GROWTH AND YIELD OF CORN INTERCROPPED WITH GIANT IPIL-IPIL ON A HILLSIDE

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ABSTRACT

Ipil-ipil intercrop significantly enhanced the maturity of corn plants and increased ear length, ear diameter, and grain yield per plant. However, tasseling, plant height, ear height, number of ears per plant, and shelling percentage were not significantly affected. Corn plots intercropped with 10, 15, and 20 ipil-ipil plants per linear meter (T_1, T_2, and T_3) gave computed yields of 69.9, 73.4, and 7.0 g/plant, all of which were significantly higher than the control plot (T_0) which yielded 48.5 g/plant. This indicated that grain yield per plant was improved by the ipil-ipil intercrop. In terms of total grain yield, however, no marked differences were observed between the intercropped corn and control plots due to the differences in plant population. The smaller and shorter ears obtained in the control plot (T_0) were compensated by the number of plants which was twice as many as in T_1, T_2, and T_3. However, the yields in T_2 and T_3 exceeded slightly that of T_0. The average yield obtained was 49.52 cavans or 2.77 t/ha. Hill erosion during heavy rains was greater in T_0 than in T_1, T_2, and T_3.

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INTRODUCTION

Due to limited "good agricultural lands", small farmers are compelled to cultivate and plant crops on hilly lands. However, a hilly land requires proper management because its fertility is continuously depleted by run-off water and erosion during heavy rains. Even the presence of sparse vegetation does not help in preventing the tremendous soil erosion.

For effective crop management in hilly areas, it is important to grow on denuded areas a combination of crops that will not only conserve and restore the fertility of the soil but will also give additional income to the farmers. This study determined the growth and yield of corn intercropped with giant ipil-ipil

(Leucaena leucocephala) [(Lam.) de Wit] grown on a hillside, the effect of giant ipil-ipil leaves when applied as an organic fertilizer to corn plants, the agronomic characteristics of corn variety, Phil. DMR Composite 1, in association with ipil-ipil intercrop, and through actual observation the degree of soil erosion that occurred during the experiment.

MATERIALS AND METHODS

Land Preparation. — Soil samples for NPK, organic matter and pH analyses were taken at random from the area 30° in slope. Tall grasses were cut down before stripped furrows where ipil-ipil seeds would be planted were made across the slope. The experimental area was cleared of weeds one week before the planting of corn (Phil. DMR Composite 1 variety). Corn plants were planted in furrows between the growing ipil-ipil seedlings and in the two outer furrows.

Experimental Design and Treatments. — A randomized complete block design was used in the study. The experimental area, measuring 783.75 sq m, was divided into four blocks separated by 1.5 m alleyway. Each block had an area of 172.5 sq m, divided into four treatments with a dimension of 7.5 x 5 m. The treatments were as follows:

(1) T_0 = control (no ipil-ipil intercrop

(2) T_1 = 10 ipil-ipil plants per linear meter

(3) T_2 = 15 ipil-ipil plants per linear meter

(4) T_3 = 20 ipil-ipil plants per linear meter

Planting of Ipil-ipil and Corn. — Ipil-ipil was planted after the plots were laid out. Each intercropped treatment had five rows, measuring 5 m long and a distance of 1.5 m between rows in the direction across the slope. Giant ipil-ipil seeds were sown 90 days ahead of corn seeds. Two to three weeks after germination the ipil-ipil plants were thinned to the desired number.

Three months after seeding the ipil-ipil, corn seeds were sown between rows of ipil-ipil at a distance of 25 cm between hills, making a total of 20 hills in a row and four rows per plot excluding the two outer rows. This was equivalent to a population of 26,667 plants/ha. Corn seeds were sown at the rate of two to three seeds per hill, and then thinned to one plant per hill two weeks after emergence. In the control plot, corn was planted at a distance of 75 x 25 cm, which was equivalent to a population of 53,333 plants/ha.

Fertilizer Application. — After thinning and two weeks after emergence, corn plants were fertilized with a low level of commercial fertilizer as a plant starter for all treatments at the rate of 30 kg NPK/ha. The ipil-ipil plants were cut down to a height of 24 cm above the ground 25 days after the corn seeds had germinated. They were again cut down 58 and 89 days after corn emergence. In each cutting, the

Table 1. Total amount of ipil-ipil herbage and estimated amount of nutrients at three applications.[1]

No. of ipil-ipil plants/linear meter (Treatment)	Total Amount of Herbage (kg)	Amount of Nutrients (g)		
		N	P	K
First Application				
10 (T_1)	1.38	11.45	2.28	9.18
15 (T_2)	2.05	17.02	3.38	13.63
20 (T_3)	2.48	20.58	4.08	16.49
Second Application				
10 (T_1)	3.88	32.80	6.40	25.80
15 (T_2)	5.28	43.82	8.77	35.11
20 (T_3)	6.08	50.46	10.08	40.43
Third Application				
10 (T_1)	5.7	57.31	9.4	37.91
15 (T_2)	6.5	53.95	10.72	43.22
20 (T_3)	6.58	54.61	10.86	53.76

[1] Computation based on Benge's analysis (1977).

herbage was weighed and placed along the rows of corn plants to serve as organic fertilizer. Table 1 shows the yield of herbage in the different treatments.

