Conservation Tillage Strategies for Corn Grown in Paddy Fields: Using on-Farm Research for Technology Transfer

Romeo V. Labios,Z [1]***, Leonardo L. Tamisin Jr.*** [1]***, Jocelyn D. Labios*** [1]***, Cynthia M. Medina***[1] ***, Edicer P. Ocampo Jr.*** [1]***, Dennis M. Miciano***[1]***, Jupiter Tividad*** [2] and ***Jasper O. Manalo*** [3]

[1]Farming Systems and Soil Resources Institute, University of the Philippines Los Baños, College, Laguna 4031, Philippines
E-mail: rvl@lgn.csi.com.ph
[2]Senior Agriculturist, Office of the Provincial Agriculturist, San Jose, Mindoro Occidental, Philippines
[3]onsanto Philippines, Incorporated, Alabang, Muntinlupa City, Philippines
E-mail: jasper.o.manalo@monsanto.com.

Abstracts: Adaptation and utilization of the introduced technologies are often low because most often these technologies do not fit the farm's actual bio-physical and socio-economic environment. One of the strategies we implement to enhance technology adaptation and utilization is through the conduct of on-farm research.

Zero tillage or "Tipid Saka" is one of the technologies tested in an on-farm research conducted in San Jose, Mindoro Occidental. Its performance is evaluated versus conventional tillage and the farmers' practice. *Conventional tillage* consist of two passes of tractor-drawn plow and two times harrowing. Corn seeds are planted using a manual corn seed planter known as "farmalite". *Zero tillage* involved the spraying of POWER™ herbicide on the rice stubbles and growing weeds at the rate of six to eight li ha^{-1}. Planting was done a day after herbicide application with traditional method using a pointed wood called "bugsok". If the soil is hard, the field is flooded two to three days before spraying herbicide. *Farmer's tillage* practices consist of one to two plowing and one harrowing. Seeds are planted using "bugsok" method. In all tillage practices, corn (var C818) seeds are planted at 70 cm × 20 cm spacing. The two fertilizer levels used were 600 kg ha^{-1} Ammosul and 300 kg ha^{-1} Ammosul + one kg ha^{-1} Bio-N. Bio-N is a microbial-based fertilizer for rice and corn. It is mainly composed of microorganisms that can convert the nitrogen from the air into ammonia, and can supply up to 75 percent of the total amount of nitrogen needed by rice and corn plants.

Results showed that plots prepared with zero tillage and applied with both fertilizer levels gave the highest gross return. Likewise, it also incurred the lowest production costs, thus higher net benefits. On the other hand, conventional tillage gave the second best gross return when applied also with both fertilizer levels but it entailed higher costs for land preparation and for other labor inputs, hence smaller net returns. With these results, conservation tillage practices such as the use of zero tillage combined with the application of Bio-N + one-half the recommended rate of inorganic fertilizer can be recommended for corn production after rice in San Jose, Mindoro Occidental and other municipalities with similar growing environments.

Other than being able to verify the conservation tillage technology and utilization of bio-fertilizers and generating location-specific recommendations, it is equally significant that the research project has demonstrated another aspect of on-farm research — its use as a tool for technology adaptation and utilization.

Keywords: conservation tillage, conventional tillage, POWER ™ herbicide, on-farm research, bio-fertilizer

1 Introduction

Various crop diversification strategies have been formulated to tap the economic potential of rainfed lowland areas that depend on supplemental irrigation systems, like the shallow tube well and deep well. The production of corn, soybean, sweet potato, peanut and other vegetables after wetland rice are some of the strategies to answer the uncertainty of the domestic supply of wetland rice and the seasonality of its production (Labios, 1992; Labios and others, 1997; Moya and Miranda, 1989). In addition, the production of upland crops after wetland rice offers opportunities for increasing the productivity and income of farmers. However, crop establishment during the dry season is constrained by limited water for irrigation (Labios, 1992; Labios and others, 1997; Gines and others, 1989) and appropriate tillage systems for sustained productivity (Labios and others, 1999).

Based on experiences of farmers in San Jose, Mindoro Occidental, corn can be produced satisfactorily with a tillage system that stirs the soil deeply and frequently. Yet since the onset of the dry season cropping for 1999—2000, they realized that corn may also be produced without soil disturbance to get the seeds planted (Labios and others, 1999). The local demand for hired labor is usually high during the land preparation period, which contributes to the high cost in corn production. Conservation tillage technology for corn after rice provided the farmers in the area with alternatives to the high production cost for corn incurred during land preparation. It also decreased the time and power required for crop establishment with reduction in or complete elimination of the number of tillage applied (Triplett, 1976). Further, when the soil surface is left undisturbed, soil moisture is conserved at a time when dry periods are a problem.

