum actaefolium var. brevistylum(참꿩의 다리)	1	6
Isodon inflexus var. macrophyllus (깨나물)	—	6
Persicaria fauriei(가시여뀌)	1	4
Smilax sp.(청가시나무)	4	3
Circaea quadrisulcata(말털이슬)	—	2
Dioscorea japonica(마)	1	2
Quercus acutissima(상수리 나무)	1	1
Arisaema amurense var. serratum (천남성)	—	1
Impatiens textori(물봉숭)	—	1
Viola variegata var. chinensis (알룩제비꽃)	—	1
Urtica thunbergiana(쐐기풀)	5	—
Vicia pseudo-orobus(큰등갈퀴덩굴)	1	—
Viola ovatc-oblonga(긴잎제비꽃)	1	—
Total in species	9	12
Total in individuals	30	53

Table VI, Change in Abundance of Vegetation in Plot No. 5-T

Botanical Name (Korean Name)	1965	1966
Polygonatum japonicum(둥굴레)	55	301
Vitis kaempferi(산머루)	10	18
Persicaria faueiei(가시여뀌)	6	17
Phaseolus nipponensis(새팥)	—	12
Morus bombycis(산뽕나무)	2	4
Impatiens textori(물봉숭)	1	4
Aralia elata var. canescens(드릅나무)	3	4
Aresaema amurense var. serratum (천남성)	1	3
Commelina communis(달개비)	1	3
Pinus koraiensis(잣나무)	—	1
Viola mandshurica var.ciliata(제비꽃)	—	1
Thalictrum actaefolium var. brevistylum(참꿩의 다리)	—	1
Urtica thunbergiana(쐐기풀)	6	—
Viola variegata var. chinensis (알룩제비꽃)	3	—
Amphicarpa trisperma(새콩)	3	—
Dioscorea japonica(마)	1	—
Asiasarum heteropoides var. manchuricum(족두리풀)	1	—
Indigofera kirilowi(땅비싸리)	1	—
Quercus dentata(떡갈나무)	1	—
Vicia pseudo-orobus(큰등갈퀴덩굴)	1	—
Total in species	16	12
Total in individuals	96	369

Table VII, Change in abundance of Vegetation in Plot No. 2-C

Botanical Name (Korean Name)	1965	1966
Asplenium incisum(꼬리고사리)	251	251
Carex lanceolata var. nana(산거울)	—	212
Isodon inflexus var. macrophyllus (깨나물)	—	88
Viola xanthopetela(노랑제비꽃)	—	51
Impatiens textori(물봉숭)	—	45
Aster spp. (취)	—	45
Pleuropteropyrum ochreatum(승애)	—	43
Astilbe chinensis var. typica (노루오줌)	2	36
Rubus parvifolius(멍석딸기)	30	53
Ixeries dentata(씀바귀)	—	24
Rubia akane(꼭두서니)	20	23
Dioscorea japonica(마)	1	13
Clematis trichotoma(할미질빵)	10	12
Angelica decursiva(바디나물)	—	13
Eccoilopus cotulifer(기름새)	—	19
Circaea quadrisulcata(말털이슬)	—	9
Clematis tubulosa(조희풀)	—	9
Cocculus trilobus(댕댕이덩굴)	—	8
Tradescantia canaliculata (자주달개비)	—	6
Lysimachia barystachys(까치수염)	10	6
Duchesnea wallichiana(뱀딸기)	1	6
Clematis mandshurica(으아리)	1	5
Vicia nipponica var. typica (네잎갈퀴)	3	4
Vicia pseudo-orobus(큰등갈퀴덩굴)	21	3
Actinidia arguta(다래나무)	2	3
Quercus dentata(떡갈나무)	2	3

Codonopsis lanceolata(덕궝)	—	3
Thalictrum acquilegifolum var. japonica(궝의다리)	—	3
Quercus acutissima(상수리나무)	—	2
Larix kaempferi(낙엽송)	—	2
Morus bombycis(산뽕나무)	1	2
Viola mandshurica var. ciliata (오랑캐꽃)	—	2
Lespedeza bicolor var. japonica (싸리나무)	—	2
Desmodium podocarpum var. glabrescens(민둥도둑놈의갈구리)	—	2
Rhus trichocarpa(개옻나무)	—	1
Cirsium setidens(고려엉겅퀴)	—	1
Siegesbeckia glabrescens(진득찰)	—	1
Ranunculus japonicus(미나리아제비)	—	1
Iris nertschinskia(붓꽃)	—	1
Securinega suffeuticosa(광대싸리)	—	1
Cyclosorus acuminatus(별고사리)	195	—
Viola ovato-oblonga(긴잎제비꽃)	40	—
Festuca ovina var. vaginata (키다리김의털)	30	—
Urtica thunbergiana(쐐기풀)	38	—
Festuca duriuscula(이삭김의털)	22	—
Rubus crataegifolius(산딸기)	17	—
Carpesium divaricatum(긴담배풀)	13	—
Oxalis corniculatum(괭이밥)	13	—
Thalictrum actaefolium var. brevistylum(참궝의다리)	6	—
Elsholtzia patrini(향유)	8	—
Vicia chosenens(참갈퀴덩굴)	5	—
Paraixeris denticulata(고들빼기)	5	—
Asiasarum heteropoides var. mandshuricum(족두리풀)	4	—
Arundinella hirta var. ciliata (새)	4	—
Arisaema amurense var. serratum (천남성)	2	—
Smilax nipponica(밀나물)	2	—
Spuriopimpenella bracycarpa(참나물)	1	—
Cassia nomame(차풀)	1	—
Amphicarpa trisperm(새콩)	1	—
Total in species	33	40
Total in individuals	565	1006

