Preliminary Experiments on the Effect of Waste Wool and Fulvic Acid on Plant Growth in Murun, Northern Mongolia

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1. INTRODUCTION

Although Murun in northern Mongolia receives only approximately 200 mm of precipitation each year, it once had a diverse ecosystem[1]. Overgrazing has had adverse effects on the ecosystem, such as decreasing the prevalence of vegetation and promoting desertification[2]. However, reducing the number of livestock, which are the property of local nomads, is challenging, and natural recovery is unrealistic.

The authors propound that active vegetation restoration is essential to recovering degraded land (grasslands) and soils, and we focus on fulvic acid to promote plant growth. Although the effects of fulvic acid have been reported in Japan[3], its application to grassland restoration in Mongolia has not been presented. However, the use of wool, which is often discarded in Mongolia, as a fertilizer has been reported, but we have not found any research cases where it has been used as greening sheets in Mongolia. This study conducted plant growth experiments in the field as the first step in the development of greening technology using waste wool and fulvic acid in Murun.

2. PLANT GROWTH EXPERIMENTS

The plant growth experiments began in August 2021 on the site of the experimental collaborator in Murun. The dry bulk density at 10–30 cm in the site was in the range of 2.59–2.68 g/cm^3, and the soil was classified as sandy soil based on the grain size distribution. The seeds used in these experiments were *Elymus dahuricus* and *Bromus inermis* (Poaceae), and the results of germination tests demonstrated that the germination rates of these species were 85.3% and 64.0%, respectively.

In this experiment, a 4.0 m-long and 5.0 m-wide area was first plowed, cleared of weeds, and leveled. Next, six 1.0 m-long and 2.0 m-wide plots were prepared (see Figure 1). Three of the six plots lacked wool sheets, comprising one plot where only seeds were first spread and then covered with 2.5 cm of soil (S), one plot where seeds and fulvic acid were applied at 1.0 L/m^2 and covered with soil (Sf), and one plot where neither seeds nor fulvic acid were applied (NS). Two of the remaining three plots were seeded on the ground surface and then covered with a sheet of waste wool and covered with soil (WS), and one plot was sprayed with fulvic acid and covered with both waste wool and soil (WSf). For the last plot (WSs), the topsoil was removed to approximately 5 cm, waste wool was buried in the soil, seeds were spread, and the plot was covered with soil. Soil temperature was measured at -5.0 cm below the ground surface in the WS and S plots. Plant counts and grass height were also periodically checked to confirm growth.

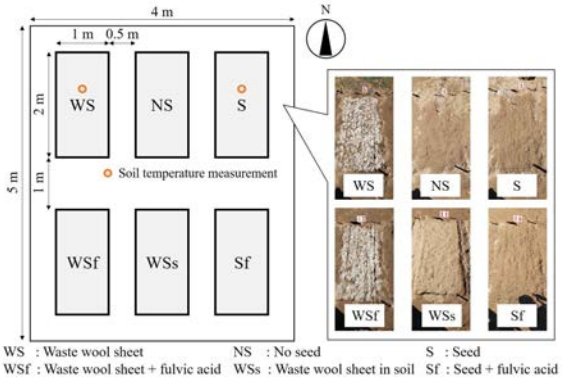

Figure 1. Schematic view of plant growth experiments

3. RESULTS

Figure 2 shows the time variation in the average daily air temperature T_{air} (°C) and daily precipitation P (mm) for August–October when the plant growth experiments were conducted. The monthly mean temperature in August, during the early growth period, was 14.7 °C, whereas T_{air} dropped sharply from

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September onward, with the monthly mean temperature dropping to 0.6 °C in October. August had the highest monthly precipitation (135.8 mm), which was equivalent to approximately 40% of the annual precipitation, whereas September had little rainfall (18.3 mm). Figure 3 shows the time variation in soil temperature T_{soil} in WS and S plots on November 6, a cold day with T_{air} of -11.83 °C. T_{soil} in the S plots dropped to a minimum of -6.7 °C, whereas that in the WS plots was approximately 3 °C higher at -3.7 °C. Thus, wool sheets reduced soil temperature loss.

