

Corn response to N applications and population densities at two locations in Puerto Rico¹

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ABSTRACT

The effect of nitrogen applications and population densities on grain and dry matter yield, leaf area and agronomic traits of three commercial corn hybrids was studied at two locations in Puerto Rico. Treatments included sidedressed N at 0, 60, 120, 180, and 240 kg/ha and three population densities of 20,000, 40,000 and 80,000 plants/ha. For most traits, significant differences were found between locations, hybrids, population densities and N levels, and there were significant interactions of location × hybrids, location × population densities, hybrids × population densities, location × N, hybrids × N and population density × N. Grain yield increased significantly with N rates. Best results were obtained with 120 kg N/ha and 40,000 plants/ha. Over-all grain yield was higher in Sabana Grande, a drier southern location. Highest grain yield (8,607 kg/ha) was obtained with Pioneer Brand Hybrid 304C with 40,000 plants/ha and 120 kg N/ha. Highest dry matter yield (9,393 kg/ha) was obtained in Isabela, a more humid northern location, with Pioneer Brand Hybrid 5800 at 40,000 plants/ha and 120 kg N/ha. At both locations over-all leaf area was greatest with application of 120 kg N/ha.

INTRODUCTION

Exceeded only by wheat and rice, corn (*Zea mays* L.), plays an important role feeding millions of people throughout the world (1,19). Although corn is not grown commercially in Puerto Rico for animal feed, more than \$50 million worth is imported yearly (24).

Research on corn breeding and management at Mayagüez indicates that Puerto Rico could reduce imports of cereals if at least 50,000 hectares of mechanizable land were utilized intensively to cultivate corn and/or sorghum (15,17).

With the objective of developing a sound technological package of practices for this crop, the study herein reported was designed to evaluate the effect of N levels and population densities on yield and a series of agronomic traits on three commercial corn hybrids at two locations in Puerto Rico.

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Grove et al. (11) determined the effects of N fertilization on corn grown on an Oxisol in Brazil, and found a response to applications of up to 203 kg N/ha with yields of 6.1 t/ha. These results agree with those reported by other authors working in the tropics (3,5,10,13,20). Fox et al. (10) studied the effect of three N levels on 15 corn cultivars in Oxisols and Ultisols in Puerto Rico with highest yields (6.3 t/ha) obtained with applications of 67 kg N/ha 5 weeks after sowing. These authors concluded that without limiting factors of climate or diseases, N recovery in the tropics is similar to that of temperate areas.

Most reports indicate a linear increase in yields of corn with increased population densities (4,6,7,21); other studies indicate the opposite (12,16,18). According to Dungan et al. (7), ear and grain weight/plant and stem strength, protein, oil, lysine and tryptophane content decreased as population density increased. Other researchers (6,7,12,19) have shown that plant vigor decreases as population density increases. At Lajas, Puerto Rico, Vázquez (23) studied the effect of three population densities on local corn variety Mayorbela and reported a linear increase in yield with increasing population density from 25,826 to 51,652 plants/ha. At Isabela, Puerto Rico, Sotomayor-Ríos et al. (18) evaluated twelve corn cultivars at population densities of 45,000 and 90,000 plants/ha. At the high population density, the diameter of the third node decreased significantly although the number of ears/plant increased. The highest yielders, Pioneer Brand Hybrids (PBH) 304C and 105A, had similar yields at the two population densities.

Torres-Cardona et al. (22) studied the effect of N levels and planting dates on two commercial corn hybrids (PBH 304C and DBH 670) on a Vertisol at Lajas, Puerto Rico, and found that PBH 304C and DBH 670 required less than 140 kg N/ha for an optimum grain yield.

