Grassland Renovation by Taking Advantage of Natural Reseeding

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Introduction

Recently, old, deteriorated, weedy and unproductive grasslands have increased in number in various parts of Japan. Such areas need renovation to change into highly productive grasslands. The traditional method of grassland renovation by means of entire cultivation and sowing, however, has many difficulties such as high cost, risk of erosion, etc. Cultivation by machinery is inapplicable to hilly and rocky grasslands, widely distributed in Japan. Therefore, it is necessary to find out a new practical method of renovation in place of the traditional one.

The authors have studied a new method of grassland renovation, i.e., the practical application of natural reseeding, to evade the difficulties of conventional seed-bed preparation. This new method is to renovate old swards with low cost and labor-saving by taking advantage of natural reseeding of standing grasses without cultivation.

The results of the present study starting in 1976 are given briefly in this paper. The practical application of natural reseeding aiming at grassland renovation is termed 'natural reseeding treatment' in this paper.

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Procedure of the natural reseeding treatment

The keys to success of the natural reseeding treatment are as follows: (1) It is essential to have good supply of shed seeds (from mature grasses), which can germinate well and establish seedlings, by early autumn. Early autumn is the suitable seeding time for either establishing or renovating grasslands. (2) The mature grasses accumulated during the period from spring to summer must be cleaned up by grazing or cutting until early autumn. Intensive grazing on the accumulated grasses is useful to scatter the shed seeds and trample them into the ground like hoof cultivation. (3) The environment for the shed seeds must be adjusted by fertilizer application, grazing, and cutting in order to secure the best germination. (4) After shed seeds germinated, the growth of adult plants must be suppressed properly by grazing or cutting so that the seedlings can well be established, due to reduced competition between adult plants and the seedlings.

Grassland management before the seed shedding

Fertilizer application is effective for seed production. Liming material application is useful not only in amending soil acidity but also reducing soil hardness[6].

Roberts[8] and Kitahara[2] showed that cutting after ear formation reduced the number of heads, seed yields and percentage of ripen-

ing seeds. Hence in this renovation method, it is recommended that grazing or cutting in spring should not be extended beyond the stage of inflorescence formation. In weedy grasslands, weeds should be suppressed or killed with herbicide until the end of the year preceding the year of the natural reseeding treatment.

Grassland management after the seed shedding

It is necessary to utilize (by grazing or cutting) the accumulated mature grassess approximately from late July to late August, when 70% or more of the total seed yield of orchardgrass and tall fescue has already shed to germinate in rainy autumn[3].

Since the grasses accumulated by that time without being utilized include a large amount of dead materials, the nutritive value of them is fairly inferior to that of usual grasses[1]. Cattle, however, clean up the accumulated material quite well irrespective of their maturity[1]. It is desirable that about 60–70% of the total mass of the accumulated grasses can be utilized by grazing. If the utilization is insufficient, a large quantity of litter accumulate on the ground, which may inhibit the germination of shed seeds.

After the removal of the accumulated grasses, open space on the grasslands increased and about 70% or more of the total adult plants died (its value differs with climate, years after the establishment of grassland and species of grasses[4,5]. The death of adult plants is very favorable for germination of shed seeds and seedling establishment because of reduced competition to the adult plants. The most important aspect at this time is weeding. When weeds grew rankly, they must be removed. It is also necessary at this time to apply fertilizer to promote the growth of seedlings.

Before seedlings are fully established in autumn, the grassland should be properly grazed or cut to reduce the competition between adult grasses or weeds and seedlings.

