Annals of Tropical Research 24(1):35-48

Cultural management manipulation for baby corn (*Zea mays* Linn) production. I. Effects of variety and organic manure on the growth and yield of baby corn

Reynaldo R. Javier

Department of Agronomy and Soil Science, Leyte State University, Visca, Baybay, Leyte, Philippines

ABSTRACT

Javier, R. R. 2003. Cultural management manipulation for baby corn (*Zea mays* Linn) production. I. Effects of variety and organic manure on the growth and yied of baby corn. *Ann. Trop. Res.* 24(1):35-48.

The percentage organic matter and total N and Olsen P in the soil were significantly increased with 120-180 kg N ha $^{-1}$ organic matter manure application.

The application of organic manure at increasing rates (60-180 kg N ha $^{-1}$) shortened the days to tassel, silk, and harvest of baby corn; increased the leaf area index (LAI), crop growth rate (CGR), net assimilation rate (NAR) and herbage yield; and improved the yield components which markedly increased the baby corn yield. The highest marketable and total yield of baby corn were attained by Pioneer 3014 at 180 kg N ha $^{-1}$ and by VM2 and Davaonon at 120 kg N ha $^{-1}$ of organic manure application.

Keywords: baby corn, organic manure, hybrid corn, open pollinated corn

Correspondence: R. R. Javier *Present Address:* Department of Agronomy and Soil Science, Leyte State University, Visca, Baybay, Leyte, Philippines

INTRODUCTION

Vegetables are substantial food and can contribute significantly to the quality of the human diet. Vegetable is not ordinarily a staple but is usually eaten with the staples. Production of vegetables has been known also to provide a good source of income to many rural farmers.

Corn (*Zea mays* Linn), although utilized as a staple food or as a substitute for rice, is also popular as a vegetable crop. Baby corn is eaten as a young cob after boiling and is used in meals as vegetable or soup with meat (Gonzaga, 1998). Corn as a vegetable is done by harvesting the young cobs 2-3 days after silking (Bautista, 1983).

Growing baby corn for optimum yield in many areas confronts the farmers with many problems. One of these is the application of fertilizers. The common practice is to apply inorganic fertilizers. Due to high cost and at times to the scarcity of inorganic fertilizers, farmers are discouraged to apply as recommended or if they do, only at minimal amounts, hence, the yield is low.

Organic manure has been found as an alternative, supplement, and/or substitute for costly inorganic fertilizers. Using organic manure may bring a number of favorable effects in maintaining high level of soil productivity and also a means of conserving water and nutrients in the soil (Ratilla, 1989). It also modifies the physical properties of the soil by aggregation, thus improving its soil structure and tilth.

Another problem confronting the baby corn production system is about the performance of corn which has shown to differ with the varieties planted. Escasinas (1998) revealed that many farmers claimed that hybrids or high yielding varieties (HYVs) performed better than the local varieties. However. other farmers claimed that local variety is better than open pollinated varieties. In this regard, limited information about varieties of corn grown as baby corn is available.

This paper presents the effects of cultural management practices that have been found to improve baby corn production. Specifically, this focuses to evaluate the effects of organic manure on the growth and yield of baby corn and to determine its amount to be applied and the kind of variety for baby corn production.

MATERIALS AND METHODS

The experiment was conducted during the late rainy season at the experimental area of the Leyte State University, Baybay, Leyte, Philippines from December 1999 to June 2000. The soil was clay loam having a 6.10 pH, 1.25% OM, 0.06% total N and 17.31 mg kg $^{-1}$ P. The area had a monthly rainfall of 412 mm and an average daily temperature of 26.7 ^{0}C (minimum) and 31.3 ^{0}C (maximum).

An experimental area of 810 m^2 was laid out in split plot in RCBD with three replications. The experiments included the variety as main plots; V_1 = hybrid (pioneer 3014), V_2 = open pollinated variety (VM2), and V_3 = native (Davaonon) and fertilizer as subplots; F_0 = control, F_1, F_2, and F_3 = 60, 120, and 180 kg N ha $^{-1}$ of organic fertilizers, respectively, and F_4 = 60-30-30 inorganic fertilizer. The unit plot was 18 m^2.