MATERIALS AND METHODS

The experiment was conducted at Sabana Grande in southwestern Puerto Rico, 33 m elevation with ambient temperatures ranging from 18.9 to 31.4° C, and at the Tropical Agriculture Research Station (TARS), Isabela experiment farm, USDA-ARS, 128 m elevation with ambient temperatures ranging from 18.5 to 29.4° C. The soil at Sabana Grande is a Fraternidad clay (Udic Chromusterts, very fine, montmorillonitic, isohyperthermic) with an organic matter content of 2.3%. Soil pH was 6.4. The soil at Isabela is a Coto clay (Tropeptic Haplorthox, clayey kaolinitic, isohyperthermic) with an organic matter content of 1.9%. Soil pH was 5.4. The experimental design was a randomized block arranged in split-split plot replicated four times. Main plots were 60 rows × 5 m split into 3 sub-plots (20 rows) and into 5 sub-subplots of four rows planted 92 cm on center. Varieties were the main plots (PBH 304C, PBH 5800 and DBH 670); population densities, the subplots: 20,000 (low);

40,000 (intermediate); and 80,000 (high) plants/ha; and nitrogen (N) rates the sub-subplots (0, 60, 120, 180, and 240 kg/ha). Nitrogen was applied as $(\text{NH}_4)_2\text{SO}_4$ 4 weeks after planting. Planting date was June 1981 at both locations.

Before sowing, all plots were fertilized with 100 kg/ha of P and K as P_2O_5 and K_2O , respectively. Weeds were controlled with a preemergent herbicide, propazine [2-chloro-4,6-bis(isopropylamino)-s-triazine] at a rate of 2.5 kg ai/ha, and by hand-weeding. For the control of soil-borne insects and nematodes, carbofuran (2,3-dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate) was applied 1 week after sowing at a rate of 3.0 kg ai/ha. Methomyl (*S*-methyl N-[(methylcarbamoyl) oxy]) thioacetimidate) was applied at a rate of 0.50 kg ai/ha to control foliar insects. Yields were determined on 4-m lengths in the two central rows of each sub-subplot. Overhead irrigation was applied to all plots as needed.

Before harvesting, we recorded, on the basis of two plants/row chosen at random, plant height (soil surface to tip of the tassel), ear height (soil surface of topmost ear-bearing node), third node diameter (with a Vernier caliper), leaf area/plant (LA) (length \times width of the second leaf from the tip \times 0.747 \times number of leaves), root and stem lodging, and days to midbloom. Ears harvested were dried to a uniform moisture content; ear length and ear diameter were measured at random on 10 ears/plot. Grain yield (GY) was adjusted to 15.5% moisture. In addition, we recorded dry matter yield (DMY), grain N percent, grain N content and dry matter N content, grain to stover ratio, and N harvest index (grain N content/dry matter N content).

All data were subjected to analysis of variance (ANOVA) combined over locations and regression, and significant differences were identified with Duncan's multiple range test.

RESULTS AND DISCUSSION

The combined ANOVA showed significant location, hybrid, population density and N level effect and location \times hybrid, location \times population density, hybrid \times population density, location \times N level, hybrid \times N level and population density \times N level interactions for most traits (table 1). Location \times population density, location \times hybrid and location \times N level interactions were expected because location effect was present although it varied in magnitude over population densities, hybrids, and N levels. Hybrid \times population density interaction indicated that hybrids were affected with changes in population density. Hybrid \times N level interaction reflected a steady increase in terms of GY with N rate increases. Population density \times N level interaction indicated that GY response to increasing N depends on plant population density. The over-all agronomic performance of hybrids, including third node diameter, ear

TABLE 1.—*Combined analysis of variance for 17 traits of corn hybrids at five N levels and three population densities in Puerto Rico*

