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CORN STUDIES

IN

LOS LLANOS

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1971

Merida, Venezuela

cod 2167

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CORN STUDIES IN LOS LLANOS

Raymond W. Miller[1], Evaristo Martinez[2], Alfonso Bustillos[2], Alberto Gonzales[2], and Tito Guilarte[2]

INTRODUCTION

Corn production in Venezuela is very important to the economy of the country. In some areas of the world rice or wheat forms the food base; in Venezuela corn fills much of this role. The diet of the people reflects the dominance of corn. "Arepas", a round thick toasted tortilla of corn, is often eaten at all meals in the day. The arepa is filled with various materials to serve as a sandwich. Several fried corn meal meat cakes are used for snacks or breakfasts.

Production of corn in 1960 and 1961 was about 450,000 metric tons annually (Anonymous, 1962). Needs today are undoubtedly higher making it desireable to increase production. Servicio Shell, an agricultural experimental group established by Shell Oil Company, predicted the demand for 1963 to be 600,000 metric tons.

Nearly all corn in Venezuela is produced without irrigation. In Los Llanos it is planted in April or May and is wetted by the rainfall, which begins in April, reaches its peak in late June or July and tapers off from August until mid December. Drainage is

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a common problem because of the intensity of some storms. However, other problems of climate also occur. Unpredictable lack of rains in April and May can result in inadequate rain even through May. A wet September can delay harvest and cause grain losses by several causes including from moldy and sprouted seed. Research must include many aspects, all of these important in corn production.

REVIEW OF LITERATURE

A limited amount of available research has been done on corn in tropical South America. Primarily, workers have studied varieties, densities and fertility aspects. Marked changes in varieties, climates and soils make extrapolation of those studies, all in "tropical" areas, sometimes difficult. Therefore, this review will include some general conclusions relative to corn in other areas, primarily in the United States. One major difference must be kept in mind for such literature--climate is different in the United States than in warm, tropical South America. Los Llanos in Venezuela has day lengths from 12 to 12.5 hours year around and slight average monthly temperature variation from 26-30°C. In contrast, the corn belt of the United States has cool springs and falls, warm summer months and maximum day lengths reaching nearly 16 hours, plus relatively long periods of twilight before sunrise and after sunset. The season length for corn and total radiant energy (daylength times radiation intensity times season days) for growth is greater in the United States. These differences will effect growth schedules, thinning dates, and growth rates.

Tillage

It is interesting that tillage has received considerable attention in the United States but is not mentioned in two popular pamphlets circulated for Venezuela (Funación Shell, 1962; Klindt and Mosquero, 1962). Several reasons exist for this difference. First, in the United States, private equipment and interest in good seed beds caused over-preparation of land. Economics and the soil physical condition have made minimum tillage attractive. Second, production specialists in Venezuela have other problems (insects, drainage, weeds) that seem more pressing immediately. Third, the majority of small farmers in Venezuela hire tractor labor; excessive tillage seldom occurs. Fourth, the growth of weeds in the "off season" seems to demand as a minimum the amount of land preparation now being done in Venezuela.

When tillage becomes more extensive, it will be wise for agriculturists in tropical Venezuela to keep in mind the relative merits of different degrees and kinds of tillage. Numerous references listed by Larson and Blake (1966) have presented persuasive arguments favoring minimum tillage or even "no-tillage." The advantages have included a saving of time and power costs and reduced soil breakdown. Many clayey Venezuelan soils could have in the future problems of structure deterioration (Dudal and Bramao, 1967). The layman manual put out for the Venezuelan campesino (Klindt and Mosquera 1962) simply states under "Preparation of Land" to prepare the land very well and don't burn to remove weeds.

There are many considerations to be investigated in future tillage programs, expecially of problem soils. These include (1) tillage versus no tillage, (2) the optimum number of passes with a disc, (3) the possibility of plowing, seeding and fertilizing in one operation, (4) rotary tillering versus plowing, (5) benefits from subsoiling and (6) wheel-track planting (Larson and Blake, 1966).

Populations and Date of Planting

In the warm topics the effects of population and planting dates are often traceable to how these variables fit that season's climate. Early April planting with a dry May results in poor yields. Late May planting with heavy June rains causes damage from poor drainage. For maximum advantage of high numbers of plants, growth conditions must be good. For example Rossman and Cook (1966) state that population recommendations are from about 29,000 to 59,000 plants per hectare in the United States but only 15,000 to 29,000 plants in semi-arid regions without irrigation.

Venezuelan sources suggest 40,000 plants/ha (Anonymous, 1968a; Klindt and Mosquero, 1962). This value is a compromise. It can be too large under poor growth conditions and too small for maximum yields with nearer optimum conditions.