The different amounts of organic fertilizer using poultry manure were computed based on the laboratory analysis (2.51% N and 2.21% P - ADW basis). The manure was evenly spread in furrows and incorporated into the soil in each treatment plot a day before planting.

Two to three seeds of corn were planted at 50 cm between rows and 20 cm between hills. Two weeks after planting, the seedlings were thinned to 1 plant per hill to satisfy the 100,000 plants ha $^{-1}$. The crop was weeded twice after planting and did not receive any spray.

The young corn ears were harvested 2-3 days after the appearance of the silks every other day for two weeks. The young ears were dehusked and the young cobs were sorted to marketable and non-marketable baby corn.

After crop harvest, soil samples from each treatment plot were collected at 0-15 cm depth. They were analyzed for soil pH, OM (%), N(%) and available P (mg kg $^{-1}$ of soil).

Horticultural characters, yield components and yield data were taken down from each treatment plot. Growth analysis parameters such as leaf area index (LAI), crop growth rate (CGR) and net assimilation rate (NAR) were computed as follows:

Leaf Area Index, LAI (Pearce *et al.*, 1975)

$$LAI = \frac{L \times W \times 0.75 \times 9.39}{\text{ground area allotted per plant}}$$

Where:

L = length (cm) of leaf No.8

W = width (cm) broadest portion of leaf No.8

Crop Growth Rate, CGR ($g\ m^{-2}\ d^{-1}$)

$$CGR = \frac{W_2 - W_1}{t_2 - t_1\ (GA)}$$

Where:

GA = ground area allotted per plant

W_1 = initial dry weight

W_2 = final dry weight

t_1-t_2 = time interval between the initial and final measurement

Net Assimilation Rate, NAR ($g\ m^{-2}\ d^{-1}$)

$$NAR = \frac{(W_2 - W_1)(\ln L_2 - \ln L_1)}{(L_2 - L_1)(t_1 - t_2)}$$

Where:

L_1 = leaf area at time 1

L_2 = leaf area at time 2

W_1 = dry weight at time 1

W_2 = dry weight at time 2

$t_2 - t_1$ = time interval between the first and second measurement

ln = natural log

RESULTS AND DISCUSSION

Effect on Soil Chemical Properties

Table 1 shows that application of organic fertilizer at 120 and 180 kg N ha $^{-1}$ significantly increased the % OM and % N content of the soil. This could be attributed to the high amount of organic materials content of poultry manure (Sims and Wolf, 1994). At these rates, the organic materials upon decomposition enhanced the release and supply of nutrient elements such as N, P, and K and other micronutrients held in organic forms and also facilitated the release of exchangeable cations present in organic matter (Brady, 1974).

Table 1. Soil pH and organic matter, nitrogen and phosphorus content of the soil as influenced by variety and organic manure application.

	pH	OM (%) (Modified Wlkley-Black)	Total N (%) (Micro Kjeldahl)	P (mg kg $^{-1}$ soil) (Olsen P)
Initial	6.10	1.24	0.06	17.31
Treatment	Mainplot			
V_1 - Pioneer 3014	6.31	1.71	0.083	15.49
V_2 - VM2	6.27	1.80	0.087	17.18
V_3 - Davaonon	6.29	1.66	0.083	16.57
Mean	6.29	1.72	0.084	16.51
	Subplot			
F_0 - control	6.29	1.63 ^{c}	0.080 ^{b}	13.83 ^{b}
F_1 - 60 kg N ha $^{-1}$	6.27	1.69 ^{abc}	0.084 ^{ab}	15.43 ^{b}
F_2 - 120 kg N ha $^{-1}$	6.30	1.80^{ab}	0.090 ^{a}	19.32 ^{a}
F_3 - 180 kg N ha $^{-1}$	6.32	1.83^{a}	0.090 ^{a}	20.77^{a}
F_4 - 60-30-30 (inorg)	6.26	1.64 ^{bc}	0.079 ^{b}	13.21 ^{b}
Mean	6.29	1.72	0.084	16.51
C.V.% (a)	1.44	22.2	18.80	21.90
(b)	1.30	9.25	9.81	13.27

