EFFECTS OF NITROGEN LEVEL AND ROW SPACING ON THE GROWTH AND YIELD OF FLINT CORN

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ABSTRACT

Application of nitrogen fertilizer up to 90 kg/ha with 30 kg each of P_2O_5 and K_2O did not remarkably affect the growth and yield parameters of flint corn. However, visual observation indicated that fertilization resulted in the development of sturdier corn plants with darker green and broader leaves. It likewise promoted earlier initiation of reproductive stage and hence, maturity. Row spacing at 50 cm resulted in the highest leaf area index, stover and grain yields. Increase in row spacing from 50 to 75 or 100 cm markedly reduced these parameters. Significant interaction effects of nitrogen level and row spacing were observed on stover yield only.

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KEY WORDS: Flint corn. Nitrogen level. Row spacing. Growth. Yield.

The nutrient status of soils constantly changes due to crop removal, soil erosion, and leaching. Espinosa (1976) pointed out that some soils contain higher amount of certain nutrients needed by the plant than others, and that soils containing lesser amount of nutrients could only be corrected through the application of the right kind and proper amount of fertilizer to obtain better yields.

Pearson (1967) and Davide (1972) reported that application of inorganic fertilizers or a combination of N and P and in some cases K, at the rates appropriate for the crop is necessary to ensure early and rapid growth of corn. Gupta (1975) also claimed that N facilitates the development of optimum LAI with parallel acceleration of photosynthesis allowing earlier initiation of the reproductive phase. Continuous

application of N may accelerate the utilization and removal of other nutrients such as P and K. However, Samonte (1975) observed that excessive amounts of N in the soil significantly reduced crop yields due to the build-up of acidity and decreased uptake of phosphorus.

Proper row spacing is an equally important cultural practice in corn production. Closer spacing than necessary not only leads to production of unhealthy seedlings due to mutual shading but also facilitates rapid transfer of diseases from one plant to another. Furthermore, it requires more planting materials and lengthens the duration of planting. On the other hand, wider spacing than necessary promotes excessive growth of weeds which may lead to intense competition for water and nutrients resulting in decreased crop yield. Lower crop yield at this spacing is also due to the lesser plants which can be harvested per unit area.

Considering the ever-increasing prices of inputs such as seeds and fertilizers, this study was conducted to determine the optimum nitrogen fertilizer level and row spacing for corn production.

The study was conducted using the split-plot arranged in randomized complete block design with three replications. Nitrogen levels were designated as the mainplots and row spacings as the subplots. The treatments were as follows:

Mainplot (Nitrogen Level)

0 (unfertilized)
30 kg/ha
60 kg/ha
90 kg/ha

Subplot (Row Spacing)

50 cm
75 cm
100 cm

Corn (DMR var. 2) seeds were sown at 25 cm between hills in furrows following the specified row spacing treatments with two to three seeds per hill. Urea (45-0-0) and complete fertilizer (14-14-14) were applied according to the rates specified in this study, namely 0-0-0, 30-30-30, 60-30-30 and 90-30-30 kg N, $P_2 0_5$, K_2O/ha. Complete fertilizer was evenly drilled in furrows before planting while urea was sidedressed 5 weeks after planting to satisfy the N fertilizer requirement.

Handweeding was done regularly until the crop was about 40 days old. Hilling-up was also performed 35 days after planting. Control of insect pests using 3-5 tbsp/20 L Thiodan, and fungal diseases using 2 tbsp/16 L of Benlate, was done at 10-day interval starting at 2 weeks after seedling emergence up to 4 weeks before harvest.

Growth parameters determined were plant height and leaf area index (LAI). Only plants in the inner rows of each treatment excluding the end plants were harvested. All sample ears were sorted, measured, shelled, dried, and the grains weighed. Yield and yield components determined

were stover yield, ear size, weight of 1000 seeds and grain yield.. Cost and return analysis was also done.

Results of soil analysis taken before planting and fertilizer application showed 2% o.m., 26 ppm P and 436 ppm K (Table 1). These are more or less equivalent to 2000 kg total N /ha, 119.10 kg $P_2 0_5$/ha, and 1046.40 K_2O/ha, respectively. Based on these results, the fertilizer rate recommended by the Bureau of Soils for normal growth and development of corn is 60-10-0 kg NPK/ha.

The different N levels used had no significant effects on all growth parameters of corn (Table 2). However, visual observation showed that fertilized plants were sturdier, had darker green and broader leaves, and reached reproductive stage and maturity earlier than the unfertilized plants.

Generally, plants grown at closer spacing were taller but had more slender stalks and narrower leaves that overlapped with other leaves than those planted farther apart.

Table 3 shows that only leaf area index and stover yield were signifi-

Table 1. Initial soil analysis and nutrient requirement of the experimental area.

pH	% O.M	Olsen's P (ppm)	Extractable K	Nutrient Requirement (kg/ha)		
				N	P	K
5.8	2.0	26	436	60	10	0

Table 2. Growth parameters of corn as influenced by N level averaged across row spacings.

Nitrogen Level (kg/ha)	Plant Height (cm)	LAI	Stover Yield (t/ha)
0 (unfertilized)[1]	207.32	3.32	4.98
30	239.88	4.29	5.83
60	236.06	4.30	5.71
90	225.98	4.24	5.80

[1] Data not included in statistical computation but only used for comparison.