Management. — Recommended cultural management practices were done in all treatments.

Harvesting and Drying. — All plants in each treatment, except the end hills in the two middle rows, were harvested to get yield samples. Husked corn ears were dried shortly after harvesting. Three days later, the ears were shelled and the grains sundried up to approximately 14% moisture content before weighing.

RESULTS AND DISCUSSION

Crop Environment.

Results of the soil analysis showed that the experimental area contained traces of phosphorus, 212 ppm exchangeable potassium, 3.26% organic matter (approximately 0.16 % N), and a pH of 3. Rainfall distribution during the whole growth period of corn plants ranged from 1.5 to 44 mm. Weekly mean minimum temperatures from corn emergence up to maturity ranged from 31 to 33°C and 23 to 26°C, respectively.

Measurement of Growth and Yield Parameters.

Date of Emergence. Corn seeds germinated uniformly and emerged from all plots five days after sowing. This resulted despite the tendency of the corn seeds to be sown in varying depths when the experimental area was being prepared, which could cause variation in the emergence of seedlings. Sorour *et al.* (1977) had observed that zero

Fig. 1a. Growth stage of the corn plants one month after emergence one day before first cutting of ipil-ipil intercrop.

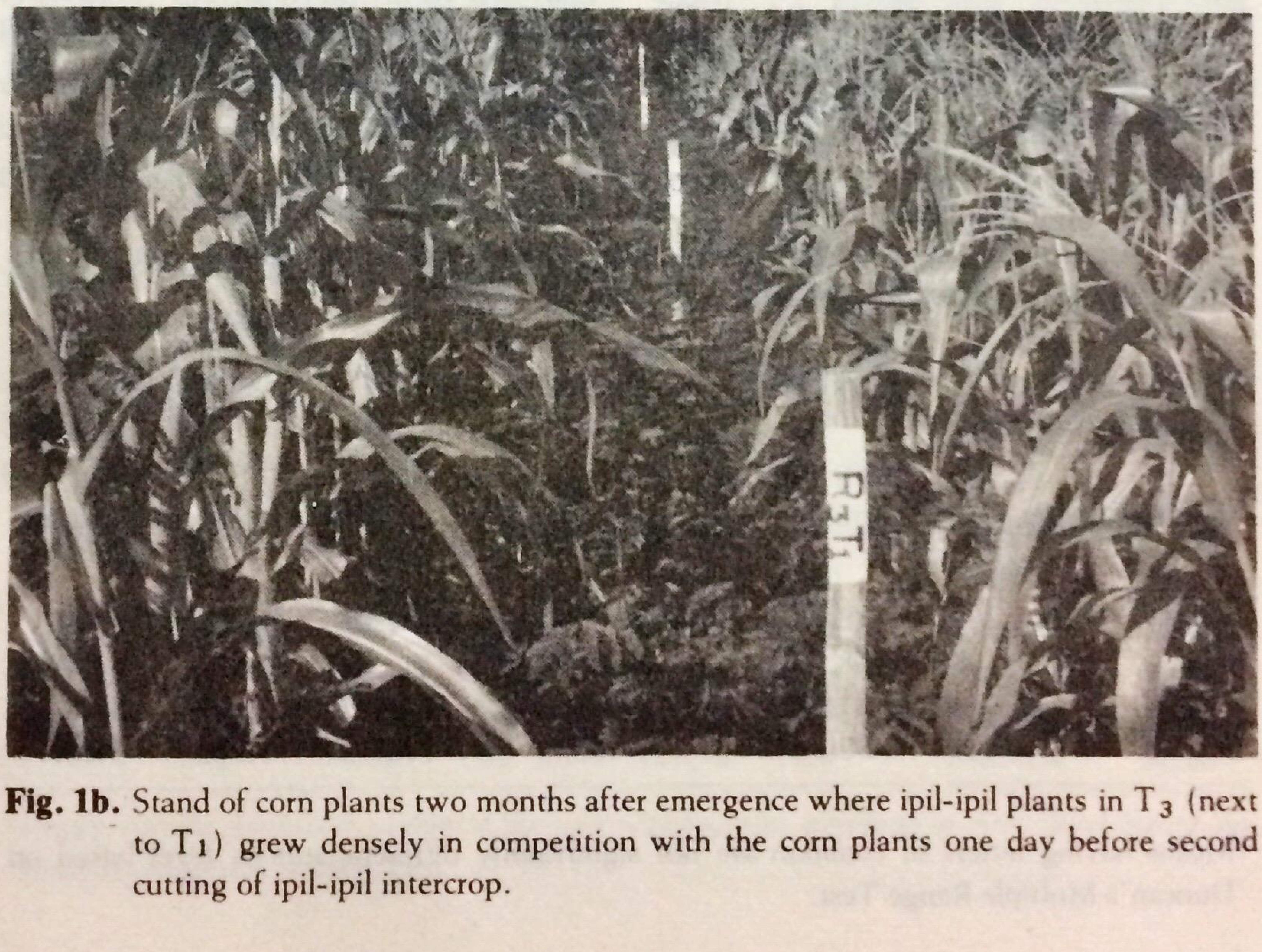

Fig. 1b. Stand of corn plants two months after emergence where ipil-ipil plants in T_3 (next to T_1) grew densely in competition with the corn plants one day before second cutting of ipil-ipil intercrop.

tillage enhanced the emergence of corn seelings while deep plowing retarded the emergence of seedlings and decreased their number. The appearance of corn plants one and two months after emergence is shown in Fig. 1.

Number of Days from Emergence to Tasseling. The various densities of ipil-ipil intercrop did not show a marked influence on the number of days from emergence to tasseling of corn plants (Table 2). The first herbage application, which was done 25 days after emergence, neither shortened nor lengthened the tasseling period.

Number of Days from Emergence to Maturity. Results showed significant differences in the number of days from emergence to maturity among treatment means. T_1 and T_2 matured significantly earlier than T_0 (control). No significant differences, however, were noted between T_3 and the other treatments. These results seemed to corroborate the findings of Gupta (1975) and Martin *et al.* (1976) that plants of different species do not compete intensively with each other compared with plants of the same species mainly because of differences in root system and periods of nutrient and water requirements. Apparently, ipil-ipil utilized the available nutrients from the deeper portion of the soil, while the corn plants used the nutrients found in the upper zone of the soil.

