ROLE OF PASTURAGE GRASS ROOTS FOR SOIL CONSERVATION - SOIL PARTICLE HOLDING FUNCTION WITH PASTURAGE GRASS ROOTS

Hiroshi KOBAYASHI and Toshihiro SUGIURA
School of Veterinary Medicine and Animal Sciences, KITASATO UNIVERSITY
Towada-shi, AOMORI 034, JAPAN

ABSTRACT
With the latest advance of large-scale grassland establishment, grassland agriculture requires not only a high productivity of good quality forages for livestock but also effective of soil conservation. We must obviously study the physical effects of pasture cropping on the grassland soils. In this paper, we deal with the soil holding function of pasturage grass-roots as a part of studies on roots and grassland soil.

The results obtained are as follows :

1) Soil compact strength of perennial roots shows a high value. For example, in perennial roots of Tall fescue (*F.arundenacea*), its value is 70kg or more per one tiller. Good vegetational conditions make the values higher.
2) The vigorous roots of Italian ryegrass (*L.multiflorum*) which are cultivated in a grass box were used in the experiment of soil holding function by grass-roots. Holding soil weight of all roots per one tiller increase rapidly with increasing growth stage. However, as the conversion for one root, this weight is not increased after an 8-week growth.
3) The conditions of holding soil particles of vigorous roots were investigated by microtechnique. The root hair which grows from adventitious roots or branch roots held soil particles directly.
4) The points of contact of root hairs with soil particles were investigated by the microchemical method. The vigorous roots or root hair are distributed between voids of soil in a netted condition.

KEYWORDS
Pasturage grass roots, soil particle

INTRODUCTION
Pasturage grass, which is a thick stand crop, covers the surface of agricultural land and has an abundance of root systems. Consequently, these factors have been recognized to reduce water loss and erosion due to wind and water (Hughes *et al.*, 1962). With respect to the land conservation function of pasturage grass root systems, the basic mechanism is considered to be the root's soil particle holding function.

For the past few years, we have been conducting research on primarily pasturage grass of the Gramineae family. We have completed research on the land conservation function from the perspective of both grass and soil. This is for two reasons : first, the root system of pasturage of the Leguminous family ; another reason is that we thought that grasses, which spread over a larger area than legume, are more advantageous when considering land conservation.

EXAMPLE I ; COMPACT SOIL BY PERENNIAL PASTURAGE GRASS ROOTS

MATERIALS AND METHODS
Sample Grass Type: At the grassland of Kitasato University which is Sandy Loam soil, Timothy (*Phleum pratense L.*) was selected from among the various grass types being grown in the two year sward and six year sward. The 75 specimens from the two year sward and 100 from the six year sward were tested as samples of average growth patterns.

Measurement of Binding Strength: The binding strength of a root system was defined as the resistance factor measured when individual roots were pulled from the ground. A spring tension meter (capacity of 100kg) was used for measurement and it was taken by inserting metal pins of à@10m/m at a cross angle 5cm under the earth's surface and connecting them to the meter by a wire cord.

RESULTS AND DISCUSSION
The measurement results are shown in Table 1. According to these results, there wasn't a big difference in the degree of tension of two sections. In the case of Timothy perennial root systems, the binding strength was in the 70-80kg range.

In the case of pasturage grasses, the soil holding function undergoes a rapid increase during its growth to a mature plant (Kobayashi *et al.*, 1977). It can be inferred that after two years, under perennial growth conditions, the pasturage grass will hold the soil completely.

The tension value of individual roots in correlation with its growth tiller is shown in Table 2. Here, both the two year sward section and the six year sward section are proven valuable. This demonstrated that the individual roots with lush growth above ground are able to hold the soil firmly.

Upon observation, the samples that were pulled from the ground almost all was individual roots with a thickness of about 15cm. This corresponds to the aforementioned main root group functions in the consolidation of the plant.

This type of test has also begun to be applied to the issue of revegetation on a artificial slope by pasturage grass.

