久米島浦地川流域のサトウキビ圃場の赤土流出解析

Analysis of Sediment Yield under different Sugarcane Cultivation Systems in *Urajigawa* Watershed Area in *Kume* Island, Okinawa

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Red-soil erosion problem in Okinawa gained recognition in late 1950s and it has been considered a serious agricultural and environmental problem since early 1970s. Off-site effects of soil erosion in Okinawa has drawn much attention due to its enormous impact on downstream water bodies, coral reef and coastal ecosystems, than its immediate on-site effects on farmlands and other development sites. Agricultural activities, sugarcane farming in particular, without appropriate erosion control measures have been recognized as one of the major causes of accelerated red-soil erosion and red-soil pollution.

In most of the cases the water-induced soil erosion prediction in Okinawa has been made based on the Universal Soil Loss Equation-USLE the widely used empirical model that has limitation in predicting time series soil erosion. Even though the effectiveness of different soil conservation measures at experimental plot level and small scale farm level have been shown in Okinawa, research works aiming at analysis of effectiveness of soil erosion prevention measures/soil conservation practices on large scale agricultural watershed areas are still limited. GeoWEPP, the geo-spatial interface of the Water Erosion Prediction Model (WEPP) is a physically based model that predicts soil loss and sediment deposition using a spatially and temporally distributed approach. In such a background this research study was mainly devoted to predict the soil erosion under different sugarcane cultivation methods and to examine the effectiveness of soil conservation measures on sugarcane farmlands at large scale agricultural watershed areas.

The *Urajigawa* river watershed area in *Kume* Island, where sugarcane is extensively cultivated, was selected as the study area of this research study. The GeoWEPP model was applied to *Urajigawa* watershed area in predicting sediment runoff in watershed under different soil conservation measures on sugarcane farmlands. Four groups of parameters: climate, soil, crop/management and topography of *Urajigawa* watershed area were used in the model. Different soil conservation measures simulated with three different sugarcane cultivation methods (summer cropping, spring cropping and spring-perennial cropping systems) were mulching with sugarcane crop residue, using sunhemp (*Crotalaria juncea*) as a cover crop/green manure during the fallowing period of summer cropping system, and shifting from regular summer and spring cropping system into spring-perennial cropping system.

The highest annual sediment yield (52.8 t/ha/yr) on a unit area of watershed was reported in the summer sugarcane cropping system practiced without any conservation measure while the lowest annual soil loss, 15.0 t/ha/yr was recorded under the spring-perennial cropping system with the conservation measure of mulching. A remarkable difference in annual sediment loss between three conventional cropping systems (without any soil conservation measure) could be observed. The annual soil loss from the watershed under three conventional sugarcane cropping systems: summer cropping, spring cropping and spring-perennial cropping system are 52.8t/ha/yr, 37.1t/ha/yr and 29.3t/ha/yr respectively (Figure 1). The mulching can reduce the annual soil loss by 23.9 t/ha (45.26%) and 4.2 t/ha (11.32%) in summer and spring

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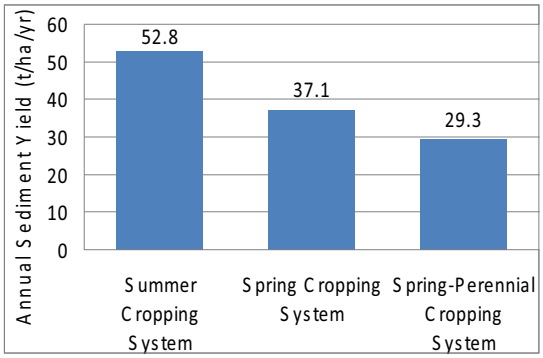

図 1:慣行栽培の場合の赤土流出量

Fig 1: Sediment Yield under Regular Cropping Systems

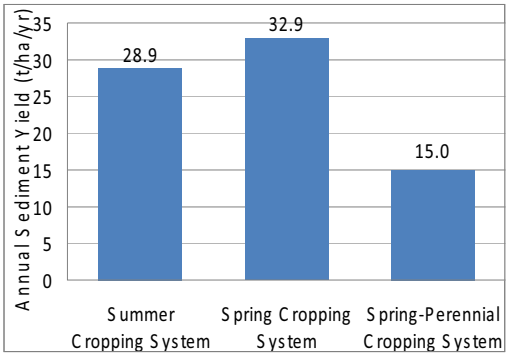

図 2:マルチングをした場合の赤土流出量

Fig 2: Sediment Yield with Mulching

cropping systems respectively. The sediment reduction efficiency that can be achieved through mulching in spring-perennial cropping system is 48.8% (by 14.3 t/ha). However, there is a practical problem of the availability of sugarcane crop residues, in the early stage of summer crop (August – October), to be used as mulching material. Therefore, the mulching as a soil conservation measure is more appropriate for the spring and spring-perennial cropping systems than summer cropping system.

The cover cropping/green manure with sunhemp is also a promising soil conservation measure for the summer cropping sugarcane system. This measure is able to reduce the annual soil loss in the regular summer cropping system, by 36.6 t/ha (69.32%). Since the less availability of mulching materials in the summer cropping system, the cover cropping/green manure can be considered as the most suitable soil conservation measure for the farmers who are willing to continue the summer cropping system. Shifting from regular summer cropping and regular spring cropping systems to spring-perennial system is also an effective measure in soil erosion control perspective. The sediment reduction efficiencies of shifting from regular summer and regular spring cropping systems to spring-perennial cropping system are 44.5% and 21.0% respectively. The annual soil loss of regular summer cropping and regular spring cropping systems can be reduced by 37.8 t/ha/yr (71.6%) and 22.1 t/ha/yr (59.6%) respectively, if those cropping systems are changed into spring-perennial cropping system with mulching.

According to the results generated by the GeoWEPP model, the soil loss under all three regular sugarcane cropping systems are high and the most erosive cropping system is summer cropping system while spring-perennial system has been reported as the least erosive cropping system. The sediment reduction efficiencies that can be achieved through practicing soil erosion control measures are remarkable. Shifting from regular cropping systems especially from summer cropping system into spring-perennial cropping system with mulching can highly be recommended. Therefore, it is highly recommended that application of appropriate soil conservation measure/s for different cropping systems is essential in order to control soil erosion on sugarcane farmlands in Okinawa.

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