| Traits | Source ¹ | | | | | | | | | | C.V. (%) | |
|----------------------|---------------------|----|-----|----|----|-----|-----|-----|-----|-----|----------|-------|
| | L | H | LxH | D | N | LxD | HxD | LxN | HxN | DxN | | |
| Days to midbloom | **2 | * | | ** | | | | | | | | 1.1 |
| Ear height | ** | | | ** | ** | | | ** | | | | 8.6 |
| Plant height | | | | ** | ** | | | ** | | | | 4.7 |
| Third node diameter | ** | ** | | ** | ** | ** | ** | | ** | | | 5.6 |
| Ear length | ** | ** | | ** | ** | | ** | | | | | 4.6 |
| Ear diameter | ** | ** | * | ** | ** | ** | | ** | ** | | | 3.3 |
| Leaf area | * | ** | ** | ** | ** | ** | | ** | ** | ** | | 8.7 |
| Root lodging | | * | | ** | ** | | ** | * | * | ** | | 163.5 |
| Stem lodging | ** | | ** | * | ** | ** | | * | ** | ** | | 68.1 |
| Grain yield | ** | ** | | ** | ** | * | * | | ** | ** | | 10.3 |
| Grain N % | | ** | | ** | ** | | | | * | | * | 10.2 |
| Dry matter yield | ** | ** | ** | ** | ** | ** | | ** | ** | ** | | 9.7 |
| Dry matter N % | ** | ** | ** | ** | ** | ** | | ** | ** | ** | | 5.2 |
| Grain N content | | * | | ** | ** | ** | | | | ** | | 11.3 |
| Dry matter N content | ** | * | ** | ** | ** | ** | | ** | ** | ** | | 10.9 |
| Grain/stover ratio | ** | | ** | ** | ** | * | * | ** | * | ** | | 15.7 |
| N harvest index | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | | 18.0 |

¹L = Locations, H = Hybrids, D = Densities, and N = Nitrogen rates.

* Significant at the 0.05 probability level; ** significant at the 0.01 probability level.

TABLE 2.—*Mean comparison between locations for 17 traits of three corn hybrids across five N levels and three population densities*

| Traits | Location | | |
|---|----------|---------------|-----------|
| | Isabela | Sabana Grande | \bar{x} |
| Days to midbloom (days) | 55 | 57 | 56.0 |
| Ear height (cm) | 100 | 128 | 114.0 |
| Plant height (cm) | 241 | 237 | 239.0 |
| Third node diameter (cm) | 2.4 | 2.8 | 2.6 |
| Ear length (cm) | 15.4 | 16.9 | 16.1 |
| Ear diameter (cm) | 4.5 | 4.8 | 4.7 |
| Leaf area (cm ²) | 5,979 | 6,024 | 5910.5 |
| Root lodging (%) | 1.6 | 1.2 | 1.4 |
| Stem lodging (%) | 7.3 | 3.7 | 5.5 |
| Grain yield (kg/ha) | 5,181 | 5,958 | 5564.5 |
| Grain N % | 1.6 | 1.6 | 1.6 |
| Dry matter yield (kg/ha) | 4,729 | 6,696 | 5712.5 |
| Dry matter N % | 0.9 | 1.2 | 1.0 |
| Grain N content (kg/ha) | 83 | 97 | 90.0 |
| Dry matter N content (kg/ha) ² | 42 | 78 | 60.0 |
| Grain to stover ratio | 1.1 | 0.9 | 1.0 |
| N harvest index | 2.0 | 1.2 | 1.6 |

¹Grain N content = Grain yield x grain N %.

²Dry matter N content = Dry matter yield x dry matter N %.

length, ear diameter, leaf area, GY, DMY, dry matter N content, and grain N content, were higher at Sabana Grande than at Isabela (table 2).

Days to midbloom were similar (56), except for DBH 670 which, flowered 1 day later as compared to PBH 304C and PBH 5800 (table 3). On the other hand, days to midbloom were significantly delayed as plant population densities increased (table 4). These results are in agreement with those reported by Buren et al. (6). Hybrids took two more days to reach midbloom at Sabana Grande than at Isabela (table 2). Ear height was significantly higher at Sabana Grande (128 cm) than at Isabela (100 cm) (table 3), and increased significantly as plant population densities increased (table 4). When no N was applied, ear height of hybrids was significantly higher as compared with that of the remaining N levels (table 5). The hybrids exhibited similar plant heights at Sabana Grande and Isabela and were not affected by plant population densities (tables 2, 4). Similar results have been reported by Dungan et al. (7). When no N was applied hybrids were significantly taller as compared with the remaining N levels (table 5). Diameter of the third node was significantly higher at Sabana Grande (2.8 cm) than at Isabela (2.0 cm) (table 2) and decreased as plant population densities increased (table 4). These results confirm previous data from by Sotomayor-Ríos et al. (18). The diameter