Because corn growth in Los Llanos is possible without irrigation, the choice of planting date is critical but difficult to establish within a 6-week period. The best date will vary with climate changes each year. These are not predictable without establishing a probability relation from many past years climatic data.

Although yield increases are possible with population increases, some losses are also possible. Rossman and Cook (1966) report several investigators' data all stating increased lodging (8.5% to 70%) with increased populations for 20,000 to 54,000 plants/ha. Harvesting with commerical pickers rather than by hand may result in loss of some of the apparent increases, as a result of the lodging increases.

Other factors influencing population optimums are hybrid differences (dwarf types, early maturing, prolific types, male sterility types), tillering, diseases, insect attacks, and that seasons climate.

Increased populations seem to have increased yields if the plants are spaced more equidistant, i.e., narrow rows (Pionke and Walsh, 1968), but results are not consistant nor large (Nunez and Kamprath 1969; Rossman and Cook, 1968).

Variety

Considerable work has been done by M.A.C. and other groups in the 1960"s on new varieties. Klindt and Mosquera (1962) listed 8 varieties and hybrids: Venezuela 3, Sicarigua Mejorado, Tuina, Guaicaipuro, Obregon, Venezuela 1, Pajimaca and Mara. By 1968 the Comite de Fomento Regional del Maiz (Anonymous 1968b) had tested a new variety, Foremaiz-1, but had as 4 other comparison varieties and hybrids Tunapuy, Sicarigua Mejorado, Obregon and Foremaiz-4.

Water Requirement

For the corn belt in the Untied States, Shaw and Burrows (1966) state that a commonly used guide is, "...to produce a good crop of

corn, one inch of rain per week is needed during summer months." At the present time in Los Llanos of Benezuela, the rainy season begins at the planting time (April or May) and follows 3 months of practically no rain. Therefore, the corn crop depends on seasonal rain but does include soil storage from rains of April, May, and June of that same season.

During the period of maximum use, water requirements per day may average 0.45 cm per day with short interval needs reaching 1.0cm daily (Shaw and Burrows, 1966). It has been shown by several workers (Holt and Van Doren, 1961; Denmead and Shaw, 1960; and Robins and Domingo, 1953) that there is a period most critical to yield that is from tasseling to kernel formation. At this time the plant also has the highest water requirement. As example Robins and Domingo (1953) found reduced grain yields of more than 20% as a result of severe moisture stress for <u>one</u> or <u>two</u> <u>days</u> during tasseling or the pollinating period. A 50% loss occurred if stress continued 6 to 8 days. Runge (1968) claimed rain had little influence on corn yields prior to 26 days before anthesis (tasseling) and after 14 days after anthesis. Thus, he listed a 5.5 week period during which water stress affected seed yield. In Venezuela, the anthesis (tassel) may show within 50 days of planting. Thus between the period of "planting plus 25 days" and "planting plus 65 days" moisture availability needs to be high for maximum yields.

The requirement for water during tasseling and seed-set probably exceeds 2.5 cm per week. Thompson (1966) lists an optimum rainfall of

4 to 5 cm weekly for corn in Iowa during July (flowering and seed set time). Silking (tasseling) occurs about July 16 (Denmead and Shaw, 1969).

Drainage

Most crops grow more poorly in conditions of poor drainage. Williamson (1964) estimated an optimum oxygen diffusion rate (related to soil porosity) for corn. Then he showed that reducing that rate by 20% reduced corn yields 75%. The advantages of good drainage are known; the economics -- costs of drainage versus benefits -- are often the determining factor.

Land grading has become popular in humid areas to take care of most surface drainage (Schwab, 1966), but is not a simple solution to the problem. Grading is expensive. Also, small ridges formed during tillage are adequate to cause small, localized areas of poor drainage. Enough "pockets" result in high losses from poorly drained spots in the field.

Another problem from land grading is the loss of top soil over certain portions of the field. Walker and Lillard (1961) had first-year yield reductions from previous value of 7800 Kg/ha (122 bu/a) to 7,300 Kg/ha (114 bu/a). They calimed 10% higher yields from areas with shallow cuts and fills compared to areas with deep cuts and fills.

Nitrogen Requirements

Nitrogen is needed in large amounts for high yields of corn in intensive farming practices. Several N-related physiological

interactions are important. Schreiber et al. (1962) claimed an increased number of rows of kernels per ear by the addition of small amounts of N only at a very early state (before plants were 20 cm tall). Later larger additions did not influence rows of kernels.