Means in a column with the same letters are not significantly different at 5% level, DMRT

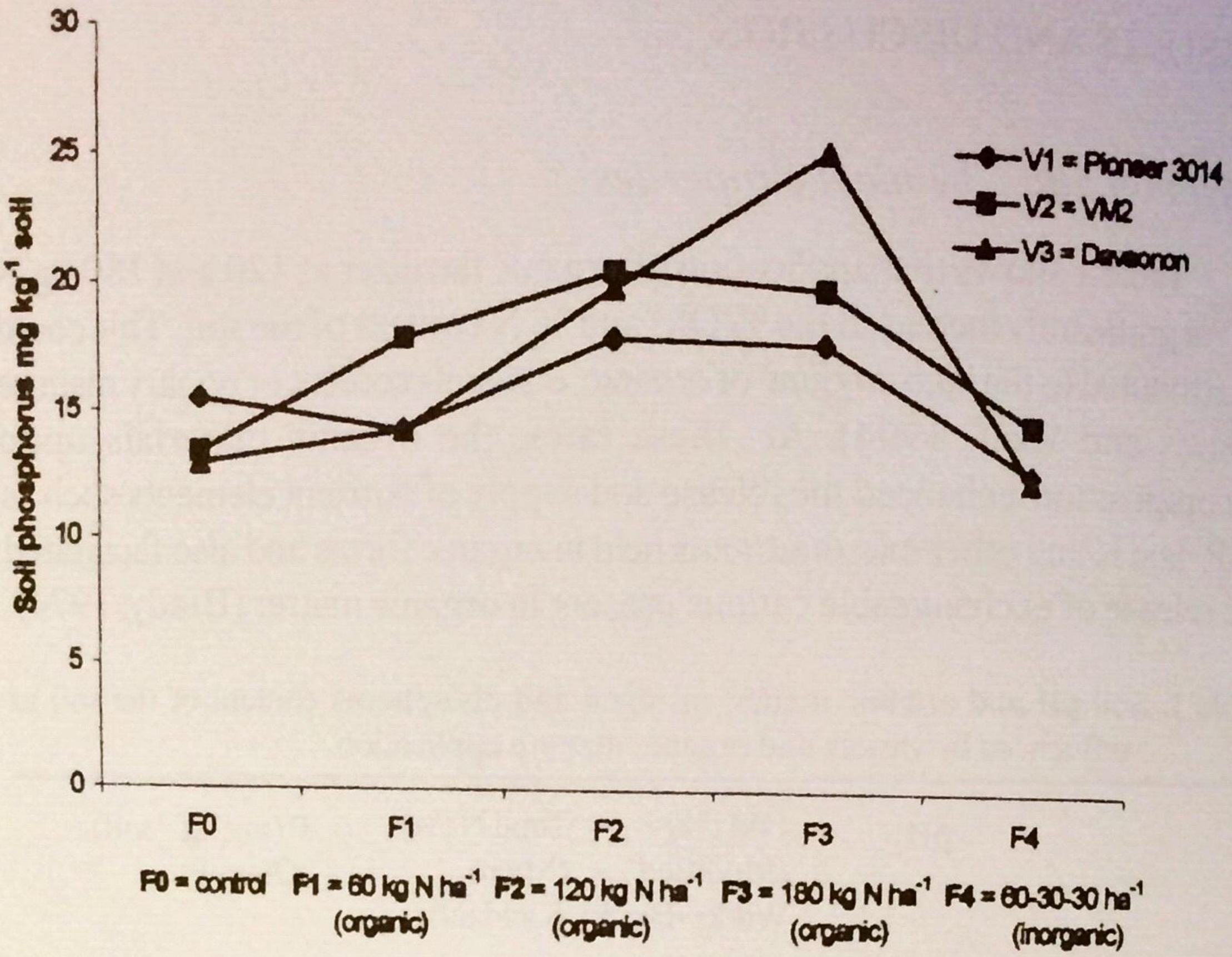

Figure 1. Interactrion effect between the variety and fertilizer on soil phosphorus

The variety and fertilizer interaction effect in Figure 1 presents that the P content in the soil in the plot with the native variety markedly increased with the rates of application of organic manure, but the P content in VM2 and Pioneer 3014 plots levelled off at 120 kg N ha $^{-1}$ application. This indicates that the variety of corn which utilized soil phosphorus which are either inherent or applied makes a significant difference in P content in the soil (Sim *et al*, 1991). This suggests that the open pollinated and the hybrid corn varieties with high rates of organic manure ably utilized more available phosphorus from the soil than the native variety.