On the other hand, the density of the ipil-ipil intercrop in T_3 perhaps exceeded the optimum so that it competed with the corn plants not only for space but also for light. Thus, the maturation period of the corn plants was delayed. Apparently, the stiff competition among plants took place at the later growth stage of the corn plants, that is, when ipil-ipil intercrop grew as tall as the corn plants two to three weeks after the second cutting of the intercrop.

Table 2. Summary data on the number of days from emergence to tasseling, maturity, plant height, and yield per plant and per hectare of corn plants intercropped with ipil-ipil.[1]

No. of ipil-ipil plants/linear meter (Treatment)	Emergence to tasseling (days)	Emergence to maturity (days)	Plant height (cm)	Grain Yield	
				g/plant	cav/ha
0 (T_0)	58.00	97.75a	162.08	48.53b	47.40
10 (T_1)	58.00	97.00bc	160.83	69.93a	44.47
15 (T_2)	57.75	96.75c	172.34	73.40a	54.35
20 (T_3)	58.25	97.50ab	170.15	71.00a	51.88

[1] Means having letters in common are not significantly different at 5% level based on Duncan's Multiple Range Test.

Plant and Ear Heights at Maturity. Statistical analysis showed no significant differences among treatment means. Plant and ear heights were not markedly affected by the different population densities of ipil-ipil intercrop (Tables 2 and 3). Thus, the herbage of ipil-ipil, which was a source of organic fertilizer, and ipil-ipil as an intercrop did not influence the plant and ear heights of corn. Probably, the mineralized nutrients from the ipil-ipil herbage became available to corn plants only during their reproductive stage, i.e., when the tassels had already developed or 35 to 45 days after emergence; hence, the vegetative growth of corn plants was not significantly affected.

Number of Ears per Plant. The various treatments did not exert any significant influence on the number of ears that developed per plant. However, plants in some of the hills in the intercropped plots bore two ears, while plants in the control plot bore only one ear per plant. Analysis of variance revealed no significant differences among treatment means.

Ear Length. Analysis of variance showed highly significant differences among treatment means. All the intercropped corn plants produced significantly longer ears than those in T_0 (control). However, ear length of corn grown between rows with 10 to 20 ipil-ipil plants per linear meter did not vary significantly.