In the corn belt of the United States where soil tests are not made, recommendations for fertilizer nitrogen additions are approximately the following in lbs N/A (Kurtz and Smith, 1966):

Dark Soils (4% O.M.) Corn each year Management level		Light-colored soils (2% O.M.) Corn each year Management Level	
Medium	High	Medium	High
70-110	100-150	100-150	130-170

Those states with soil tests had a more narrow range of values about 25 lbs N/A less than the high values just listed in each category.

A problem of nitrogen application has been efficiency of the nitrogen applied. Shallow applications needed to be washed down to active root zones in drier climates. Heavy rainfall may leach away considerable nitrogen. Largest losses, however, seem to be in forms "unaccounted for." Losses of nitrogen in various gaseous forms are presumed to be these "unaccounted for" quantities. These losses vary from about 15% in some controlled lysimeter studies to about 30% in various other studies. Even losses as large as 50-75% have been measured (Allison, 1955; Allison, 1964; Owens, 1960; Kurtz and Smity, 1966).

Nitrogen application to corn in Venezuela varies. Klindt and Mosquera (1962) suggest a mixture having 24 to 36 Kg N/ha. Servicio

Shell (Anonymous, 1962) do not list a recommendation but illustrate photographically yield improvements with added fertilizer in which nitrogen is added at rates of 100 Kg N/ha. General field use in Los Llanos is mostly 30 Kg N/ha at the present time.

Phosphorus Requirements

Responses of corn to phosphorus additions is common but less marked than response to added nitrogen. The response depends on the amount of corn produced (low, moderate or high yields) and upon the soil supplies of phosphorus. Generally placements of P from 8 cm depth (for young corn) to 20-34 cm (for older corn) result in the largest amount of P supplied to corn (Hall et al., 1953). Seatz and Sterges (1963) observed that early applications of phosphorus consistantly result in higher yields than did late season application of phosphorus. The phosphorus should always be placed into the soil where moisture (and therefore roots) will exist during growth (Caldwell and Ohlrogge, 1966). The greatest efficiency will be obtained from phosphorus fertilizer added to corn when the fertilizer is drilled in a continous band 5 cm to the side and 5 cm below seed level at planting time. Generally the smaller the amount of fertilizer added, the closer it should be to the seed. When no more than 10 to 20 Kg/ha of N plus K are added, it can often be added with the seed (Caldwell and Ohlrogge, 1966). Salt injury, however, is possible.

Interactions of phosphorus with other nurients occur as shown by several workers (Grunes, 1959; Cole et al., 1963; Leonce and Miller, 1964). There appears to be an increased uptake of P if some ammonium

form of nitrogen is intimately mixed with the P source. In zinc nutrition added P reduced Zn uptake (Langin et al., 1962).

The amounts of P to add depend on soil sources; the amounts needed are quite variable. Soil tests are available to allow reasonable predictions (Bray and Kurtz, 1945; Olsen et al., 1954; Olsen et al., 1961; Olsen and Dean, 1965; Moser et al., 1959).

Servicio Shell (anonymous, 1962) also did not list recomendations for phosphorus fertilizer but did illustrate by photo a marked yield increase with 65 Kg P/ha over yields produced by an addition of half that amount, but in both examples the P was added in combination with nitrogen and potassium. Klindt and Mosquera (1962) suggested less than 10 Kg P/ha.

Potassium Requirements

Potassium is needed by corn. A 6000 Kg/ha yield may contain 100-120 Kg/ha (Barber and Mederski; 1966). The potassium accumulation is complete several weeks before the plant matures while nitrogen and phosphorus continue to accumulate. Yield increases with added potassium are common.

An important observation on potassium additions is the reduced lodging from stalk rotting and other causes. Koehler (1960) had losses bacause of rot as great as 49% with N but no K added; a low 17% loss occurred when K was added. Mederski (1962) also had similar reductions in the amount of corn that lodged, decreasing from 35% without K to 11% with high levels of K added.

Predictions of K needs of a field have been reasonably good

using exchangeable K as the soil test value. Hanway (1962) observed relatively little yield increases (up to 330 Kg/ha) from K additions if the exchangeable K level was 265 Kg K/ha. In contrast, if the exchangeable K levels were 132 and 66 Kg K/ha, the yield increases would be approximately 900 and 1450 Kg corn/ha, respectively, by adding about 140 Kg K/ha as fertilizer. Barber and Mederski (1966) suggest that when growing continuous corn only for grain (with yields at 6400 to 8300 Kg/ha), at least 28 to 39 Kg K/ha should be added yearly to replace removals.