Effects on Horticultural Characters

Table 2 reveals that the native variety (Davaonon) was the earliest to tassel, silk and harvest and the harvest time, while the hybrid (Pioneer 3014) and the open pollinated (VM2) varieties had more or less the same time to tassel and harvest and height at 30 days. However, regardless of the variety, the increasing rates of organic fertilizer application significantly shortened the required number of days for the corn crop to tassel, silk and harvest, but these required time did not differ significantly with the inorganic fertilizer application. Similarly, the increased rates of organic fertilizer application hastened the height of the plant at any sampling time. Likewise, the time required of the plants to tassel was influenced by the interaction of the variety and of the fertilizer application (Figure 2). The application of 180 kg N ha $^{-1}$ (organic) and 60-30-30 kg ha $^{-1}$ (inorganic) fertilizer appeared to be the optimum rate for effecting a change in the time to tassel for Pioneer 3014 and VM2 corn, respectively. The native variety (Davaonon) had the shortest time required to tassel in either of the fertilizer application.Effects on Growth Analysis Parameters and Herbage Yield

The leaf area index (LAI) and the crop growth rate (CGR), regardless of the varieties, were significantly improved with organic and inorganic fertilizers application (Table 3), where the LAI and CGR improvement with 120 kg N ha $^{-1}$ of organic manure was as good as with inorganic fertilizer at 35 days. Highest LAI and CGR values of 4.73 and 25.87 gm $^{-2}$ d $^{-1}$ were obtained with 180 kg N ha $^{-1}$ at harvest respectively. But these values were not significantly different from the values obtained from the former rate of organic manure application. Application of organic manure at 120 kg N ha $^{-1}$ however, appeared to be the optimum rate for effecting optimum LAI and CGR. This implies that application rates beyond 120 kg N ha $^{-1}$ would no longer improve these parameters. Likewise, the net assimilation rate (NAR) was markedly increased with fertilizer application relative to the control.

The highest herbage yield 19.39 t ha $^{-1}$ was obtained from plants with 180 kg N ha -1 organic manure application. The herbage yield of 18.7 t ha $^{-1}$ of the plants applied with 120 kg N ha $^{-1}$ organic manure is just as good as those herbage of the plants which received inorganic fertilizer. High herbage yield of the corn crop with organic manure could be due to the improved growth of the crop as manifested by the high values of LAI, CGR and NAR. It

Table 2. Horticultural parameters of baby corn as affected by the variety and organic fertilizer

Treatment	No. of days to				Plant height (cm)	
	Emergence	Tasseling	Silking	Harvesting	30 days	at harvest
Corn varieties						
V_1 - Pioneer 3014	4.0	54.5[a]	55.1[a]	56.8[a]	102.6[b]	166.2[c]
V_2 - VM2	4.0	53.8[a]	54.3[b]	56.3[a]	104.4[b]	189.5[b]
V_3 - Davaonon	4.0	51.3[b]	52.1[c]	54.7[b]	113.2[a]	215.5[a]
Mean	4.0	53.2	53.8	55.9	106.7	190.4
Organic Fertilizers						
F_0 - control	4.0	55.8[a]	55.9[a]	59.3[a]	83.3[d]	148.1[d]
F_1 - 60 kg N ha -1 (org)	4.0	53.3[b]	54.0[b]	55.6[b]	102.6[c]	180.1[c]
F_2 - 120 kg N ha-1(org)	4.0	52.6[bc]	53.3[b]	54.8[b]	111.1[b]	204.8[b]
F_3 - 180 kg N ha -1 (org)	4.0	52.0[c]	52.9[b]	54.8[b]	120.6[a]	220.7[a]
F_4 - 60-30-30 (inorg)	4.0	52.3[c]	53.1[b]	55.1[b]	115.9[ab]	198.3[b]
Mean	4.0	53.2	53.8	55.9	106.7	190.4
C.V.% (a)		2.4	1.3	2.1	6.1	7.7
(b)		1.6	2.3	2.2	7.5	7.8

Means in a column with the same letters are not significantly different at 5% level, DMRT.