Table 3. Growth parameters of corn as influenced by row spacing averaged across N levels.[1]

Row Spacing (cm)	Plant Height (cm)	LAI	Stover Yield (t/ha)
50	238.64a	6.00a	6.69a
75	234.32a	3.83b	5.58b
100	228.96a	3.00c	5.08c

[1]Treatment means within a column followed by a common letter are not significantly different at 5% level, DMRT.

cantly affected by row spacing. Markedly higher leaf area index and stover yield of 6.00 and 6.69 t/ha, respectively, were obtained when plants were grown at a row spacing of 50 cm. Values declined as distance between rows was increased. The high LAI and stover yield values obtained with narrow spacing could be attributed to the higher plant population per unit area. This conforms with the findings of Fagade and De Datta (1971) that LAI and herbage yield increase with plant density. This increase could be explained by the greater number of plants and leaves per unit area although the average leaf size was comparatively smaller.

Significant interaction effects of nitrogen level and row spacing on stover yield were noted (Table 4). Application of 30-30-30 kg N, P_2O_5, and K_2O/ha to closely spaced plants (50 cm x 25 cm) resulted in considerably higher stover yield which was comparable to those from plants which received higher amounts of N up to 90 kg/ha. As row spacing was increased to 75 cm, plants applied with 60-30-30 kg NPK/ha produced statistically similar stover yield as those applied with 90-30-30 kg/ha at narrow spacing (50 cm). At 100 cm spacing, the highest N rate (90 kg/ha) with 30 kg each of P_2O_5 and K_2O gave significantly heavier stover yield than lower N rates. The production of higher stover yield might be a result of the development of slightly taller plants with higher leaf area indices.

Application of varying levels of nitrogen with 30 kg/ha each of P_2O_5 and K_2O did not remarkably affect yield and yield components of corn. However, row spacing significantly affected ear length and grain yield of corn (Table 5). Longer ears (14.08 cm) were produced at a distance of 100 cm x 25 cm. Ear length decreased as row spacing

Table 4. Stover yield of corn as influenced by interaction between N level and row spacing.[1]

Nitrogen Level (kg/ha)	Row Spacing (cm)		
	50	75	100
0 (unfertilized)[2]	5.55	5.03	4.36
30	7.14a	5.22cd	5.14de
60	6.49a	5.97bc	4.68e
90	6.43ab	5.55c	5.43c

[1] Treatment means within a column followed by a common letter are not significantly different at 5% level, DMRT.

[2] Data not included in statistical computation but only used for comparison.

Table 5. Yield and yield components of corn as influenced by row spacing averaged across N levels.[1]

Row Spacing (cm)	Ear		Weight of 1000-Seeds (g)	Grain Yield (t/ha)
	Diameter (cm)	Length (cm)		
50	4.25a	13.01b	252.33a	2.80a
75	4.27a	13.58ab	256.87a	2.52ab
100	4.40a	14.08a	258.78a	2.30b

[1] Treatment means within a column followed by a common letter are not significantly different at 5% level, DMRT.

became narrower. Although variations noted in ear diameter and seed weight were insignificant, slightly bigger ears and heavier seeds were likewise produced when plants were set at wider distances. This is because there is generally less interplant competition at wider spacing hence, plants were able to utilize the applied nutrients more efficiently.

Significantly highest grain yield of 2.80 t/ha was obtained at 50 cm x 25 cm spacing while the lowest grain yield of 2.30 t/ha was produced at 100 cm x 25 cm spacing. Increasing the row spacing to 100 cm generally

increased ear size and seed weight. However, the magnitude of increase was not high enough to compensate for the decreased number of plants per unit area.

Although the highest cost of production (₱3,562.47/ha) was incurred when 90 kg N and 30 kg each of P_2O_5 and K_2O per hectare were applied to corn, the said treatment also gave the highest gross income resulting in the highest average net income of ₱1,977.53/ha (Table 6). The unfertilized plants gave the lowest net income of ₱1,047.70/ha. This implies that it is advisable to fertilize corn plants.

A higher net income (₱1,989.04) was obtained from closely-spaced (50 cm x 25 cm) plants than from

Table 6. Cost and return analysis of corn production per hectare, averaged across row spacings.

Nitrogen Level (kg/ha)	Average Gross Income (₱)	Average Gross Expense (₱)	Average Net Income (₱)
0 (unfertilized)[1]	3,746.67	2,698.97	1,047.70
30	4,873.33	3,224.97	1,648.37
60	4,833.33	3,387.47	1,445.86
90	5,540.00	3,562.47	1,977.53

[1] Used only for comparison

Table 7. Cost and return analysis of corn production per hectare, averaged across N levels.

Row Spacing (cm)	Average Gross Income (₱)	Average Gross Expense (₱)	Average Net Income (₱)
50	5,593.33	3,604.29	1,989.04
75	5,046.67	3,362.95	1,683.72
100	4,606.67	3,207.67	1,399.00

those grown at 75 cm x 25 cm and 100 cm x 25 cm spacings with net incomes of ₱1,683.72/ha and ₱1,399.00/ha, respectively (Table 7). This could be attributed to the higher yield obtained in the former treatment.

LITERATURE CITED

DAVIDE, J.G. 1972. Agronotes. Greenfields 1(2):22.

ESPINOSA, L.N. 1976. Using fertilizer for best results. Greenfields 6(3):17.

FAGADE, S.O. and DE DATTA, S.K. 1971. Leaf area index, tillering capacity, and grain yield of tropical rice as affected by plant density and nitrogen level. Agron. J. 63(3):503-506.

GUPTA, U.S. 1975. Physiological Aspects of Dryland Farming. Oxford and IBH Pub., New Delhi. 390 p.

PEARSON, L.C. 1967. Soil Fertility. Principles of Agronomy. Ricks College, Rexburg, Idaho. 132 p.

SAMONTE, H.P. 1975. The effect of lime, N, P, and K and micronutrient fertilizer on corn. Res. Reports. UPLB, College, Laguna·54 p.