Thus, conservation tillage, particularly zero tillage, was introduced in the area to offset the production cost during land preparation. Zero tillage or "Tipid Saka" is a technology of Monsanto Phils., Inc (Monsanto, undated; Manalo, 2000). It is one of the technology interventions tested on-farm to evaluate its performance versus conventional tillage and the farmers' practice of growing corn after rice in the area. Generally, the conservation tillage trial aims to aid in the formulation of location-specific and ecologically sound management practices and technology options for sustained corn-based productivity. Specifically, it aims to evaluate the effect of various tillage practices on the growth and yield of yellow and green corn.

2 Methodology

Guided by the philosophy of participatory development and using the FSR & D approach, a Participatory Rural Appraisal (PRA) was conducted in the project area. On the basis of the information that was gathered, research plans were discussed, analyzed, and formalized together with the farmers and the collaborating research and extension personnel in the areas. An in-depth characterization and assessment of the sites were conducted afterwards. Selection of agronomic farmer-partners was based on the set guidelines/criteria in the conduct of FSR & D.

Some of the issues and problems in the area identified through the PRA are (1) efficiency in water use and management, considering that they depend on supplemental irrigation from ground and surface water sources, and (2) availability of tractors or farm equipments particularly during land preparation.

On-farm trials conducted in Brgys. Mangarin and Mabini, San Jose, Mindoro Occidental tested zero tillage and conventional tillage against farmers' tillage practice for yellow corn (var C 818) .

The experiments were set up in four farmer-partners' farms. The treatments (tillage × fertilizer levels) were replicated twice in each farmer-partner's field. Samples and data were taken from two crop cuts per replication plot. One crop cut consists of 2 rows of corn × 5meter long. Each farmer allotted 3000 m^2 for the trial with 1000 m^2 per tillage trial plot.

For *farmers' tillage*, 1-2 plowing and one harrowing are made to prepare the land. Seeds are planted at a rate of one seed per hill (70 cm × 20 cm spacing) using the "bugsok" method of planting (Fig.1). In *zero tillage*, rice stubbles and newly grown weeds are evenly sprayed with POWER™ herbicide at the rate of 6 — 8 li ha^{-1}. Planting was done a day after herbicide application with traditional method using a pointed wood called "bugsok" (Fig.2). If the soil is hard, the field is flooded two to three days before spraying herbicide. In *conventional tillage*, land is thoroughly prepared with two passes of tractor-drawn plow and two times harrowing using a hand tractor or animal-drawn harrow. Seeds are planted using "farmalite" (manual corn seed planter) at a rate of one seed per hill, with 70 × 20 cm spacing (Fig.3).

Fig. 1 Farmer's tillage plots

Fig. 2 Zero tillage plots

Fig. 3 Conventional tillage plot, planting using "farmalite"

Two fertilizer levels were used with the three tillage practices namely: F1-600 kg ha^{-1} ammosul and F2 - 300 kg ha^{-1} ammosul + 1 kg ha^{-1} BIO-N. First fertilizer application of ammosul was done 15—20 DAP at 300 kg ha^{-1} for F1 and 150 kg ha^{-1} for F2. Second application was at 45 DAP using the same amount of ammosul.

BIO-N is a microbial-based fertilizer for rice and corn. It is mainly composed of microorganisms that can converts the nitrogen from the air into ammonia, and replaces up to 75 percent of the total amount of nitrogen requirement of rice and corn.

3 Results and Discussion

The yields obtained by four farmer-partners in testing the performance of C818 using three tillage practices are shown in Table 1. It was observed that in all four farmer-partners' cases zero tillage (T1) and conventional tillage (T2) combined with either 600 kg ha^{-1} ammosul (F1) and 300 kg ha^{-1} ammosul + 1 kg ha^{-1} BIO-N (F2) perform comparably well in effecting better yields than the farmer's tillage practice (T3). The same results show that if the farmer uses BIO-N, which is an alternative to using pure chemical fertilizer, either zero tillage or conventional tillage may be practiced with more positive effects on yield. On the other hand, farmers opting to use their own tillage practice appear to benefit more if the ammosul-BIO-N combination is applied.

Although no significant differences were found among all treatments in two out of four test farms, the observed differences in yields translate to differences in economic returns for the farmers. Fig. 4a and 4b showed that zero tillage resulted to the highest gross return when used with both fertilizer levels. Likewise, it also incurred the lowest production costs, thus higher net benefits. On the other hand, conventional tillage gave the second best gross returns when also applied with both fertilizer levels but entailed higher costs for land preparation and for other labor inputs, hence posting smaller net returns.

Added benefits are, however, obtained with zero tillage in terms of reduced losses in soil moisture with the undisturbed soil surface. This is especially relevant in the study site in as much as water becomes a serious constraint during the dry season.