TABLE 3.—*Mean comparison among three corn hybrids for 17 traits, across five N levels, three population densities and two locations*

| Traits | Hybrids | | |
|---|---------|----------|-------------------|
| | DBH 670 | PBH 304C | PBH 5800 |
| Days to midbloom | 57 a | 56 b | 56 b ¹ |
| Ear height (cm) | 113 a | 111 a | 117 a |
| Plant height (cm) | 235 a | 240 a | 243 a |
| Third node diameter (cm) | 2.5 c | 2.7 a | 2.6 b |
| Ear length (cm) | 15.3 c | 17.1 a | 15.9 b |
| Ear diameter (cm) | 4.8 a | 4.6 b | 4.6 b |
| Leaf area (cm ²) | 6,536 a | 5,408 c | 5,788 b |
| Root lodging (%) | 1.1 b | 9.9 a | 2.2 b |
| Stem lodging (%) | 5.4 a | 4.9 a | 6.2 a |
| Grain yield (kg/ha) | 5,426 b | 5,922 a | 5,345 b |
| Grain N % | 1.6 b | 1.6 b | 1.7 a |
| Dry matter yield (kg/ha) | 5,376 c | 6,038 a | 6,724 b |
| Dry matter N % | 1.1 a | 1.0 b | 1.0 b |
| Grain N content (kg/ha) ² | 88 a | 92 a | 90 a |
| Dry matter N content (kg/ha) ³ | 59 b | 62 a | 59 b |
| Grain stover ratio | 1.0 a | 1.0 a | 1.0 a |
| N harvest index | 1.5 a | 1.5 a | 1.5 a |

¹ Means in all rows followed by the same letter do not differ significantly at the 0.05 probability level.

² Grain N content = Grain yield x grain N %.

³ Dry matter N content = Dry matter yield x dry matter N %.

TABLE 4.—Mean comparison among population densities for 17 traits of corn hybrids across five N levels, three population densities and three corn hybrids

| Traits | Population density | | |
|---|--------------------|-------------|-------------------|
| | 20,000 p/ha | 40,000 p/ha | 80,000 p/ha |
| Days to midbloom | 57 c | 56 b | 57 a ¹ |
| Ear height (cm) | 107 c | 115 b | 120 a |
| Plant height (cm) | 233 a | 240 a | 244 a |
| Third node diameter (cm) | 3.0 a | 2.6 b | 2.2 c |
| Ear length (cm) | 17.6 a | 16.8 b | 14.1 c |
| Ear diameter (cm) | 4.8 a | 4.7 b | 4.5 c |
| Leaf area (cm ²) | 6,531 a | 6,109 b | 5,093 c |
| Root lodging (%) | 0.0 b | 0.7 b | 3.4 a |
| Stem lodging (%) | 4.6 b | 5.3 ab | 6.6 a |
| Grain yield (kg/ha) | 4,022 c | 6,923 a | 5,749 b |
| Grain N % | 1.7 a | 1.6 b | 1.5 c |
| Dry matter yield (kg/ha) | 4,250 c | 7,072 a | 5,816 b |
| Dry matter N % | 1.1 a | 1.1 a | 0.9 b |
| Grain N content (kg/ha) ² | 68 c | 114 a | 89 b |
| Dry matter N content (kg/ha) ³ | 47 c | 76 a | 57 b |
| Grain/stover ratio | 1.0 a | 1.0 a | 1.1 a |
| N harvest index | 1.4 b | 1.5 b | 1.6 a |

¹ See table 3.² Grain N content = Grain yield x grain N %.³ Dry matter N content = Dry matter yield x dry matter N %.