Table VIII Change in Abundance of Vegetation in Plot No. 2-T

Botanical Name (Korean Name)	1965	1966
Asplenium incisum(꼬리고사리)	—	199
Isodon inflexus var. macrophyllus (깨나물)	—	149
Carex lanceolata var. nana(산거울)	—	131
Arthraxon hispidus var. brevisetus (조개풀)	39	129
Impatiens textori(물봉숭)	22	69
Astilbe chinensis var. typica (노루오줌)	3	43
Aster spp.(2) (취二鍾)	—	55
Rubia Akane(꼭두서니)	22	40
Pleuropteropyrum polymorphum (승애)	—	30
Cocculus trilobus(댕댕이덩굴)	—	29
Clematis trichotoma(할미질빵)	9	28
Lysimachia barystachys(까치쉬엄)	12	23
Rubus crataegifolius(산딸기)	4	15
Carpesium abrotanoides(담배풀)	7	14
Vicia nipponica var. typica (네잎갈퀴)	—	12
Actinidia arguta(다래나무)	5	8
Cirsium setidens(고려엉겅퀴)	2	5
Rubus parvifolius var. triphyllus (멍석딸기)	4	4
Ranunculus japonicus(미나리아제비)	1	4
Smilax china(청미래덩굴)	2	4
Staphylea bumalda var. typica (고추나무)	—	4
Siegesbeckia glabrescens(진득찰)	1	3
Clematis mandshurica(으아리)	—	3
Quercus aliena(갈참나무)	1	2
Torilis japonica(사상자)	—	1
Securinega suffeuticosa(광대싸리)	—	1
Atractylodes lyrata(가는잎삽추)	—	1
Urtica thubergiana(쐐기풀)	124	—
Cyclosorus acuminatus(별고사리)	65	—
Spuriopimpinella bracycarpa (참나물)	35	—
Festuca ovina var. vaginata (키다리김의털)	32	—
Festuca duriuscula(이삭김의털)	31	—
Viola nipponica(아욱제비꽃)	23	—
Vicia pseudo-orobus(큰등갈퀴덩굴)	23	—
Viola ovato-oblonga(긴잎제비꽃)	22	—
Oxalis corniculata(괭이밥)	19	—
Arundinella hirta var. ciliata(새)	16	—
Aconitum jaluense(투구꽃)	8	—
Ixeris dentata(씀바귀)	8	—
Vicia chosenensis(참갈퀴덩굴)	5	—
Dioscorea japonica(마)	4	—
Duchesnea wallichiana(뱀딸기)	4	—
Cnid um officinale(천궁)	3	—
Carpesium divaricatum(긴담배풀)	2	—
Sanguisorba officinalis(오이풀)	2	—

Agrimonia pilosa var. japonica (칠신나물)	1	—
Hypericum ascyron var. genuinum (물레나물)	1	—
Carpinus laxiflora(| — |)(서나무)	1	—
Vicia unijuga var. typica(나비나물)	1	—
Unknown species(不識別種)	1	—
Total in species	33	40
Total in individuals	761	1005

摘　要

林床에 下層植生이 全然없는 35年生잣나무 및 落葉松單純林의 林冠下에 trenching(方形區둘레에 홈파주기)을 하여준 結果, 二年後 trenching을 해준 處理區에서는 對照區에比하여 發生한 植物들의 種類와 個體數가 훨씬많았었다. 또한 그 林分에서 있었던 1964年의 間伐이 土壤水分을 增加해준 結果가 뚜렷하였었다. Trenching의 效果는 試驗區의 point density에 따라 增減이 있는 것같았으며, 下層植生의 發生이 旺盛한 方形區內의 植物間에는 競爭이 있는듯한 徵候가 있었다.

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