青ナイル川流域の斜面における遮水シートを用いた天水田栽培

Rain-fed Rice Cultivation using a Geo-Membrane on a Hill site in Blue Nile Basin

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Introduction

Plenty rainfall in rainy season in Blue Nile Basin which causes large runoff and associated erosion may be used for rain-fed rice cultivation. Paddy cultivation may contribute minimizing erosion while enhancing food production compared with conventional cultivation. Permeability of soil on hill site may often be too high to keep ponding even for terrace with horizontal soil surface and levee without irrigation. Ponding duration may be enhanced by inserting geo-membrane layer at the bottom of root zone. The other option would be cultivating upland cultivar.

The objective of this study are to investigate the effect of geo-membrane on enhancing yield and which variety is suitable for the rain-fed terrace rice cultivation in the Blue Nile Basin.

Materials and methods

Experimental site was established in a hill site with with a 4.3 % slope of Aba Gerima site. Four treatments, paddy field with geo-membrane at the bottom of root zone and upland rice (MU), without geo-membrane and upland rice (CU), with geo-membrane and lowland rice (ML), without geo-membrane and lowland rice (CL) were constructed with three replicates. Geo-membrane was inserted at the depth of 25 cm and sidewall so that no drainage occurs until ponding depth exceeds 20 cm. Soil at the depth of 20 cm was compacted by ramming with foots, jumping and jogging, for more than 5 minutes by one person per square meter for plots without geo-membrane to reduce permeability. To minimize lateral seepage loss, plots were surrounded by sidewall with geo-membrane from the depth of 20 cm to 20 above the soil surface of cultivated area. Each plot had 2 meter width and 2.5 m length and cultivatable area was about 4 m2.

To monitor the ponding depth, water level sensors were installed at the depth of 2 cm of CU2 and MU2. Rainfall was monitored by an automatic rain-gauge installed near the site.

Seeds of Nerica4 (as a upland variety) and Shaga (as a lowland variety) were sown on 25 June by drilling. Seeldings were transplanted at 20 cm spacing in late July.

Results and Discussion

Total rainfall from 28 June till the end of November was 1300mm. As shown in Fig. 1, plots with geo-membrane (M-plots) kept standing water far longer than control. Ponding was kept almost continuously until September 26. On July 30 and August 31 when heavy rain was forecast, we drained water from plots with geo-membrane to prevent uncontrolled overflow from levee which might have caused erosion. In contrast, ponging disappared within 6 hours after peak in control plots. Standing water was kept only 10 % of measured duration.

Sustained ponding in M-plots led faster growth in biomass as shown in Fig.2. Figure 3 compares both above-ground biomass and grain yield. Although M-plots had higher biomass, little yield were obtained for them. In contrast, small but greater yields were obtained for plots with geo-membrane. This contrast may have caused by restricted root zone. Major root zone extended until the depth of about 30 cm for lowland variety grown without geo-membrane and they could use soil moisture below 25 cm. In addition, larger biomass for M-plots may have led larger water requirement and faster depletion. Regarding to variety, the lowland one gave higher biomass and yield than upland one for both with and without geo-membrane.

Average air temperature from July 25 to October 28 was 20.8 C. This low temperature may also account for those low yield.

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* Tottori University, **National Rice Research and Training Center, ***Project for Functional Enhancement of the National Rice Research and Training Center,****Bahr Dar Univerity