Recommendations for potassium additions in Venezuela are not common. Usually some fertilizer mixture containing K is recommended on the basis of needed N or P. Klindt and Mosquera (1962) recommended 200 to 360 Kg K/ha for the only illustration they give. The wide variation of Venezuelan soils ranging from recent, micaceous soils to highly weathered soils low in potassium required individual attention to potassium needs of various land areas.

Weed Control

Tropical lands are weed infested lands. The extensive areas not cultivated are a continual seed source. Year-around growth climates maintain seeds and root stock. Weed control is an important part of corn production in the tropics. An example of losses from weeds in Minnesota is given by Behrens and Lee (1966). An average yield reduction of corn of 51% occurred on unweeded areas (a range of 16 to 93% less corn produced). Dalapon or atrazine are common chemicals that work well.

Insect Control

In the year-around warm climates of the tropics, insect infestations are always heavy. The subject of insect control is very extensive and will not be considered in depth. The review by Petty and Apple (1966) is extensive, and can be consulted if the reader wishes more details. For the United States they list the following corn insect problems:

Insects that attack the seed	- 4
Insects that eat corn roots	- 6
Feeders on underground stalk	- 3
Feeders on exposed leaves	- 11
Feeders on Whorl, stalk, ear	- 7

This list of 31 problem insects in the United States is some different than is found in Venezuela. Servicio Shell (anonymous, 1962) lists ants, caterpillars (Laphygma frugiperda S.), green aphid, a bettle called coco jio-juao (Euetheola bidentata), a leaf hopper (Peregrinum maidis Ashm.) which transmits a stunting virus called "enanismo rayado", the ear worm (Heliothis zea. Bod.), measuring worm (Mocis repanda Fabr.), and a cornborer called gusano taladrador (Diatraea Saccharalis and Zeadiatraea lineolata). In the observations of the writer, insect control in Venezuela is absolutely essential. Seldom is it possible for a crop to produce economically without several applications of chemicals to control worms.

EXPERIMENTAL PROCEDURE

The original idea for the 1970 study was to include a number of variables at the expense of having fewer replications. Three studies were set up in a nearly identical form and included the following variables:

1. Major blocks: Landform differences included planting on the flat (the common form used commercially), planting in ridges on 76 cm wide furrowed land and planting two rows on one convex shaped bed on 76 cm wide centers but with bed widths 152 cm wide furrow center to furrow center. See figure 1.
2. Plots within blocks: Eight fertilizer levels were randomized within each block. The levels used are shown in figure 1. Only nitrogen additions were used, although some other studies indicate the possible benefit of also including phosphorus, potassium and even lime.
3. Subplots: Within each fertilizer plot, two varieties of hybrids, Obregon and Foremaiz-1, were planted in double rows. A subplot thus consisted of an outside border row, 2 rows of hybrid A, 2 rows of hybrid B and then a final outside border row. Subplots ranged from 17 to 20 m long depending on individual field space available.
4. Time of planting: To compare planting date on yield, a replication of the total experiment was planted on two different dates in all locations except Las Majaguas.

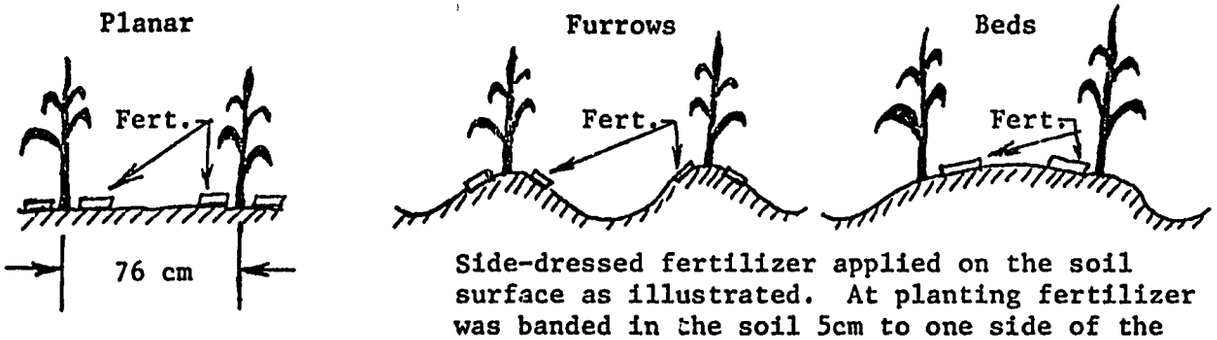
The general layout for these experiments is shown in figures 2, 3, and 4. The fourth field study (Las Majaguas) had fewer fertility treatments, using only F0 through F4, and only one date of planting.