The differences in ear length could possibly be attributed to the physical and chemical benefits derived from ipil-ipil intercrop and to the more favorable conditions present in the intercropped plots. There was greater intraplant competition expected in the control plots than in the intercropped plots resulting in shorter ears among the plants.

Ear Diameter. Results showed that the biggest ear diameter, with an average of 4.25 cm, was obtained from T_2 while the smallest ear diameter, with an average of 3.87 cm, was from T_0 (control). Analysis of variance indicated that ear diameter of all corn plants intercropped

Table 3. Characteristics of ears and shelling percentage of corn plants intercropped with ipil-ipil.[1]

No. of ipil-ipil plants/linear meter (Treatment)	CORN EARS Height (cm)	No/plant	Length (cm)	Diameter (cm)	Weight (g)	Shelling (%)
0 (T_0)	53.43	1.00	11.61c	3.78b	604.40b	80.04
10 (T_1)	49.12	1.02	13.52b	4.18a	864.28a	81.08
15 (T_2)	59.43	1.10	14.23ab	4.25a	896.68a	82.10
20 (T_3)	59.42	1.02	14.47a	4.1a	888.45a	80.00

[1] Means having letters in common are not significantly different at 5% level based on Duncan's Multiple Range Test.

with varying densities of ipil-ipil plants did not vary significantly from each other at 5% level of probability. However, all of them produced a significantly bigger ear diameter than the control plots. The superiority of the intercropped corn plants could be attributed to the beneficial effect of the herbage incorporated into the soil, thus improving the nutrition of the corn plants. Furthermore, the lower plant density of the intercropped plots provided more favorable conditions.

Ear Weight. The heaviest ears with an average weight of 896.68 g were obtained from T_0 (control). Analysis of variance revealed highly significant differences among treatment means. The ear weight of corn plants intercropped with different densities of ipil-ipil did not vary significantly from each other at 5% level of probability but all of them produced heavier ears than the control. This trend was similar to the results noted on ear diameter, which showed the effect of ipil-ipil intercropping on the weight of corn ear.

Shelling Percentage. The treatments did not have a significant effect on the shelling percentage of corn. This suggests that the development of kernels in every corn ear was not affected by the treatment, although ear development (in terms of ear diameter and ear length) was influenced significantly by the treatments.

Grain Yield per Plant. Analysis of variance showed that grain yield was significantly affected by the ipil-ipil. All the intercropped corn plants had significantly higher grain yield per plant than the control, as shown by their larger ear diameter and heavier ears over the latter. However, the intercropped corn plants did not vary significantly from each other in all of the above parameters, i.e., ear diameter, ear weight, and others.

The failure to detect significant differences in grain yield per plant among the intercropped corn plants was probably due to the inadequate rainfall during the reproductive stage of the corn plants which caused the failure of the plants to utilize fully the limited mineralized nutrients released by the partially decomposed ipil-ipil herbage, and the small differences in the amount of nutrients released by the herbage.

Grain Yield per Hectare. Corn yield was significantly affected by the ipil-ipil intercrop. This was shown by the superiority of the intercropped corn plants over the control plants in terms of ear length, diameter, weight, and grain yield per plant.

The yield of intercropped corn plants was not statistically different from those of the control plants, if yield per unit area was considered. Despite the favorable results obtained from most of the yield parameters in the intercropped corn plants, these results were not reflected in the yields obtained. However, T_2 had the highest yield at 54.35 cav/ha, followed by T_3, T_0 (control), and T_1.

The difference in corn plant population between the control and the intercropped plots evidently played a dominant factor in affecting the grain yield of the crop. Although no ipil-ipil herbage was applied into T_0, it outyielded T_1 because of the former's high plant population. More plants per unit area compensated for the low grain yield per plant in T_0. The low yield of corn plants in T_1 could be due to the lesser amount of herbage applied. T_3 had lower yield compared to T_2 probably due to intraplant competition between the ipil-ipil and the corn plant.

Degree of Soil Erosion Through Visual Observation.

The degree of soil erosion was not very distinct in the entire experimental area. However, it was observed that hill erosion was greater in the control plots. During heavy rains, especially with the advent of typhoons, the top soil was washed down to the lower part of the hill. Hill erosion was lesser in the intercropped plots. The rows of ipil-ipil intercepted the flow of run-off water. There was increased infiltration rate as a result of the ipil-ipil herbage added to the soil aside from their root penetration. This result then indicated that corn-ipil-ipil intercrop in hilly areas considerably checked hill erosion.

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