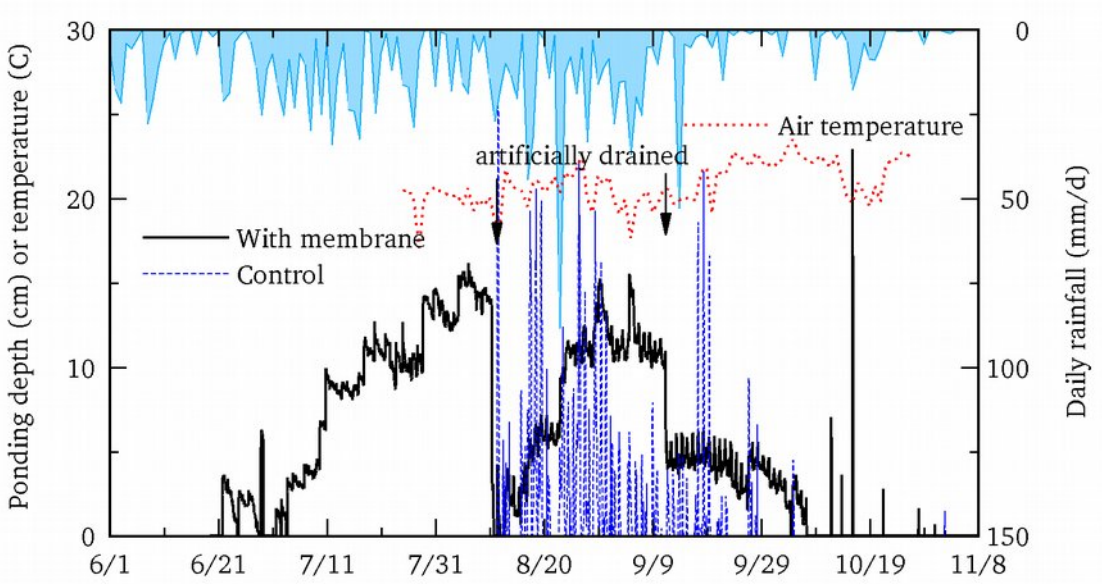

Fig.1 Time variation of ponding depth, air temprature and daily rainfall

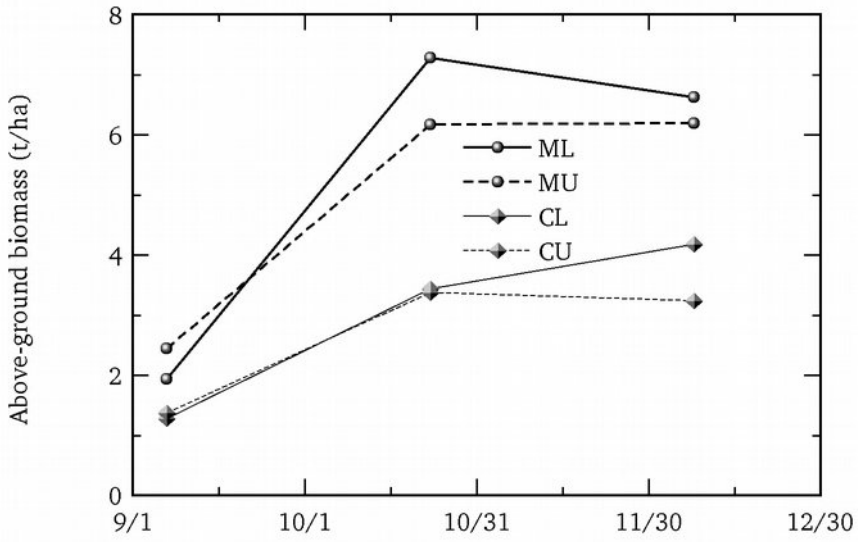

Fig.2 Time evolution of biomass

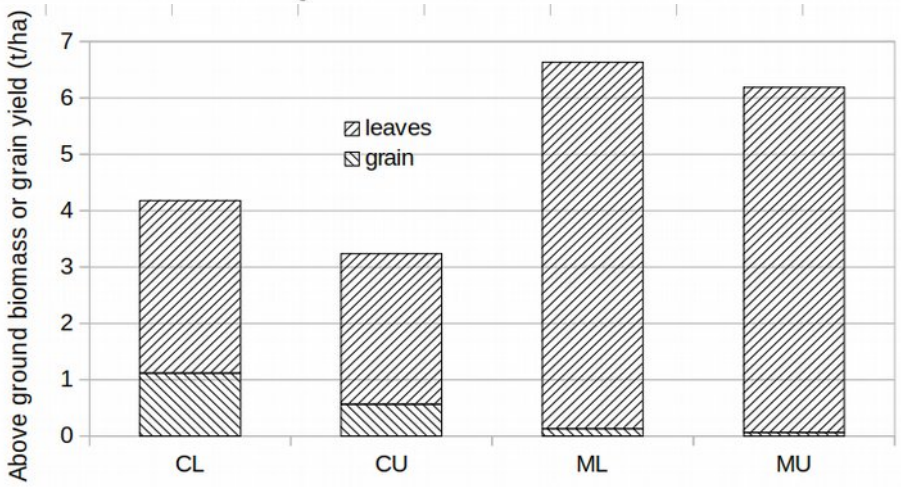

Fig.3 Comarison of biomass and grain yield