The work plan outlined a fertilization scheme and thinning pattern. Fertilizer was added at three times to certain treatments (see fig. 1) -- at planting, 35 to 40 days after planting and at time of tassel. Thinning was to be done 30 - 35 days after planting. Final plant densities were to be 45,000 plants per hectare, with a few plots planted to compare at a higher density of 55,000.

Atrazine (Gesaprin, 3 Kg/ha) was applied as a pre- and post-emergence herbicide. Several applications of different insecticides was necessary. DDT 10% plus 2% aldrin was used as powder at the rate of 15 Kg/ha for worms attacking early growth (Gusano Barredor); telodrin 2% granules was added at the rate of 15 Kg/ha for control of later season leaf eaters (Gusano Cogollero); Endrin 19.5% at the rate of 3L./200L. of water added per hectorea for ear worm and others (Gusano del Jojoto). Some applications were repeated when needed.

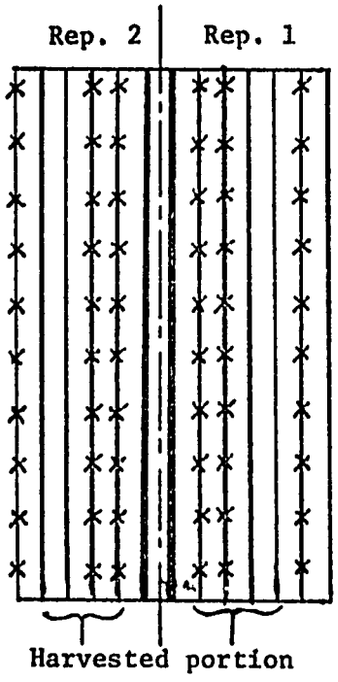
In April 1969, an earlier corn planting than the one just described was made more as a demonstration than a designed experiment. In one of the two fields used, Parcela 90, this was the first crop on recently cleared land, some surface smoothing and cutting had to be done, but uniform land grading had not been completed. The other field, Guanare Experimental Station, had

been used for 3 years but had not kept a cropping history. Each block or replication across the field was separated by soil ridges (borders). The designs of the two plantings are given in the results section. Densities were not controlled after the initial machine planting. All fertilizer was applied between planted corn rows and worked into the top few centimeters of soil by hand. Incorporation was not generally very uniform nor complete.



Side-dressed fertilizer applied on the soil surface as illustrated. At planting fertilizer was banded in the soil 5cm to one side of the seed.

Plot Detail



Obregon
Foremaiz-1

Plot dimensions:
4.56m. x 17m.

Fertilizer Treatments

F0	No fertilizer	
F1	30 Kg N/ha	at planting
F2	60 Kg N/ha	30 Kg at planting rest 35 to 40 days after planting
F3	100 Kg N/ha	
F4	140 Kg N/ha	
F5	180 Kg N/ha	
F6	100 Kg N/ha	30 Kg at planting, 40 Kg at tassle Rest 35 to 40 days after planting
F7	140 Kg N/ha	

Carrier used: Ammonium sulfate.

Fig. 1. Planting details for corn in 4 locations in Las Lanos, Venezuela: Land form of planar, furrows and beds; fertilizer treatments; and plot detail. Las Majaguas was planted with 90 cm between rows and had only fertilizer treatments F0-F4.

Beds April 22		Beds May 14		Beds May 14			Planar May 14		Planar May 14		Furrows May 14		Furrows May 14		Furrows April 22		
R2	R1	R2	R1	R2	R1		R2	R1	R2	R1	R2	R1	R2	R1	R2	R1	
F1	F2	F1	F2	F1	F2		F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	1
F7	F4	F7	F4	F7	F4		F7	F4	F7	F4	F7	F4	F7	F4	F7	F4	2
F5	F0	F5	F0	F5	F0		F5	F0	F5	F0	F5	F0	F5	F0	F5	F0	3
F6	F3	F6	F3	F6	F3		F6	F3	F6	F3	F6	F3	F6	F3	F6	F3	4
F4	F5	F4	F5	F4	F5		F4	F5	F4	F5	F4	F5	F4	F5	F4	F5	5
F0	F6	F0	F6	F0	F6		F0	F6	F0	F6	F0	F6	F0	F6	F0	F6	6
F2	F1	F2	F1	F2	F1		F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	7
F3	F7	F3	F7	F3	F7		F3	F7	F3	F7	F3	F7	F3	F7	F3	F7	8
SB	SA	SF	SE	SH	SG		SQ	SP	SN	SM	SL	SK	SJ	ST	SD	SC	

30 m. wide space between plantings

Fig. 2. Experimental layout for Sabaneta corn studies. The locations of the 3 land forms, dates of planting and fertilizer treatments are shown. All April 22 plantings were 70cm. between rows. All others were 76cm. spacings. This change was necessary because of equipment losses after the April planting. R1 and R2 refer to replicates 1 and 2. Columns SG, SH, SK, SL, SP, and SQ were intended to be 55,000 plants/ha density plantings but matured with densities comparable to the others planted for 45,000 densities.