EXAMPLE II ; HOLDING OF PARTICLES BY VIGOROUS WHITE ROOTS

MATERIALS AND METHODS
Sample Grass Type: Italian ryegrass (*L.multiflorum*, Oobahikari type)

Growth Plot: Glass boxes were filled with washed quartz sand which was sifted through 1mm mesh to even out the particles. The dimensions of the glass boxes' varied with the growth period; the two variations were, W30Å~L30Å~D0.5(cm) and W40Å~L30Å~D2.5(cm).

Culture Method: One week old young plants that had sprouted in a lab dish were replanted individually into glass boxes. The box was then soaked in the Kasugai Liquid Fertilizer. Then, this was monitored inside a phytotron at a constant condition of 15Åé, 55%, artificial light 7hrs. per day (30,000lx) until the plants were 12 weeks old.

Experiment Methods: The boxes were disassembled at 3 stages; at 4, 8, and 12 weeks. After examining the growth above ground, they were dried for a 24 hours. After that, the base of the plant was grasped and the plant was lifted out of the soil. At this point, the sand sticking to the roots were measured and this measurement was defined as the plant's sand holding power. Furthermore, the sand was separated by

rinsing with water, and at this point, the root length, number and weight were examined**.** Also, methylene blue liquid dye was used to differentiate the root from the sand particles and projectors as well as microscopes were used to observe the patterns of sand holding.

TEST RESULTS AND DISCUSSION

Table 3 shows the growth of the test grass and holding weight with respect to time.

Including the tillering number, the plant growth above ground went smoothly. With respect to the roots, the growth of the sample grass was determined as normal, as the total root number of 12 week old plants were more than 10 times that of 4 week old plants. The weight of sand particles that a single root complex could hold increased in proportion to the increase of root numbers; the 12 week roots could be seen to hold 100 times the quantity of particles as the 4 week complex. However, when this measurement is converted to the quantity of particles held per single root, there is no difference between the quantity of 8 and 12 week roots. They both hold 10 times the quantity held by 4 week plants.

Thus, excluding plants such as the 4 week grass still in their youth period, it is thought that there is a limit to the holding strength of the individual roots.

CONCLUSION

The soil holding function of pasturage grass roots is, from the point of view of the soil, the aggregation of the soil surrounding the root (Kobayashi, 1980). Thus, for this basic mechanism to lead to the creation of water resistant bonds or even to soil erosion prevention, the discussion of the interaction between the soil and organisms, including the breakdown of perennial roots into organic matter and the function of microorganisms, becomes an important issue.

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Table 1
Soil compact strength by perennial roots (Timothy)

years passage	compact strength (kg per tiller)	sample numbers
2 Years sward	79.4±3.33	75
6 Years sward	72.0±1.80	100

(mean± S.E.)

Table 2
Correlation coefficients relating numbers of perennial tillers and soil compact strength by roots (Timothy)

2 Years sward	r = 0.639***	(n = 75)
6 Years sward	r = 0.512***	(n = 100)

*** Significant at 0.1% level

Table 3
Vegetation of top and root of Italian ryegrass, and weight of catching sand by roots at 4, 8 and 12-week after sowing.

(mean ± S.E.)

vegetation	TOP	tillering numbers	1.68±0.27	11.20±1.02	31.77±4.38
		mx. leaf length, cm	17.11±2.01	32.80±3.14	42.80±4.55
	ROOT	mean length, cm	6.14±0.91	16.74±1.09	21.84±1.00
		mx. length, cm	8.98±1.04	30.87±1.69	47.28±1.64
		total numbers	10.56±1.21	34.80±3.15	113.54±23.42
		oven-dry weight, mg	6.81±2.24	234.88±46.15	1041.35±184.41
catching sand		total weight, gr	2.78±0.94	82.16±18.21	258.17±44.18
		weight per ont root, gr	0.21±0.59	2.18±0.49	2.29±0.36
sample numbers			16	10	13
after sowing			4-week	8-week	12-week