Enhancing and Sustaining Maize Production through Ridge Tillage System[1]

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Introduction

Enhancing and sustaining maize production in the upland has been the main focus of the farmers in almost all the areas in Southeast Asia where maize is the staple food. More than 70% of the upland areas in the Philippines is devoted to maize production. This is for food to human or feed to livestock, but about 80% of the upland population rely on maize as their subsistence food.

We continued working for practical ways to enhance profitability and sustain maize production in the uplands. We examined the ridge-tillage system as practiced in the United States: maintaining an alternate strips of untilled and tilled land in row-cropped field. The untilled strip (the ridge) is where the crop is planted in exactly the same row position in each successive season: the inter-row strip is tilled, controlling the weeds and hilling up to rebuild ridges. As adapted to animal-powered system, the sequence of operation is to make furrow through the stubble of the previous crop and plant in the same row; cultivate the crop with the moldboard plow, usually burying the weeds between the rows at about 14 days after emergence, and hilling up at about 30 days after emergence to create the ridges using the double moldboard plow; after the harvest, replant the next crop through the stubble in the same rows as the previous one, without any plowing or harrowing operations. If there are weed growth on the ridges, band-spray a broad-spectrum systemic herbicide (glyphosyte) at the rate of 0.5 active ingredient (a.i.) per hectare on the ridges to eliminate early weed competition. Inter-row cultivation to control the weeds in the inter-row area and rebuild the ridges.

The objectives of the study were 1.) to determine how effective the ridge tillage system in reducing soil loss on permanently farmed sloping row-cropped fields on acid

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Si Descri

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There four managem sy tems pared .) C our plantin armer practice or Co onal practi (C) C ntour barri formed by ag RT) (Figu .), .) Co toured barriers formed by get trips T), and Contoured barrier formed by T plus the til age (RT) Thes were ai randomized complete lock design epl ons. These we do two tes Ani-e trocen or the C treatment, ng harro ng hil up and seed al ng the contour using ng boar pl drawn mal Ri tillage treatm (RT vas C tially out the hi up pe ons, cm high idges spaced apart the tance betwee ad were constructed on the contour using the double moldboard plow (Figure 4). After the formation, these ridges were maintained permanently. There was no land preparation for the subsequent cropping, but the weeds were sprayed with herbicide (glyphosate at 0.5 a.i./ha). The furrows were created right on the corn stubbles of the previous cropping using a single moldboard plow. For NVS treatment, a 50-cm-wide of space along the contour for the grass strips which were left unplowed at certain interval (about 8 meters) based on 1.5 vertical drop. Natural grasses invaded on these strips. The fourth treatment was combination of NVS and ridge tillage (RT). Five contour strips of grass formed four alleyways in each plot. Each alley was approximately 9-10 meters wide depending upon the slope of the plot. The grass strips were cut near ground level at 45 days intervals and the materials were applied uniformly to the alleyways as mulch. Crop residues were also returned to the alleyways as surface mulch. At the start of the experiment, lime at the rate of 3 tons ha-1 was a added to correct soil acidity. Furrows were 60 cm apart, and hybrid maize seeds were sown at 25-30 cm. between hills. Before sowing, 30 kilograms of Phosphorus, 30 kilograms Potassium, and 18 kilograms of Furadan 3G per hectare were applied as basal. Nitrogen at the rate of 80 kilograms per hectare was applied equally in two splits: 15 and 30 days after crop emergence (DAE). These applications were followed by off-barring and hilling-up inter-row cultivation, respectively.

At the lower end of each experimental plot, a sediment collection trench (60 cm deep x 40 cm deep x 6 meters long) was dug and lined with either bamboo or perforated galvanized metal to trap sediment-carrying runoff water during rainfall events. After the water percolated through the lined trench, the soil sediment (bed load) remaining in the trench was collected and weighed two times a month. The water content of a 500 g sub-sample was determined and the mass of oven dry sediments were calculated. Thus, total dry weight of bed was calculated.

With our exciting results in Claveria we expanded our work in Lantapan, Bukidnon in collaboration with the Sustainable Agriculture and Natural Resources Management- Collaborative Research Support Program (SANREM-CRSP). The ridge tillage system was compared with the conventional method of growing maize, and with natural vegetative filter strips (NVS) laid out at an 8-m distance from each other. The 4th

treatment, combination of ridge tillage and NVS, was not implemented in Lantapan. These treatments were laid out in 5 farms with one replication in each farm. Lantapan have similar soil physical and chemical characteristics and annual rainfall average of 2000 mm of Claveria but farms were more steeper slopes.