Beds April 23 R2	Beds April 23 R1	Beds May 9 R2	Beds May 9 R1		Planar May 9 R2	Planar May 9 R1	Furrows May 9 R2	Furrows May 9 R1	Furrows April 23 R2	Furrows April 23 R1
F6	F2	F0	F2	1	F0	F2	F0	F2	F6	F2
F7	F4	F6	F4	2	F6	F4	F6	F4	F7	F4
F5	F0	F7	F0	3	F7	F0	F7	F0	F5	F0
F1	F3	F5	F3	4	F5	F3	F5	F3	F1	F3
F4	F5	F1	F5	5	F1	F5	F1	F5	F4	F5
F0	F6	F0	F6	6	F0	F6	F0	F6	F0	F6
F2	F1	F4	F1	7	F4	F1	F4	F1	F2	F1
F3	F7	F2	F7	8	F2	F7	F2	F7	F3	F7
F1	F1	F3	F0	9	F3	F0	F3	F0	F1	F1
B	A	F	E		J	I	H	G	D	C

Fig. 3. Experimental layout for Guanare experimental station corn studies. The location of the 3 land forms, dates of planting and fertilizer treatments are shown. Row spacings 76 cm. R1 and R2 are replications 1 and 2.

Planar May 9 R2	Planar May 9 R1	Planar Apr.28 R1	Beds May 9 R2	Fur. May 9 R2	Fur. May 9 R1	Furrows April 28 R2	Furrows April 28 R1	Beds May 9 R1	Beds April 28 R2	Beds April 28 R1	
F1	F2	F2	F1	F1	F2	F1	F2	F2	F1	F2	1
F7	F4	F4	F7	F7	F4	F7	F4	F4	F7	F4	2
F5	F0	F0	F5	F5	F0	F5	F0	F0	F5	F0	3
F6	F3	F3	F6	F6	F3	F6	F3	F3	F6	F3	4
F0	F5	F5	F4	F4	F5	F4	F5	F5	F4	F5	5
F4	F6	F6	F0	F0	F6	F0	F6	F6	F0	F6	6
F2	F1	F1	F2	F2	F1	F2	F1	F1	F2	F1	7
F3	F7	F7	F3	F3	F7	F3	F7	F7	F3	F7	8
F0	F2	F2	F0	F0	F2	F0	F2	F2	F0	F2	9
F3	F4	F4	F3	F3	F4	F3	F4	F4	F3	F4	10
F2	F0	F0	F2	F2	F0	F2	F0	F0	F2	F0	11
F4	F3	F3	F4	F4	F3	F4	F3	F3	F4	F3	12
F4	F3	F3	F4	F4	F3	F4	F3	F3	F4	F3	13
NL	NK	NE	NG	NJ	NH	ND	NC	NF	NB	NA	

45,000 plants / ha

55,000 plants / ha

Fig. 4. Experimental layout for Parcela 90, Guanare, corn studies. the locations of the 3 land forms, dates of planting, densities of planting, and fertilizer treatments are shown. Row spacings are 76 cm. R1 and R2 are replications 1 and 2. Positions of borders eliminating lateral surface flow of water are indicated by an X.

RESULTS and DISCUSSION

Guanare Plantings - 1969

The demonstration plantings made in May 1969 produced useful information but replications were not uniform. The data are shown in tables 1 and 2. The lack of replications and non-randomization of treatments made statistical analysis inadvisable. Even so, the data of table 1, Parcela 90, has value. It is obvious that a lack of fertilizer, treatments 0, results in low yields. This poor growth was evident visually. Even where surface drainage was good (plots 1C, 1D, 11A, 11B and 11C) the number of matured ears was only half that of good fertilized plots.

A second fact obvious in the data is that 76 Kg N/ha alone seems to be about as beneficial as any other fertilizer mixture or higher N level that was used (see plots 2A, 4B and 9B). A value near 5000 Kg grain/ha was obtained for plant densities at maturity of near 40,000 plants/ha. No treatments used produced higher yields. This is not a good yield for well managed corn.

The third observation concerning the data is the detrimental effect of poor drainage. Of the 44 plots, 6 of those observed to have poor drainage (over 13% of all plots) had such poor yields they were not even harvested. These would have had yields less than about 500 Kg/ha and less than 9000 ears/ha. This effect is an extreme one and is illustrated by numerous comparisons. Each vertical column is the area between borders, and plots adjacent vertically have no differences except fertility and drainage.