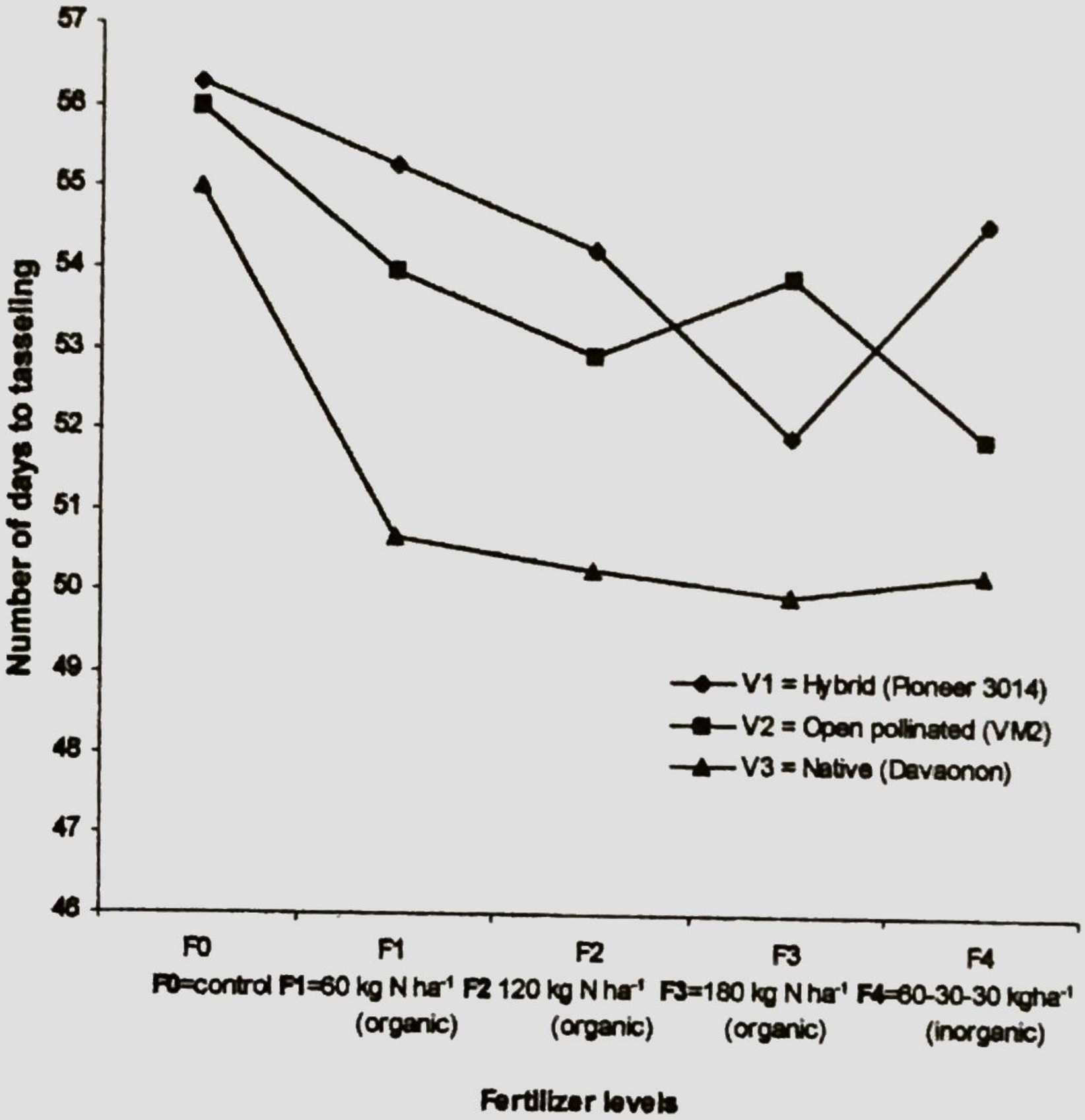

Figure 2. Interaction effects between the variety and organic manure on the number of days to tasseling