Selection of grass species suitable for the natural reseeding treatment

A 4-year field experiment was conducted to evaluate the contribution of the natural reseeding treatment to the density and production of eight temperate grass swards[4]. The experiment employed a split plot design with or without the natural reseeding treatment as the main block and kind of grasses as sub-plots. In the non-reseeding plots, grasses were cut at the same time as in the reseeding plots, but seedlings grown from the seeds naturally shed were removed as early as possible. Grasses used were orchardgrass (cv. Potomac, Akimidori, S143), tall fescue (cv. Kentucky 31), Kentucky bluegrass (cv. Baron), perennial ryegrass, smooth bromegrass (cv. Carlton) and red top. Two years after reseeding, the whole plots were harvested with five cuttings a year at the same dates. The differences in yield and

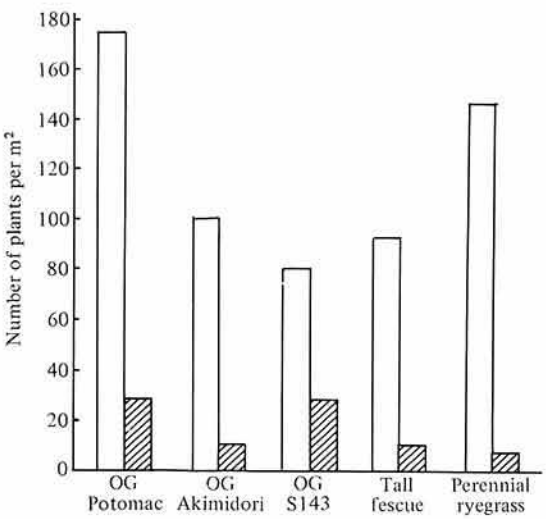

Fig. 1. Effect of natural reseeding treatment on plant density at the last cutting in the third experimental year

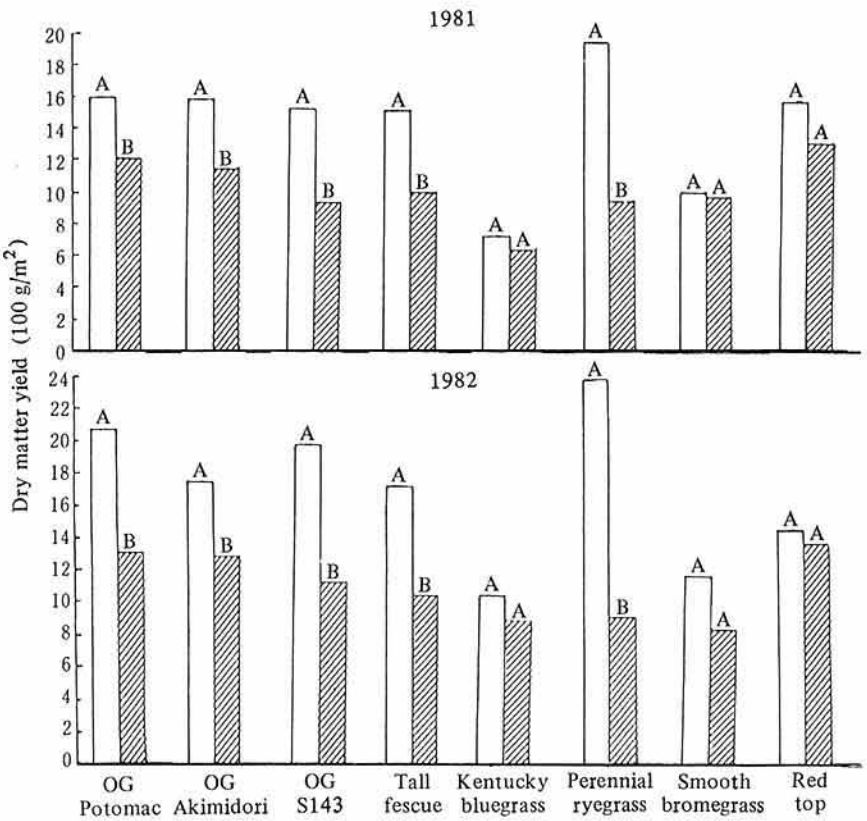

Fig. 2. Effect of natural reseeding treatment on annual dry matter yield of different grasses
See the footnote of Fig. 1.
Each pair of columns bearing a common letter on the top is not significantly different ($P<0.05$) according to the Duncan's multiple range test.

tiller density between reseeding treatment and non-reseeding treatment were regarded as the contribution of natural reseeding.