Compare yields in adjacent plots 1A and 2A, 3A and 5A, 4B and 5B, 9C and 10C, and 9D and 10D. It is obvious that poor drainage in such a field can reduce the average yield from what it shoud be with good drainage (4000 - 5000 Kg/ha) to a low average of 1500 - 2000 Kg/ha.

The yields in the second field, the Guanare experiment station, are lower than in the Parcela 90. Numbers of ears harvested per hectarea are only about 75% of those in Parcela 90. Yields are only about 60% to 70% of those in Parcela 90. Although the reason for the lower density is unknown, a persistant perennial grass that was not adequately controlled by atrazine competed vigorously after the first month's growth.

The lack of obvious response to fertilizer levels can possibly be explained by prior land history. Borders B-E had previously been used for a uniformly fertilized cotton planting which was plowed under. Just prior to planting the corn, a dense, succulent grass cover about 75 cm tall was plowed under. Only border A was different, having had corn the previous season. However, border A also had noticeably slow runoff and poor drainage. The poorest drainage exists at the slope bottoms of each border. Lower yields in all borders at positions 7, 8 and 9 are evidence of this effect and indicate reductions to nearly half that obtained in better drained plots more to the top of the border strips.

It is interesting to note that the Guanare plantings in 1970 also exhibited the same problems in (1) incompletely controlled

Table 1. Yields, harvested ears, and total plants per plot of corn harvested in Parcela 90, Guanare, in 1969. Data is not corrected for moisture content. Vareity Obregon.

Fert. treat.	Border D	Border C	Border B	Border A	
0 control	200* 101 1105	195* 106 740	238 100 925	179 76 648	1
N1	213 192 3315	266* 90 1760	206* 182 3560	225* 220 5000	2
N2	207# 164 3240	266* 208 4820	216* 184 4820	251* 210 5000	3
N1P	130# 96 1105	137 110 2020	213 208 4730	240 208 3880	4
N2PK	No# Harvest	173# 120 1850	137 120 2220	142# 130 2040	5
0 control	No# Harvest	155 64 648	No# Harvest	No# Harvest	6
N1	No# Harvest	166# 58 1780	200# 108 1200	211 188 3880	7
N2	(?) 136 3110	160# 76 925	199 142 3620	230 185 4650	8
N1P	No# Harvest	216# 187 2980	220* 204 4730	208* 232 3700	9
N2PK	230 116 4620	240* 212 3880	219 219 4260	213* 200 4650	10
0 control	No # Harvest	216 94 1295	No # Harvest	163 96 1470	11

*Plot had no problem of poor drainage.
#Visually these were poorly drained; reseeding did poorly.

Legend

179 - plants/plot
76 - ears/plot
648 - yield, Kg/ha.

Fertilizer levels

0 - none, control
N1 - 76 Kg N/ha
N2 - 152 Kg N/ha
P - 50 Kg P/ha
K - 109 Kg K/ha

Plot details

Planted plot = 5.4m x 20m
Harvested plot = 3.6m x 15m
Variety - Obregon

Density equivalents

150/plot = 27,800/ha
175/plot = 32,400/ha
200/plot = 37,100/ha
225/plot = 41.700/ha
250/plot = 46,400/ha

Table 2. Yields harvested ears, and total plants per plot of corn harvested in Guanare Experiment Station in 1969. Data is not corrected for moisture content. Variety Obregon.

Fert. treat.	Border A*	Border B	Border C	Border D	Border E	
0 Control	315 48 2090	294 156 2090	359 208 2960	383 236 3010	435 236 3320	1
N1	506 230 1850	276 100 1600	343 210 3010	299 194 2580	372 208 3075	2
N2	492 140 784	362 250 3690	382 216 3010	297 208 2830	286 186 2400	3
N2PK	420 110 550	307 259 3520	389 220 3320	288 188 2710	245 208 3200	4
0 Control	360 57 324	272 220 3620	326 204 2830	268 166 2960	285 210 2830	5
N1	No Harvest	290 208 3200	315 180 1720	295 188 2340	225 204 2460	6
N2	No Harvest	321 140 1478	340 110 1230	256 190 2220	214 102 1475	7
N2PK	No Harvest	332 140 1600	275 142 1540	279 118 1350	235 104 1415	8
0 Control	No Harvest	343 148 1600	255 90 1015	212 148 1600	222 108 1475	9

* Only border A had corn 3 months earlier (Dec.-Feb.). Column A plots 6-9 was quite poorly drained and extensive reseeded plants did not mature well. Harvested plots of A were 1/3 larger than those of other colums so to have equivalent numbers of plants and ears, reduce those of column A by 1/4 its values.

