

Modified conservation agriculture for taro production in combination with spot excavation by gas-powered apparatus and organic mulch

Taro (*Colocasia esculenta* (L.) Schott) is traditionally produced as a main staple crop in a coastal swamp of the Pacific islands. Sea level rise due to climate change, however, often causes saltwater to intrude into the taro fields and push the taro production area up toward inland slopes. Soils in the volcanic upland of the Pacific islands, however, are heavily weathered and acidic and are extremely infertile with a shallow surface organic layer. Thus, soil fertility should be improved in order to enhance taro production without soil erosion and disturbance to corals which, incidentally, attract many foreign tourists. Conservation agriculture (CA), a farming method composed of three principles, namely, minimum soil disturbance, permanent residue cover, and diverse rotations, is suggested to be the best management practice for improving nutrient cycles and soil organic matter restoration and controlling soil erosion. In this study, the effects of tillage and mulching on soil erosion and upland taro production were investigated, with modifications to the three CA principles depending on applicability to local farmers and availability of local resources.

The experiment was conducted from August to May at a research station in Palau Community College in Babeldaob Island, Republic of Palau. The slopes of the experimental plots were between 8 to 13 degrees, while the total rainfall was 2,800 mm during the cropping season. We introduced a gas-powered portable auger or a self-propelled trencher as a modified technology for minimum tillage and for planting (Fig. 1). After excavating the soil with these apparatuses down to 45 cm depth, the excavated soil and 300 g of compost were mixed and returned into the hole/ditch up to 25 cm depth. Taro seedlings (cultivar: Ngesaus etc.) were then planted in the hole or ditch. As modifications of permanent residue cover and diverse rotations, we tested three types of mulch (yard long beans/sweet potato living mulch, and betel nut leaf mulch) in combination with modified minimum tillage.

When taro was cultivated in combination with modified minimum tillage and local organic mulch (betel nut leaf), taro yield increased by 3.2 to 3.6 times (1.8 to 2.0 t ha⁻¹) compared to control (full tillage without mulch) (Fig. 2). When the portable auger was used, a single corm weighed heavier by 2.6 times (256 g per fresh corm) compared to control. In addition, the combination of modified minimum tillage and organic mulch decreased soil erosion by 80% to 91% (from 35 m³ ha⁻¹ to 3.1–6.9 m³ ha⁻¹) (Fig. 3).

In conclusion, minimum tillage using a portable auger with betel nut leaf mulch can be recommended as a modified CA method for upland taro production specially in the Republic of Palau where extremely infertile steep inlands are expected to be developed.

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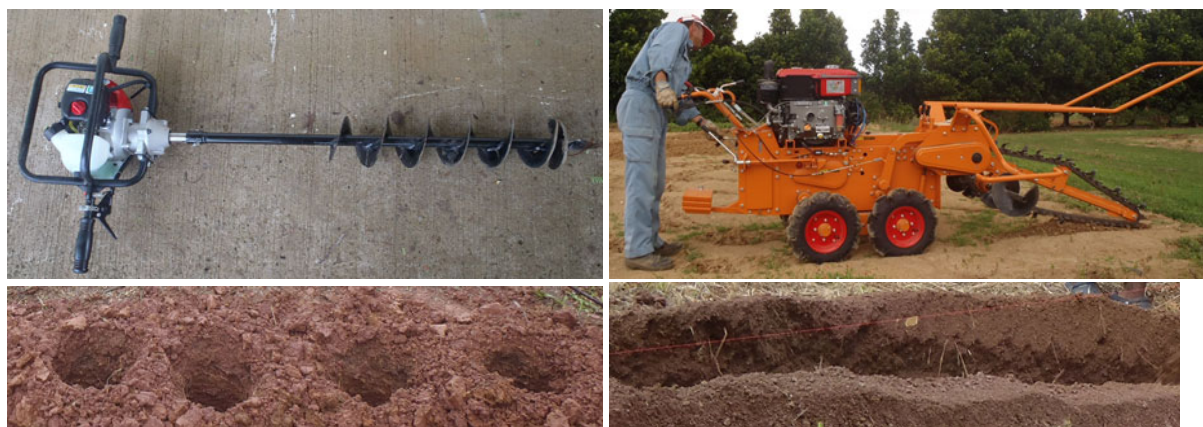


Fig. 1. Gas-powered portable auger (left) and self-propelled trencher (right)

Left: Gas-powered portable auger (AGZ5010EZ, ZENNOH, Japan) attached with a drill (15 cm in diameter, 80 cm in length); Right: Self-propelled trencher (NF-827-II, KAWABE, Japan)

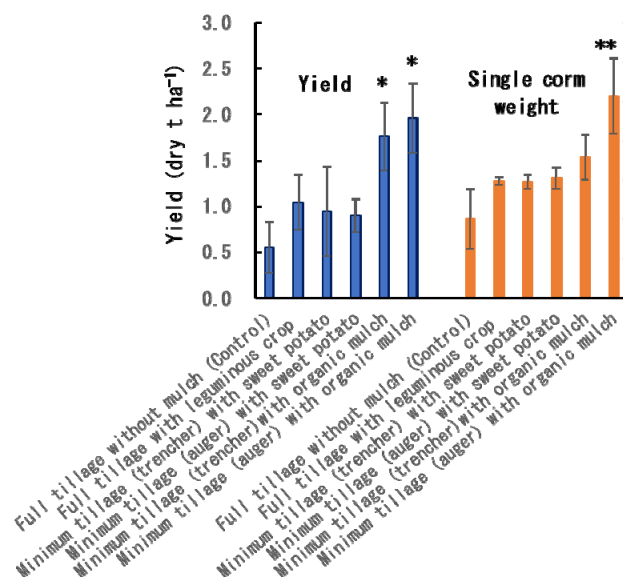


Fig. 2. Combination effects of modified minimum tillage and surface mulch on taro yield and single corm weight

*, **: Significantly different from control

(* : $p < 0.05$, ** : $p < 0.01$) (Dunnett's test)

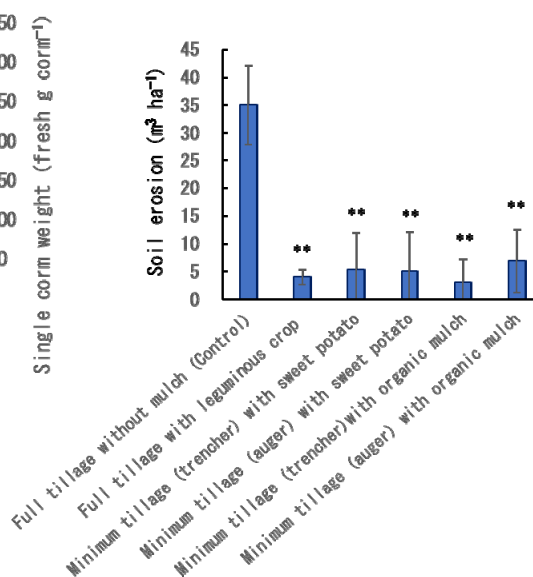


Fig. 3. Combination effects of modified minimum tillage and surface mulch on soil erosion

To measure eroded soil, experimental plot was enclosed with a wooden frame and soil trap was installed at the down end.

**: Significantly different from control
(** : $p < 0.01$) (Dunnett's test)