The results obtained are shown in Figs. 1 and 2. It seems that perennial ryegrass and orchardgrass are suitable for the natural reseeding treatment. Fortunately, orchardgrass is one of the most important grass species in Japan. Legumes suitable for natural reseeding treatment have not been identified.

Difference between the method of natural reseeding treatment and the sod-seeding method

Both methods have a common seed-bed preparation, i.e., not to plough and not to till the ground. However, there are several points of differences between both methods.

(1) There is a great difference in quantity of shed seeds between the natural reseeding treatment and the sod-seeding method. For example, in orchardgrass the quantity of the former is about 700–900 kg per ha[5].

(2) Soil moisture content in September, which influences seed germination and seedling establishment, is higher under the natural reseeding treatment (Fig. 3). The high soil moisture content shown under the treatment seems to be caused by the decrease of transpiration due to the removal of grasses by grazing or cutting in late summer, and by the reduction of evaporation due to a large

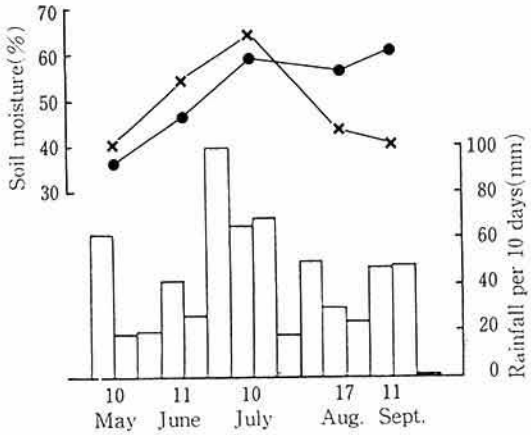

Fig. 3. Soil moisture content as affected by the natural reseeding treatment (top), and rainfall from May to September in 1984 (bottom)
● : Grassland under the natural reseeding treatment.
× : Grassland under rotational grazing.

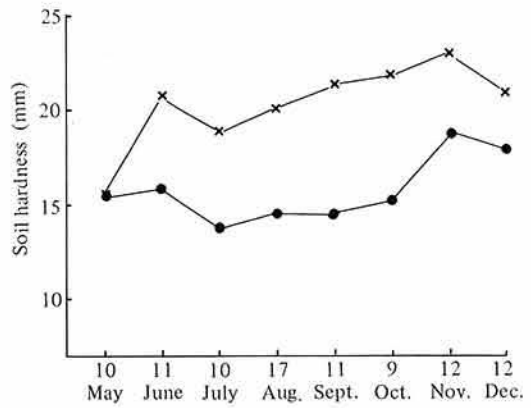

Fig. 4. Change of hardness of soil surface as affected by differed grazing in 1984
● : Grassland under the natural reseeding treatment which includes differed grazing.
× : Grassland under rotational grazing.

amount of litter accumulated during the rest period.

(3) With regard to soil physical condition, Ogawa et al.[6] showed that cessation of grazing caused softening of soil (especially the upper soil layer), increase of non capillary pore and promotion of the decomposition of organic matter accumulated in the soil surface. Furthermore, they indicated that cessation of grazing brought about increase of earthworms and decrease of larvae of *Scarabaeidae*, and that this result related to improvement of grassland productivity[7].

The present authors examined the soil hardness under the natural reseeding treatment in comparison with that under rotational grazing[5]. As shown in Fig. 4, the former was significantly decreased as compared with the latter after early June.

From these results, it can be considered that soil physical conditions of the grassland which adopted the natural reseeding treatment are better than the grassland which adopted sod-seeding.