Results and Discussion

Maize grain yield

Mean grain yield of 6 crops over the 3-year period in Claveria and of 3 crops in 2 years in Lantapan are presented in figure 1. In Patrocenio, the ridge tillage system yielded slightly higher than the conventional system but was not statistically different. In Lantapan and Anie, the conventional system yielded slightly higher to ridge tillage system, and in fact significantly higher in Ani-e. The NVS had low yield across all the locations considering the fact that about 12% of the crop area is allocated for hedgerows. Combining the ridge tillage system with NVS do not provide added advantage to the mean grain yield.

Annual Soil Erosion Losses

Soil erosion was one of the aspects that we looked at this experiment. We found out that ridge tillage system reduced soil erosion to more than 50% compared with conventional system across all the locations (Table 2). The use of NVS reduced soil erosion from 73-97%. The NVS is more effective when the slope is not high and the vegetation are perennial creeping grasses like *Paspallum spp*, *Digitaria ssp.* as opposed to erect and shrubby type like *Cromolaena odorata*, *Imperata cylindrica*, *Borreria laevis*, or *Ageratum spp.* Etc. Combining the ridge tillage system with NVS further increased the reduction of soil loss to 1.1 t ha-1 in Ani-e and 0.3 in Patrocenio.

One of the features of the ridge tillage system is no land preparation during the subsequent cropping period thus dramatically reducing the turn around time (time between two crop periods). In areas where rainfall is evenly distributed with assured 10 months of growing period, farmers can grow more maize crops in a year (Figure 2). This enables the farmers to grow successful crops of 3 in a year instead of 2 as what normally happens in Claveria and Lantapan.

Ec mic Benefits

The elimination of land preparation during the subsequent crop periods reduces th produc ost dramatical hence gi ing farm rofi th Th ridge tillage system enables the farmers to have crops of maize year with total gro revenue 68 42 as compared to co vent rops sy m: 00 (Table 3). The ridge tillage system provides added cash benefits to farmers 464.2 per year compared to the ventional system

W found out some advantages f ridge tillage system Dramatically red soil loss, b.) Increase water infiltration as the ridges may act as partial barrier to the surface flow ater but their major distinct that the act as zone grea infiltration, .) Labor and expense land preparation have been dramatical reduced th ncreas ng farm profi d. Reduce turn around between cro periods nable farmers to plant more in crop year

Table 1. Soil Profile Description of the Experimental Site

Claveria, Misamis Oriental, Philippines

Depth (cm).	Clay (%)	CEC (Meq)	BS (%)	Exch.Al (Meq)	pH	Carbon (%)	Nitrogen (%)	Bray P (ppm)	Bulk Den (g/cm3)
ANE-I SITE			Very fine, kaolinitic, isohyperthermic, Lithic Hapludox						
0 - 15	78	9.1	33	1.0	4.1	1.6	0.2	5.7	0.73
15 - 37	85	8.2	21	1.6	3.7	0.9	0.1	2.0	0.85
37 - 77	88	8.0	21	2.1	4.1	0.5	0.1	2.3	0.94
PATROCINIO SITE			Very fine, kaolinitic, isohyperthermic, Rhodic Hapludox						
0 - 23	72	9.7	56	0.1	4.4	1.6	0.2	4.5	0.90
23 - 48	84	6.7	46	0.5	4.0	0.9	0.1	2.5	0.94
48 - 64	79	5.8	18	2.4	4.1	0.3	0.1	3.4	0.92
64 -148	83	5.4	29	1.5	4.1	0.5	0.1	3.4	0.93
148-192	69	5.9	14	2.6	4.5	0.2	0.1	3.8	0.88

Table 2. Soil loss as influenced by different land management system.