could be attributed to the available nutrient elements released upon decomposition of the applied organic manure. When the organic manure was incorporated into the soil before planting, large portion of it must have been gradually decomposed with time, and adequate quantities of nutrient elements had been mineralized and released at the time the corn plants required sufficient supply of nutrients for its growth and development.

Effects on Yield

Table 4 presents the summary data on yield and yield components of baby corn as affected by variety and fertilizer application. Of the varieties, Pioneer 3014 produced longer cobs and heavier marketable and total yield of baby corn than the Davaonon and VM2. Davaonon had the heaviest non-marketable baby corn but it produced almost similar size and weight of baby corn to VM2.Regardless of the variety, the length and width,the weight of marketable and the total yield of baby corn were enhanced by the increased application of organic manure relative to the control. When organic manure was applied at 120 kg N ha $^{-1}$, the corn plants had produced all yield components and yield equal to the plants with inorganic fertilizer. The plants with organic manure at 60-180 kg N ha $^{-1}$ had produced more yield components and consequently resulted in high yields of baby corn. The application of 120 kg N ha^{-1} organic manure appeared to be the optimum rate for effecting an increase in the total yield of baby corn, as well as all yield components. This implies that rates higher than 120 kg N ha $^{-1}$ would just level off in the improvement of the parameters.

Figure 3 reveals the interaction effects between the variety and the fertilizer where the highest yields of baby corn (marketable and total yield were achieved when organic manure were applied at 120 kg N ha $^{-1}$ for VM2 and Davaonon and 180 kg N ha $^{-1}$ for Pioneer 3014. The data showed that organic manure application at 120 kg N ha $^{-1}$ would be the optimum rate for effecting yield increase for OPV and native varieties, whereas at 180 kg N ha $^{-1}$ rate of organic manure, it appeared not to be the optimum rate yet for Pioneer 3014. This implies that a higher rate than the 180 kg N ha $^{-1}$ of organic manure would further improve the baby corn yields of the hybrid corn.

Table 3. Growth parameters and herbage yield of baby corn as affected by variety and organic fertilizer

Treatment	LAI		CGR ($g\ m^{-2}d^{-1}$) Sampling		NAR ($g\ m^{-2}d^{-1}$) Sampling		Fresh Herbage Yield
	35 days	harvest	1st	2nd	1st	2nd	($t\ ha^{-1}$)
Corn Varieties (A)							
V_1 - Pioneer 3014	1.97	4.30	6.83	20.38	6.23	6.25	17.65
V_2 - VM2	1.98	3.97	6.92	19.12	6.14	6.34	16.34
V_3 - Davaonon	1.95	3.86	6.61	21.78	5.92	7.22	13.91
Mean	1.97	4.04	6.78	20.43	6.10	6.61	15.97
Organic Fertilizer							
F_0 - Control	1.00^{d}	2.79^{c}	3.26^{d}	10.14^{c}	5.52	5.27^{b}	10.52^{d}
F_1 - 60 kg N ha^{-1}	1.79^{c}	4.04^{b}	6.08^{ab}	19.73^{b}	6.07	6.86^{a}	14.36^{c}
F_2 - 120 kg N ha^{-1}	2.33^{ab}	4.63^{a}	8.03^{ab}	25.80^{a}	6.20	7.45^{a}	18.70^{ab}
F_3 - 180 kg N ha^{-1}	2.65^{a}	4.73^{a}	9.09^{a}	25.87^{a}	6.35	6.70^{a}	19.39^{a}
F_4 - 60-30-30 (inorg)	2.07^{bc}	4.01^{b}	7.45^{bc}	20.62^{ab}	6.35	6.75^{a}	16.88^{b}
Mean	1.97	4.04	6.78	20.43	6.10	6.61	15.97
C.V.%(a)	25.6	11.7	35.2	37.4	22.9	17.2	36.8
(b)	17.8	13.1	22.2	25.1	15.2	16.9	12.7