Table 1 Mean yield of yellow corn (Cargill 818) under Tillage Practices trial, San Jose, Occidental Mindoro (DS 1999—2000)

TREATMENTS	YIELD (tons· ha^{-1})			
	FARMER 1	FARMER 2	FARMER 3	FARMER 4
F1T1	5.29	5.37	5.77	5.33
F1T2	4.66	5.74	6.46	4.45
F1T3	3.48	5.08	3.80	3.41
F2T1	4.60	4.94	5.51	5.52
F2T2	5.17	3.64	5.89	5.35
F2T3	4.27	3.51	4.78	4.32
Mean	4.58	4.72	5.37	4.73

F1 = 600 kg· ha^{-1} Ammosul
F2 = 300 kg· ha^{-1} Ammosul + 1 kg· ha^{-1} Bio-N

T1 = ZERO TILLAGE
T2 = Conventional Tillage
T3 = Farmer's Tillage Practice

Farmer 1 = Yolanda Garcia
Farmer 2 = Teresita Cabado
Farmer 3 = Anastacio Agustin
Farmer 4 = Eleazar Fuentes

Variety = Cargill 818

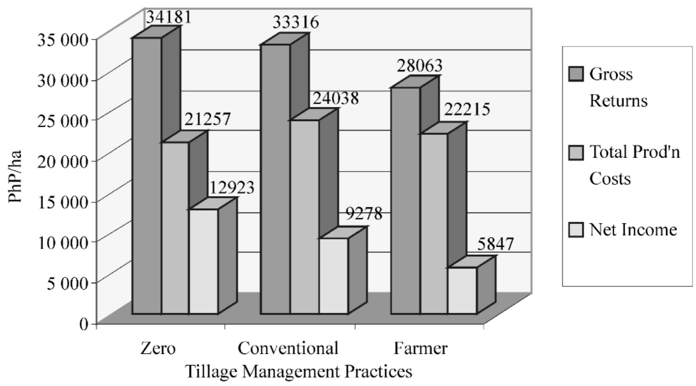

Fig.4a Net income (PHP) of C818 using different tillage management practices applied with 600 kg· ha^{-1} ammosul, Mindoro Occidental , 2000 DS (4 sites)

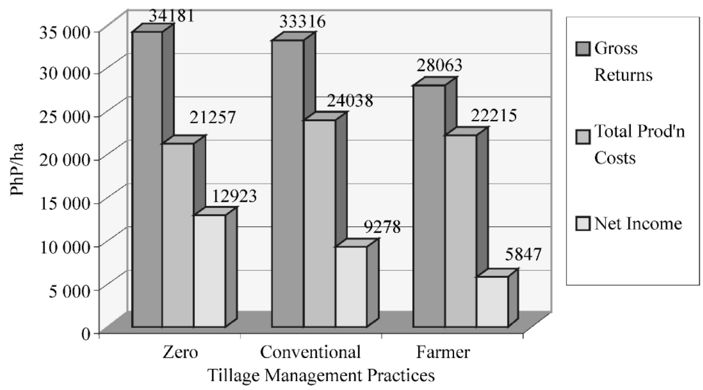

Fig. 4b Net income (PHP) of C818 using different tillage management practices applied with 300 kg· ha^{-1} ammosul + 1 kg· ha^{-1} Bio-N, Mindoro Occidental, 2000 DS (4 sites)

Fig.5a—5d shows the corn stand at various growth stages and field operations under Conservation Tillage technology.

Fig. 5a Status of the field at planting

Fig. 5b Corn stand at about three weeks after planting

Fig. 5c Corn stand at late vegetative stage

Fig. 5d Corn stand before harvest

4 Other project considerations

After just one cropping season of on-farm research (dry season of 1999—2000) in San Jose, these alternative technologies are spreading to other villages in San Jose and to the municipalities of Sablayan and Sta. Cruz during the dry season of 2000—2001, with support from the local government unit (LGU) at the municipal and provincial levels. The area for corn production in the province is almost double that of the previous year and the number of corn farmers have increased significantly during the same period. More traders and feed millers are now becoming more active in the San Jose area. This has been made possible through collaborative efforts among the provincial and municipal LGUs of Mindoro Occidental, the Southern Tagalog Integrated Agricultural Research Center (DA-STIARC), MONSANTO Philippines, Inc., and the UPLB on-farm research group.

5 Summary and recommendation

High yields of yellow corn (var C818) can be obtained using zero tillage and conventional tillage compared to the farmers' tillage practices. But the highest net returns mainly due to lower production costs are attained with zero tillage. Reducing the rate of fertilizer application to half of the recommended rate plus application of 1 kg· ha^{-1} BIO-N results to better yields when combined with zero tillage and contributes to an increase in net income of the farmers.

Corn production after rice offers opportunities for increasing the productivity and income of farmers. However, high costs and other constraints during land preparation reduce the net benefits for the farmers.

Zero tillage provides farmers higher returns as it minimizes the cost of labor and other farm inputs during land preparation. Further, soil moisture is conserved at a period when it is most limiting. Zero tillage technology, therefore, is a viable option for corn production after rice.

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