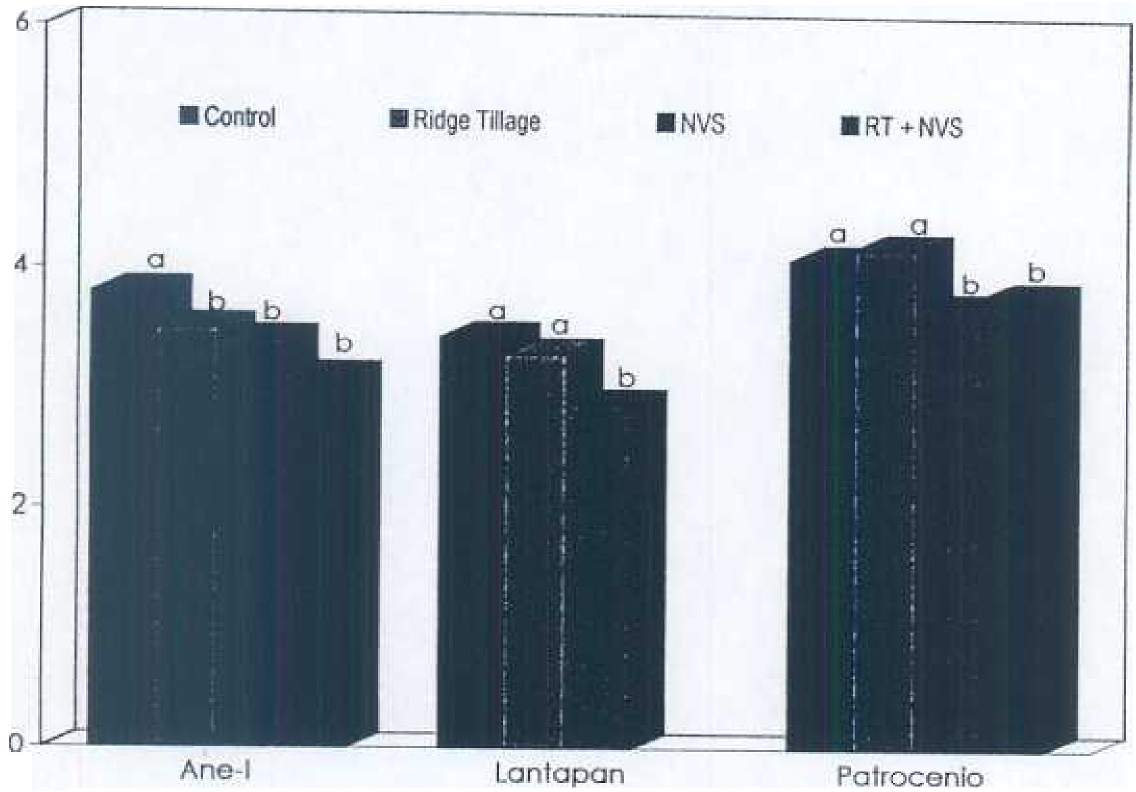
Treatments	tons/ha		
	Ane i	Patrocenio	Lantapan
Control	23.4	7.2	14.78
Ridge Tillage (RT)	9.8	3.7	7.38
Natural Vegetative Strip (NVS)	2.2	0.2	4.06
RT plus NVS	1.1	0.3	

Table 3. Input-output analyses as influenced by different land management systems

Land management system	Input	Output	Net profit
Ridge Tillage (for 3 croppings)	**29, 075.75**	**68, 542.50**	**39, 446.75**
Conventional Farming (for 2 croppings)	**21, 102.50**	**46, 085.00**	**24, 982.50**

Ridge Tillage	Conventional Farming		Income margin per year/hectare
P 39, 446.75	**P 24, 902.50**	=	**P 14, 464.25**

Figure 1. Grain yield as affected by different land management systems. Mindanao, Philippines. (Mean of 3 years)



Bars having a common letters are not significantly different by DMRT at 5% level.

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Claveria site Claveria, Misamis Oriental Philippines