Means in a column with the same letters are not significantly different at 5% level, DMRT

Table 4. Yield and yield components of baby corn as affected by variety and organic fertilizer

Treatment	Average						
	No. of ear plant $^{-1}$	Young cobs length (cm)	Young cobs width (cm)	No. of young cobs per plot	Weight of young cobs (t ha-1) marke-table	Weight of young cobs (t ha-1) non-marketable	Total yield of young cobs (t ha-1)
Corn Varieties							
V_1 - Pioneer 3014	1.4	9.61a	1.70	126.1	1.07a	0.10b	1.19a
V_2 - VM2	1.3	7.86b	1.52	101.5	0.45b	0.13b	0.58b
V_3 - Davaonon	1.4	7.68b	1.68	104.1	0.44b	0.17a	0.61b
Mean	1.4	8.38	1.63	110.5	0.66	0.13	0.79
Organic fertilizers (B)							
F_0 - control	1.2^b	7.38^d	1.40^d	84.6^b	0.26^d	0.07^d	0.33^d
F_1 - 60 kg N ha-1(org)	1.3^b	8.05^c	1.57^c	91.3^b	0.53^c	0.10^{cd}	0.64^c
F_2 -120kg N ha-1 (org)	1.5^a	8.73^b	1.74^{ab}	125.3^a	0.79^b	0.16^{ab}	0.95^{ab}
F_3 -180 kg N ha-1 (org)	1.6^a	9.31^a	1.79^a	120.3^a	0.95^a	0.14^{bc}	1.09^a
F_4 - 60-30-30 (inorg)	1.4^a	8.44^{bc}	1.66^{bc}	131.1^a	0.74^b	0.18^a	0.92^b
Mean	1.44	8.38	1.63	110.5	0.66	0.13	0.79
C.V.% (a)	15.6	5.5	11.3	21.1	28.5	24.1	31.4
(b)	11.6	6.9	7.4	14.9	14.8	36.5	17.4

Means in a column with the same letters are not significantly different at 5% level, DMRT