TABLE 5.—Mean comparison among N levels for 17 traits of corn hybrids, across three corn hybrids, three population densities and two locations

| Traits | 0 | 60 | 120 | 180 | 240 |
|---|---------|---------|---------|---------|-------------------|
| Days to midbloom (days) | 56 a | 56 a | 56 a | 56 a | 56 a ¹ |
| Ear height (cm) | 122 a | 111 c | 109 c | 116 b | 111 c |
| Plant height (cm) | 246 a | 235 b | 236 b | 238 b | 239 b |
| Third node diameter (cm) | 2.5 c | 2.6 b | 2.7 a | 2.6 b | 2.6 b |
| Ear length (cm) | 15.4 c | 16.5 a | 16.4 a | 16.1 b | 16.3 ab |
| Ear diameter (cm) | 4.4 c | 4.7 a | 4.7 a | 4.6 b | 4.7 a |
| Leaf area (cm) | 4,613 e | 5,735 d | 6,916 a | 6,047 c | 6,242 b |
| Root lodging (%) | 1.0 c | 0.0 d | 0.3 d | 1.9 b | 3.7 a |
| Stem lodging (%) | 10.1 a | 1.9 c | 2.2 c | 6.6 b | 6.7 b |
| Grain yield (kg/ha) | 4,663 d | 5,771 b | 6,200 a | 5,657 a | 5,531 c |
| Grain N % | 1.5 b | 1.6 a | 1.6 a | 1.6 a | 1.7 a |
| Dry matter yield (kg/ha) | 5,099 d | 5,864 b | 6,384 a | 5,653 c | 5,653 c |
| Dry matter N % | 0.9 c | 1.0 b | 1.1 a | 1.1 a | 1.1 a |
| Grain N content (kg/ha) ² | 71 c | 94 b | 101 a | 93 b | 91 b |
| Dry matter N content (kg/ha) ³ | 45 d | 59 c | 70 a | 63 b | 64 b |
| Grain/stover ratio | 0.9 c | 1.0 b | 1.0 b | 1.1 a | 1.1 a |
| N harvest index | 1.6 a | 1.6 a | 1.5 a | 1.5 a | 1.4 b |

¹ See table 3.² Grain N content = Grain yield x grain N %.³ Dry matter N content = Dry matter yield x dry matter N %.

of the third node increased with N applications at both locations (table 5). Ears were significantly longer at Sabana Grande (16.9 cm) than at Isabela (15.4 cm) (table 2). Pioneer BH 304C had significantly longer ears (17.1 cm) than the other hybrids (table 3). Ear length decreased as plant population densities increased (table 4). On the other hand, ear length increased with N applications (table 5). At Sabana Grande ear diameter (4.8 cm) was greater than at Isabela (4.5 cm), with DBH 670 showing the highest value (tables 2, 3). Ear diameter decreased as plant population density increased whereas the opposite was observed up to the 60 kg N/ha application (tables 4, 5). Root lodging was lower than stem lodging, which was higher at Isabela (table 2). Root and stem lodging increased with plant population densities (table 4). At the higher N application, root lodging was at its highest, as in results reported by Aldrich (2). On the other hand, stem lodging was higher at the no N application (table 5). Grain N percentage was similar at both locations (table 2). A significantly higher grain N percentage was obtained from PBH 5800 (1.7) (table 3). Plant population densities had a negative effect on grain N percentage (table 4). Similar results have been reported by Earley and DeTurk (8). A significant response for grain N percentage was obtained with the initial 60 kg N/ha (table 5). The average N percentage at the maximum grain yield was 1.6%, as in data reported by Pierre et al. (14). Grain N content (grain N percentage \times grain yield) was significantly higher at Sabana Grande (97 kg/ha) than at Isabela (83 kg/ha) (table 2). Grain N content increased up to the intermediate plant population density (table 4). A significant response of up to 120 kg N/ha was obtained (table 5). Comparable results were reported by Grove et al. (11) on an Oxisol in Brazil. At Sabana Grande, dry matter N percentage (1.2) was significantly higher than at Isabela (0.9) (table 2). At the highest plant population density, hybrids showed the lowest dry matter N percentage (table 4). The dry matter N percentage increased with N applications up to 120 kg N/ha (table 5). Dry matter N content (dry matter N percentage \times dry matter yield) was significantly higher at Sabana Grande (78 kg/ha) than at Isabela (42 kg/ha) (table 2). A significantly higher dry matter N content was obtained with PBH 304C (table 3). Dry matter N content was significantly higher at the intermediate plant population density (table 4). With an increase of N to 120 kg/ha, dry matter N content also increased (table 5). Significant differences between locations were obtained for the grain/stover ratio; Isabela showed the highest value with 1.1 (table 2). The grain/stover ratio increased with applications up to 180 kg N/ha (table 5). Average corn grain/stover ratio was 1.0. This result concurs with those obtained by Fox et al. (10) and Grove et al. (11). The highest N harvest index was recorded at Isabela with 2.0, as compared with 1.2 at Sabana Grande (table 2). The best N harvest index, 1.6, was