Regarding the growth survey results, Figures 4 and 5 show the time variation for the number and height of grasses in each plot. Although the number of grasses in the S and Sf plots exceeded 100 on August 5, the height of grasses in all plots was 4–6 cm, with the differences being insignificant. Grass height and number increased in all plots except the NS plot, but growth stopped roughly after September 4, when T_{air} was <10 °C. The number and height of grasses in all plots decreased after mid-September when the temperature dropped below freezing. The maximum number of grasses in the Sf plot with fulvic acid was 428, which was 1.37 times higher than that in the S plot (313); this suggests that fulvic acid may be effective in promoting plant growth. However, because the quantity of experimental data was limited, it is necessary to examine the effect of fulvic acid through detailed soil chemical analysis and growth evaluation.

Follow-up investigation revealed that the S and Sf plots were unable to overwinter, and only the WS, WSf, and WSs plots that had waste wool were confirmed to germinate in July 2022. This may be due to the suppression of soil temperature drop and the moisture retention effect of the waste wool, which should be further investigated in detail.

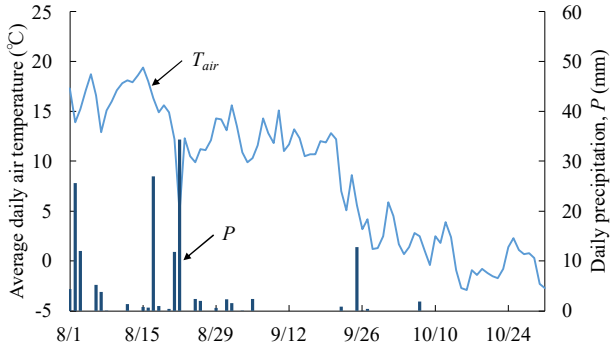

Figure 2. Time variation of the T_{air} and P[1)].

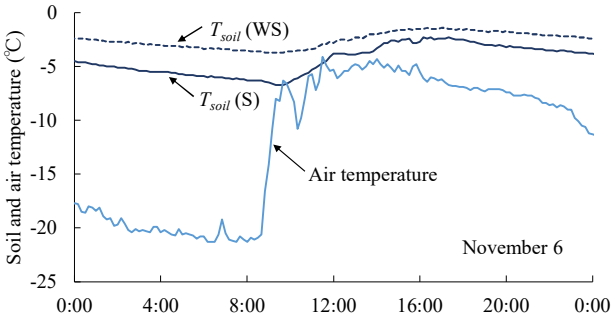

Figure 3. Time variation of T_{soil} in WS and S plots.

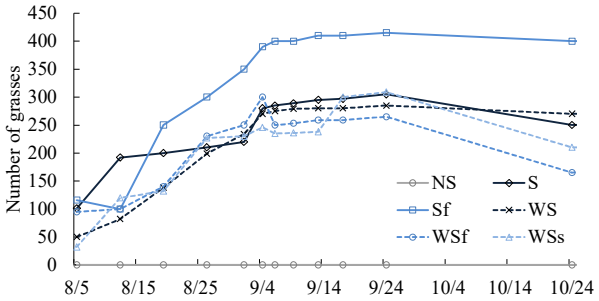

Figure 4. Time variation of the number of grasses in each plot.

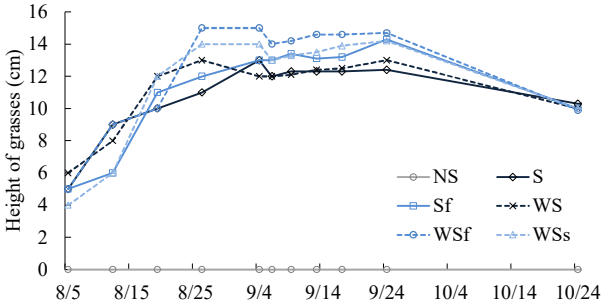

Figure 5. Time variation of the height of grasses in each plot.

4. CONCLUSIONS

Plant growth experiments were conducted using fulvic acid and waste wool in Murun, northern Mongolia. Accordingly, we obtained basic knowledge of the growth-promoting effects of waste wool and fulvic acid on plant growth. In the future, we will investigate the effects of waste wool and fulvic acid through large-scale field experiments.

ACKNOWLEDGMENTS

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