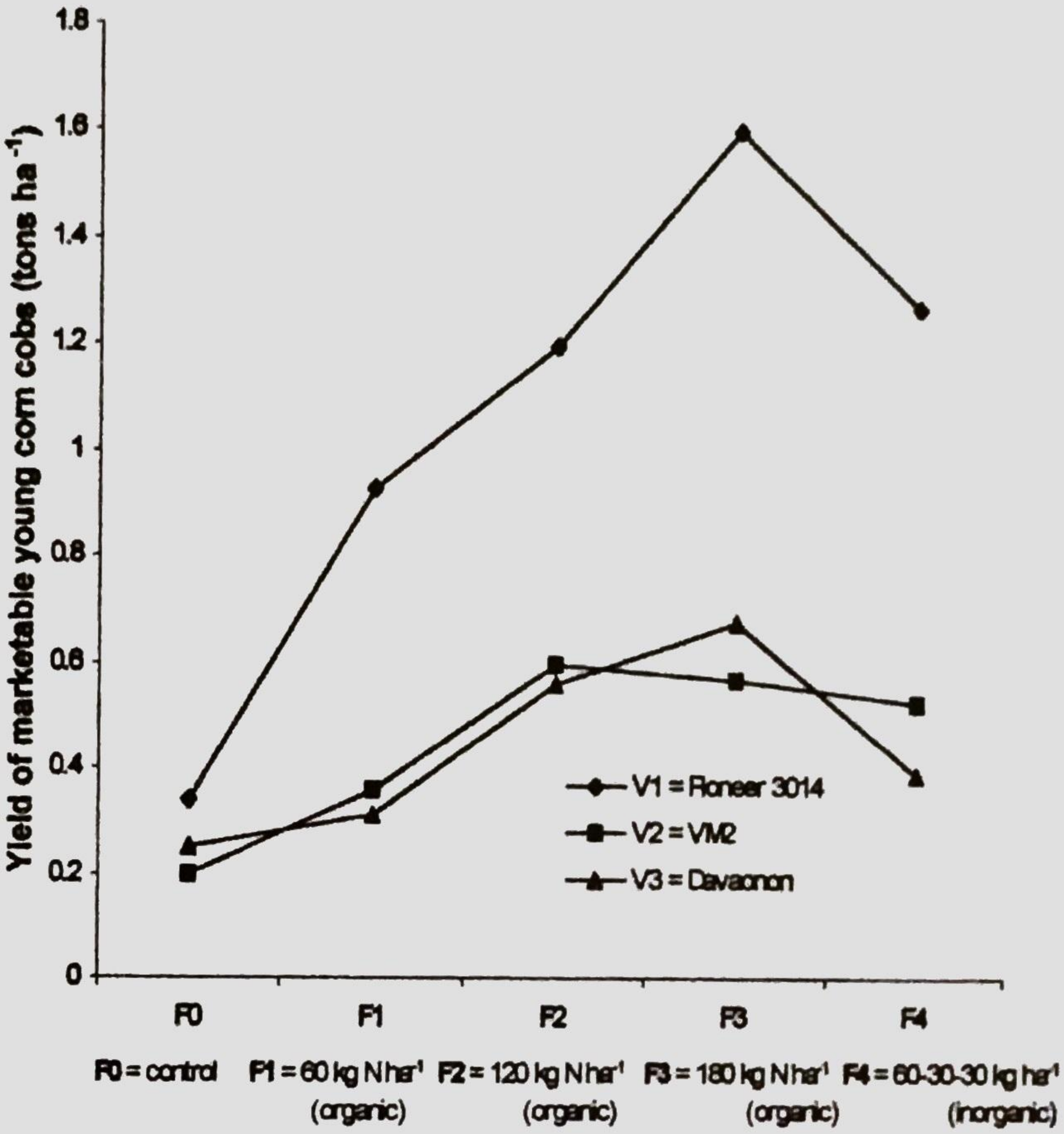

Figure 3. Interaction effects of variety and fertilizer on the yield (t ha^{-1}) of marketable young corn cobs

CONCLUSION

The application of organic manure markedly increased the percentage organic matter and total nitrogen and the extractable phosphorus in the soil. Organic manure at 120-180 kg N ha $^{-1}$ hastened the corn reproductive development and early harvesting of baby corn; improved the growth and herbage yield and increased the yield of baby corn. Among the varieties of baby corn, the hybrid corn significantly responded to high rates of organic manure more than either the open pollinated (OVP) or the native varieties.

REFERENCES

BAUTISTA, O. K. 1983. *Introduction to Tropical Horticulture*. Department of Horticulture, UPLB, Los Baños,Laguna. pp. 69

BRADY, N. C. 1974. *The Nature and Properties of Soil. 8th ed*. MacMillan Publ. Co. Inc. New York. pp 639.

ESCASINAS, A. B. 1998. *Agronomic management manipulation to improve corn seed production*. Ph.D. Dis. UPLB, Los Baños, Laguna. pp 123.

GONZAGA, E. R. 1998. *The effects of plant spacing on the growth and yield of two corn varieties grown as baby corn*. Undergrad. Thesis. ViSCA, Baybay, Leyte.pp 45.

PEARCE, R. B., MOCK, J. J. and BARLEY, T. B. 1975. Rapid method for estimating leaf area per plant in maize. *Crop Sci*. **15**(5):691-694.

RATILLA B. C.1989. *Time of incorporation of field legume herbage and its influence on the growth and yield of upland rice*. M.S. Thesis. ViSCA, Baybay, Leyte.

SIMS, J. T. and WOLF, D. C. 1994. Poultry waste management. Agricultural and Environmental Issue. *Adv. In Agronomy*. **52**:1-79.

SIMS, J. T., SCHILKE-GARTLEY, K. L. and MCGOWAN, W. 1991. *Evaluation of best management practices for agricultural use of poultry manure in Delaware*. Final Tech. Rep. Delaware. Dept. Nat. Res.Environ. Control. pp 75.