(4) Concerning the competition after summer between seedlings and adult plants, the natural reseeding treatment is more advantageous for the growth of seedlings than

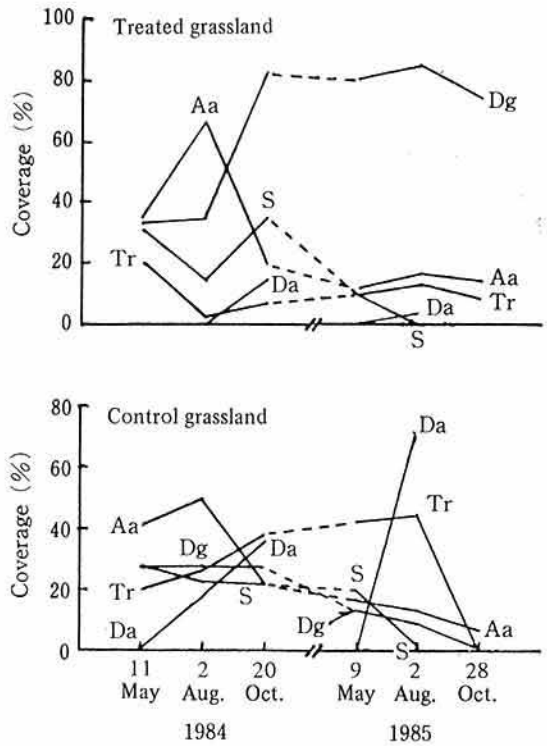

Fig. 5. Change of the coverage of grasses and weeds as affected by the natural reseeding treatment
Aa : *Agrosis alba*, Dg : *Dactylis glomerata*, Tr : *Trifolium repens*, Da : *Digitaria adscendens*, S : *Stellaria* spp.

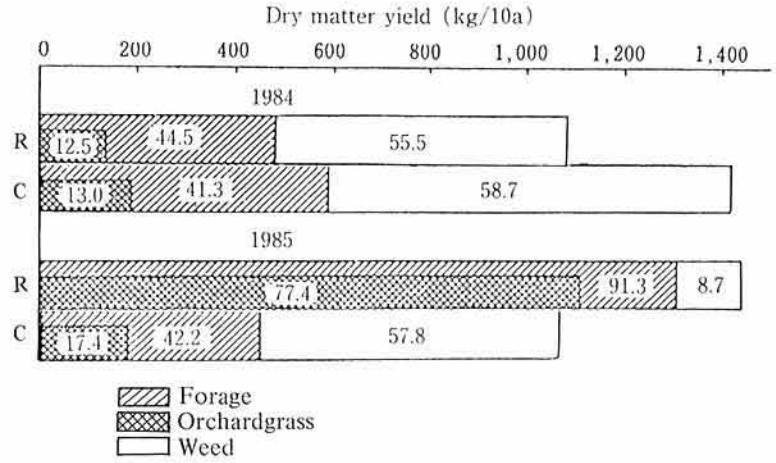

Fig. 6. Effect of the natural reseeding treatment on annual dry matter yields and botanical composition
Numerals shown in bars indicate % composition.
R : Plots with the natural reseeding treatment,
C : Control plots without the treatment.

Plate 1. Vegetational state of the grassland with orchardgrass and red top
Left : Three years after the natural reseeding treatment,
Right : Untreated control.

the sod-seeding method because a lot of adult plants in the treated grassland die after summer grazing or cutting as stated before. This also may reduce allelopathic effects of adult plants to the seedlings.

An example of grassland renovation by adopting the natural reseeding treatment

It was tried to renovate an old deteriorated and weedy pasture, with the remainders of orchardgrass and red top, by practical application of the natural reseeding treatment, and the result was compared with the untreated control plot in grazing seasons of 1984 and 1985[5].

Treated plot: Cutting in early August after deferring cutting from spring in 1984, followed by two times of grazing in September and October (plot size 12.5 a).

Control plot: Conventional grazing (plot size 25 a).

In the following year, both plots were grazed simultaneously after removing the fences between two plots. The results obtained are shown in Figs. 5 and 6. In the treated plots, the amount of vegetation remarkably increased after the treatment due to the marked increase of plant population because a large number of plants, especially orchardgrass, emerged under the treatment. To the contrary, in the control plot, invasion of aggressive weeds, *Digitaria adscendens* Henr., made the vegetational status worse. Thus, the trial of natural reseeding treatment resulted in success (Plate 1).

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