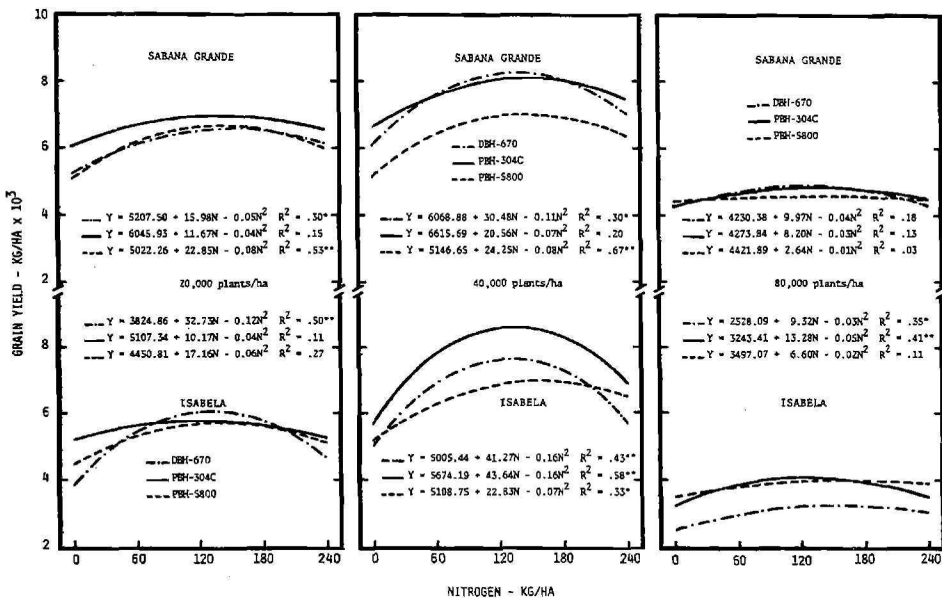


FIG. 1.—Relationship between nitrogen levels, population densities and grain yield of three corn hybrids at two locations.

obtained at the highest population density (table 3). The lowest harvest index value (1.4) was recorded at the maximum N application (table 5). These results are not in agreement with those reported by Grove et al. (11).

Hybrids generally showed a quadratic GY response to increasing N applications at both locations and all population densities. Significant increases in corn GY up to 120 kg N/ha were obtained at both locations. The strongest effects of increased N were observed at intermediate population density. The low and high population densities often showed no significant quadratic response to increased N. The highest GY was obtained with PBH 304C (Isabela) and DBH 670 (Sabana Grande), 8,607 and 8,142 kg/ha, respectively, with 120 kg/ha at the intermediate population density. The significant population density \times N level interaction (table 1) confirms that GY response to increasing N depends on population density.