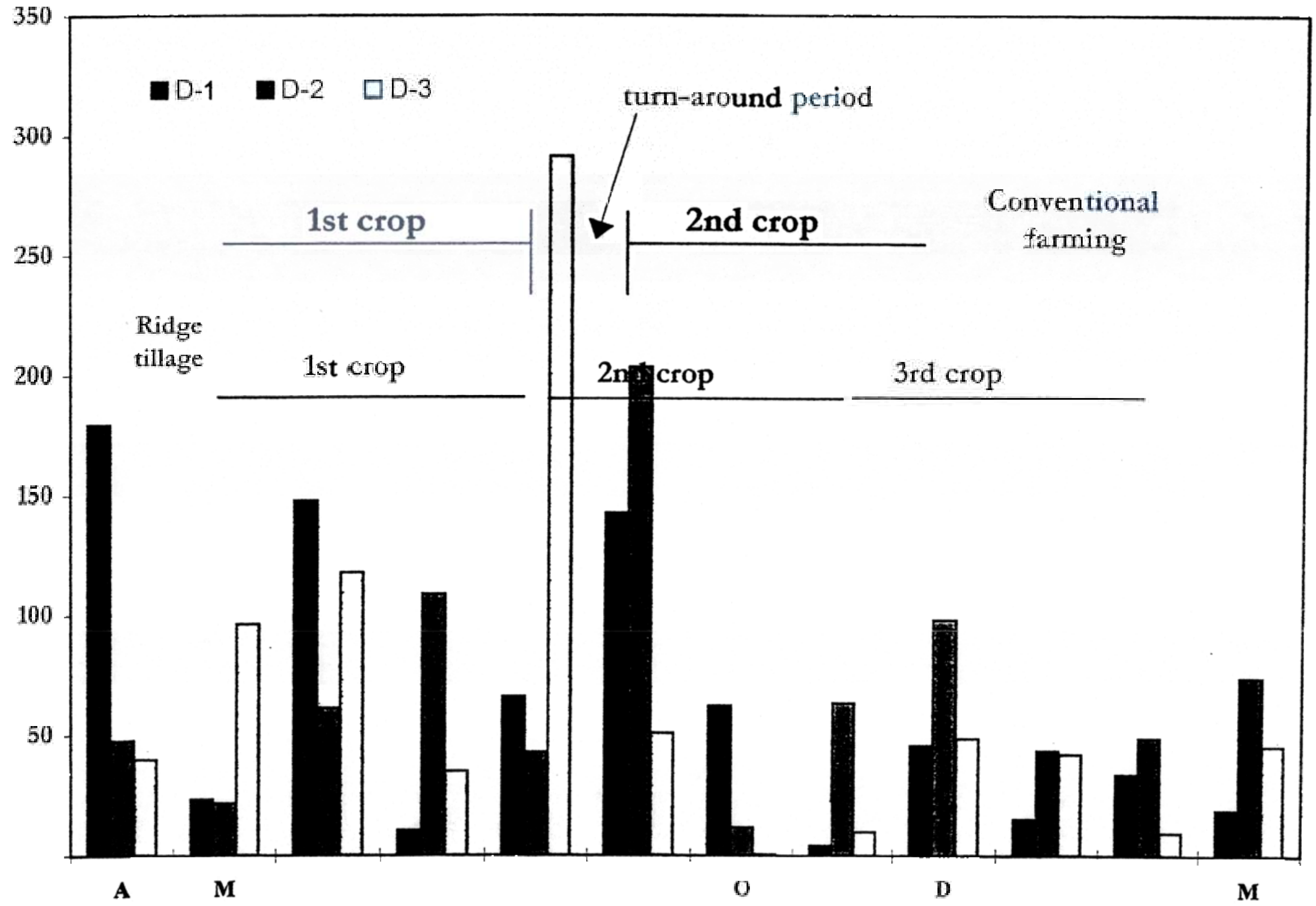

Figure 3. Ridges created by the double moldboard plow during interrow cultivation.

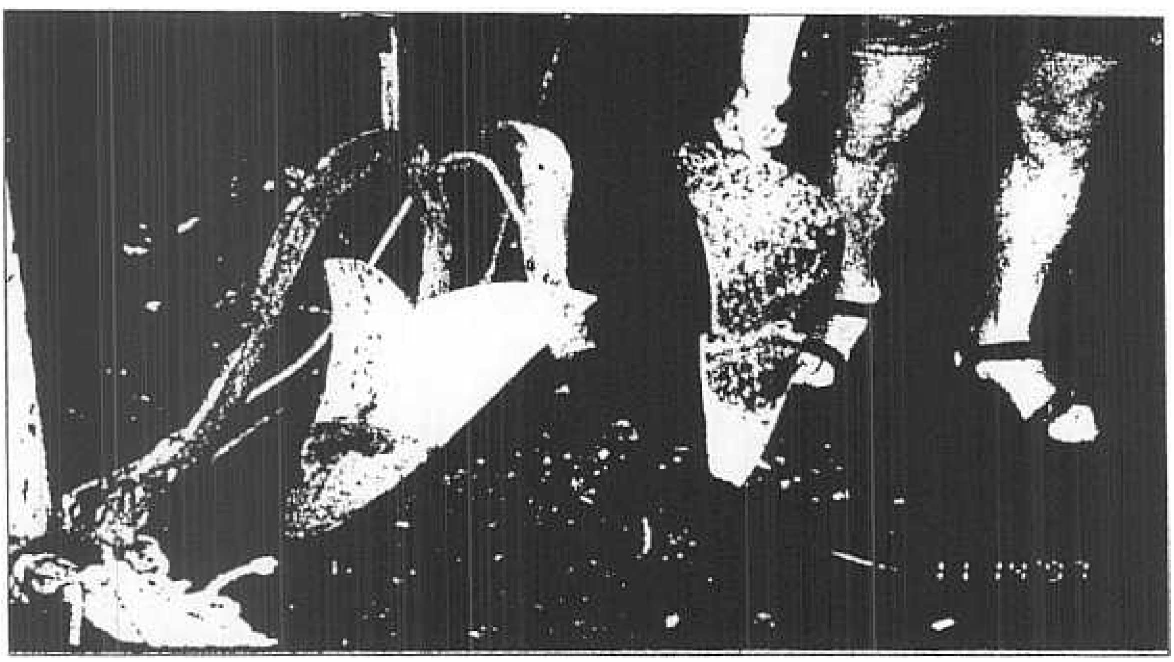

Figure 4. Double moldboard plow (left) which is used to create ridges and a single bladed molboard plow

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