Nitrogen rates which produced maximum GY were estimated with the first derivative, setting $dy/dn = 0$, and solving for N (fig. 1). At the intermediate population density the resulting values were 139, 147, and 152 kg N/ha for DBH 670, PBH 304C and PBH 5800, respectively, at Sabana Grande; and 129, 136, and 163 kg N/ha at Isabela. Yield maxima obtained by substituting these N levels in the original yield equation, equaled 8,180, 8,125 and 6,984 kg/ha at Sabana Grande; and 7,667, 8,650 and 6,970 kg/ha at Isabela.

Over-all DMY were higher at Sabana Grande than at Isabela. Hybrids showed a quadratic DMY response to increasing N application at Sabana Grande over all population densities. Significant increases in DMY up to 120 kg N/ha were obtained at Sabana Grande. The strongest effects of increased N were observed at intermediate population density. There was no significant quadratic response to increasing N in any of the hybrids at Isabela (fig. 2). Similar results, in terms of response to N, have been reported by Badillo et al. (3).

Hybrids showed a quadratic LA response to increasing N applications in both locations over all plant population densities (fig. 3). Significant increases in LA up to 120 kg N/ha were obtained at both locations. The greatest effects of increased N were observed at intermediate population density. In this study, LA decreased with an increase in population density. These results are in agreement with those reported by Eik and Hanway (9).

ECONOMIC CONSIDERATIONS

Table 6 shows a rough cost estimate of producing corn under irrigation in Puerto Rico. Because this experiment shows that the best corn hybrids can produce over 8 tons of grain/ha every 120 days, grain yields are estimated at about 7 tons/ha if a 15% wastage of harvested grain is

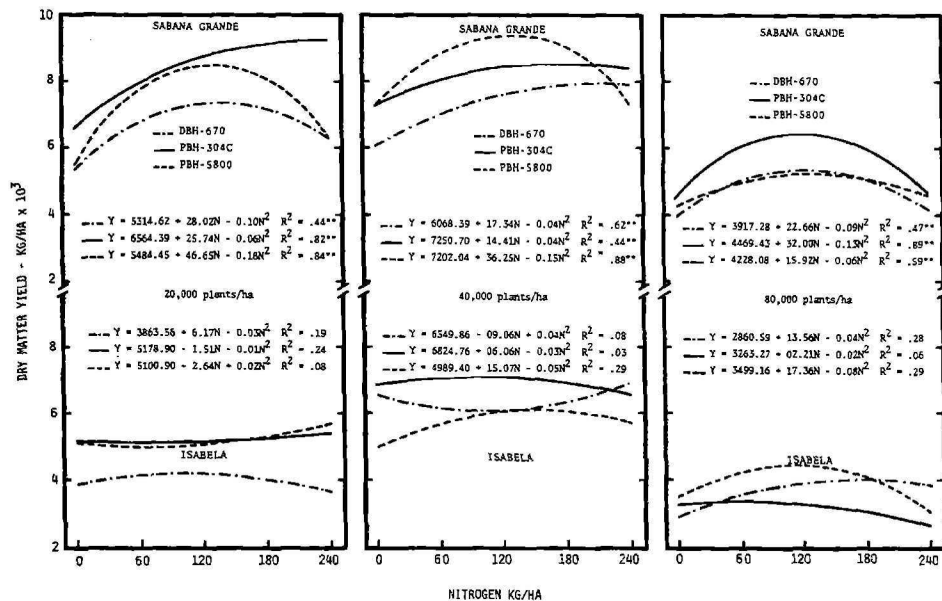


FIG. 2.—Relationship between nitrogen levels, population densities and dry matter yield of three corn hybrids at two locations.

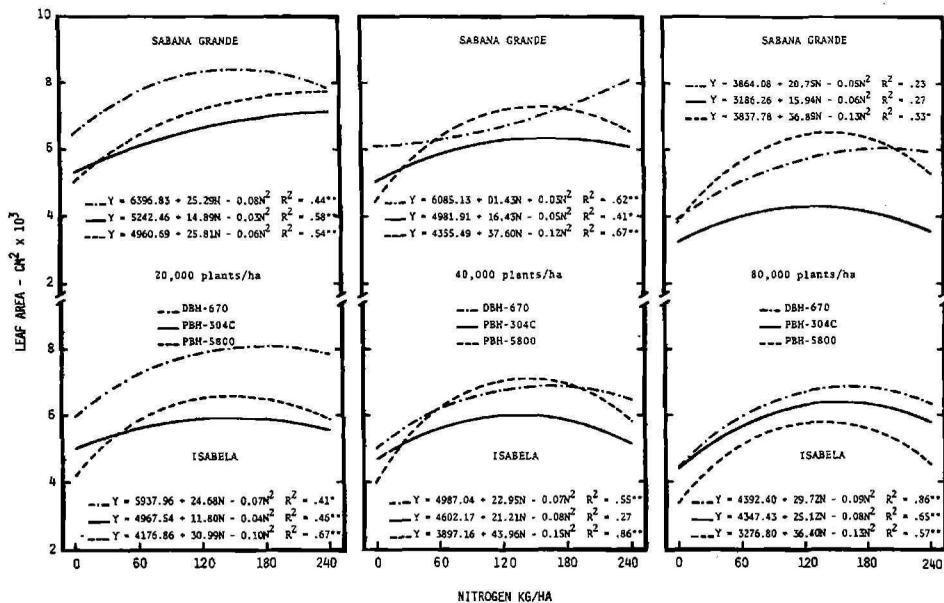


FIG. 3.—Relationship between nitrogen levels, population densities and leaf area of three corn hybrids at two locations.

assumed. The cost/ha for harvest, and transporting the 7.0 tons is \$654.00 at \$93.43/ton of grain. In Puerto Rico this would have a market value of approximately \$1232.00 (\$176.00/ton); thus the net profit from corn production would be \$578.00/ha in a 120-day period (\$1232.00 - \$654.00).

CONCLUSIONS

We obtained a positive response for GY, DMY and LA to increasing N applications up to 120 kg/ha at a population density of 40,000 plants/ha. The strongest effect of increased N was observed at intermediate population density. For most traits there were significant interactions: location \times hybrid, location \times population density, hybrid \times population density, location \times N, hybrid \times N and population density \times N. The best GY performers in this study were PBH 304C at Isabela and DBH 670 at Sabana Grande. The over-all means of GY and most agronomic traits were higher at Sabana Grande; thus this location could be a better site for growing corn commercially in Puerto Rico. A rough estimate of net profit from growing corn in Puerto Rico is \$578.00/ha.

RESUMEN

Respuesta del maíz a cantidades de N y densidades de siembra en dos localidades de Puerto Rico

Se estudió el efecto de cantidades de N y densidades de siembra en el rendimiento de grano y materia seca, y una serie de características agronómicas en tres híbridos comerciales de maíz en dos localidades en Puerto Rico (Sabana Grande e Isabela). El N se aplicó a 0, 60, 120, 180 y 240 kg./ha. a densidades de 20,000 (baja), 40,000 (intermedia) y 80,000 (alta) plantas/ha. Se encontraron diferencias significativas entre localidades, híbridos, densidades de siembra y cantidades de N, localidades \times híbridos, localidades \times densidades de siembra, híbridos \times densidades, localidades \times N, híbridos \times N y densidades de siembra \times N para la mayoría de las características estudiadas. La producción de grano aumentó significativamente con la aplicación de N, especialmente con 120 kg./ha. y en la densidad de siembra intermedia. La producción media fue mayor en Sabana Grande. El híbrido PBH 304C registró la mayor producción de grano con la aplicación de 120 kg./ha. y en la densidad de siembra intermedia. La mayor producción de materia seca (9,393 kg./ha.) se obtuvo en Isabela con PBH 5800 con la aplicación de 120 kg. N/ha. y a la densidad de siembra intermedia. El área foliar media fue mayor cuando se aplicaron 120 kg. N/ha. en ambas localidades. Se estima que de la información obtenida surge que la ganancia neta produciendo maíz con riego podría ser de \$578.00/ha.

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