Legend

435 - plants/plot
236 - ears/plot
3320 - yield, Kg/ha

Fertilizer levels

0 - none, control
N1 - 54 KgN/ha
N2 - 108 KgN/ha
P - 50 KgP/ha
K - 109 KgK/ha

Plot details

Planted = 7.2m x 18m
Harvested = 5.4m x 18m
Variety = Obregon

Density equivalents
(Columns B-E only)

200/plot = 24,700/ha
250/plot = 30,900/ha
300/plot = 37,000/ha
350/plot = 43,200/ha

Comments

Columns B-E had heavy green manure (grass) plowed down before planting

All columns had heavy grass competition by time of maturity.

grass competition and (2) lower general overall yields per hectarea than obtained in other stations.

Guanare Plantings - 1970

Guanare plantings were done under the direct supervision of R. W. Miller and A. Gongales. Production supervision was maintained primarily by Ing. Gonzales using as field work directors laboratory assistant Santiago and perito Palacios.

At harvest, the early plantings particularly, but all plantings to an important degree, were heavily infested by tall grass. The yield losses from fallen plants, fungas attacks from the wet August and September and even germinated "corn in the ear" were obvious. It was not unusual to observe a laborer pick an ear of corn, break it in half or shell part of the deteriorated part and throw the rest of the ear into the harvest. It is done matter-of-factly from long experience with these types of corn losses during drying stages. In some Central America countries, the stalk is bent over to keep the ear hanging downward during drying. It is believed that this reduces water penetration into the grain and helps drainage of the ear after rains. It is also time consuming.

Yield data are shown in figures 5 and 6 and details in tables 3 through 12. The figures illustrate the relatively good "apparently linear" yield increase as number of harvested ears increases. The lines, drawn arbitrarily as the best fit line through the origin and the control (0 fertility) plots, are a reference for the effect of fertilizer treatments. The number at each plotted point is the

fertilizer treatment number. Points to the right of the line are higher yields per harvested density (per number of ears). If fertilizer additions increased yields by larger ears, the point would be to the right of the control reference line. However, if yields were increased by more ears per stalk even though each ear was smaller, that point on the graph would suggest a yield reduction from treatment (the point would be to the left of the line). Other factors such as plant survival and production of an ear of corn can further complicate the picture. Throughout this discussion, yield increase is suggested to result from larger ears. This conclusion will not always be valid.

The data of figures 5 and 6 have the majority of points to the right of the line. Added fertilizer appears to increase yields. Obregon variety seems more clearly affected than does Foremaiz-1. The level of fertilizer added and its effect on yield is not apparent. Data points for both high levels and low levels are completely intermixed. Based upon these observations, one would have to conclude that response to added fertilizer seems clear but response is weak. For Obregon, the average response from fertilizer is about 10% in yield increases with about 25% of the averages having no increase or a decrease in yields. For Foremaiz-1, response was approximately equal in yield increases and yield decreases.

The effect of land form (beds, furrows or planar) in not clear. If an effect is evident, it is that beds resulted in poorer yields than planting on the flat. This is the opposite of expected results.

The data of the climate (fig. 7, and table 13) help explain the reverse effect on yields due to land form. 1970 was a dry year in May and early June. Comparisons are as follows:

Month	1969	1970
April	132 mm	107 mm
May	190 mm	94 mm
June	484 mm	213 mm
July	168 mm	190 mm
August	160 mm	172 mm
September	131 mm	240 mm

The 1970 year had 94 mm of rain from May 1 until June 7 in comparison to 213 mm in 1969 for the same period. Also, the 94mm had 68 of these fall within a 6 day period of April 23 and April 38. Two storms over 30mm each had intensities of 24.5 and 15 mm/hr. and would have had some loss by runoff. Other examples of the dryness of May in 1970 are:

Month	Days without measured rainfall	
	1969	1970
May	14	19 (10 consecutive)
June	5	13

The climatic data of fig. 7 and table 13 have some interesting relations to low corn yields obtained. Up to the date of tassel, 5 of the 8 weeks had higher class A pan evaporation than was obtained in rainfall. Even total rainfall minus the calculated consumptive use values only increased to a total of 30 mm during planting-to-tassel time. This assumes no runoff loss. During this time 38 mm were lost in runoff if one considered all runoff to be that rain in excess of 10 mm/hr. intensity for over 1 hour duration. (This is an unchecked assumption.) It also seemed to the writer that the

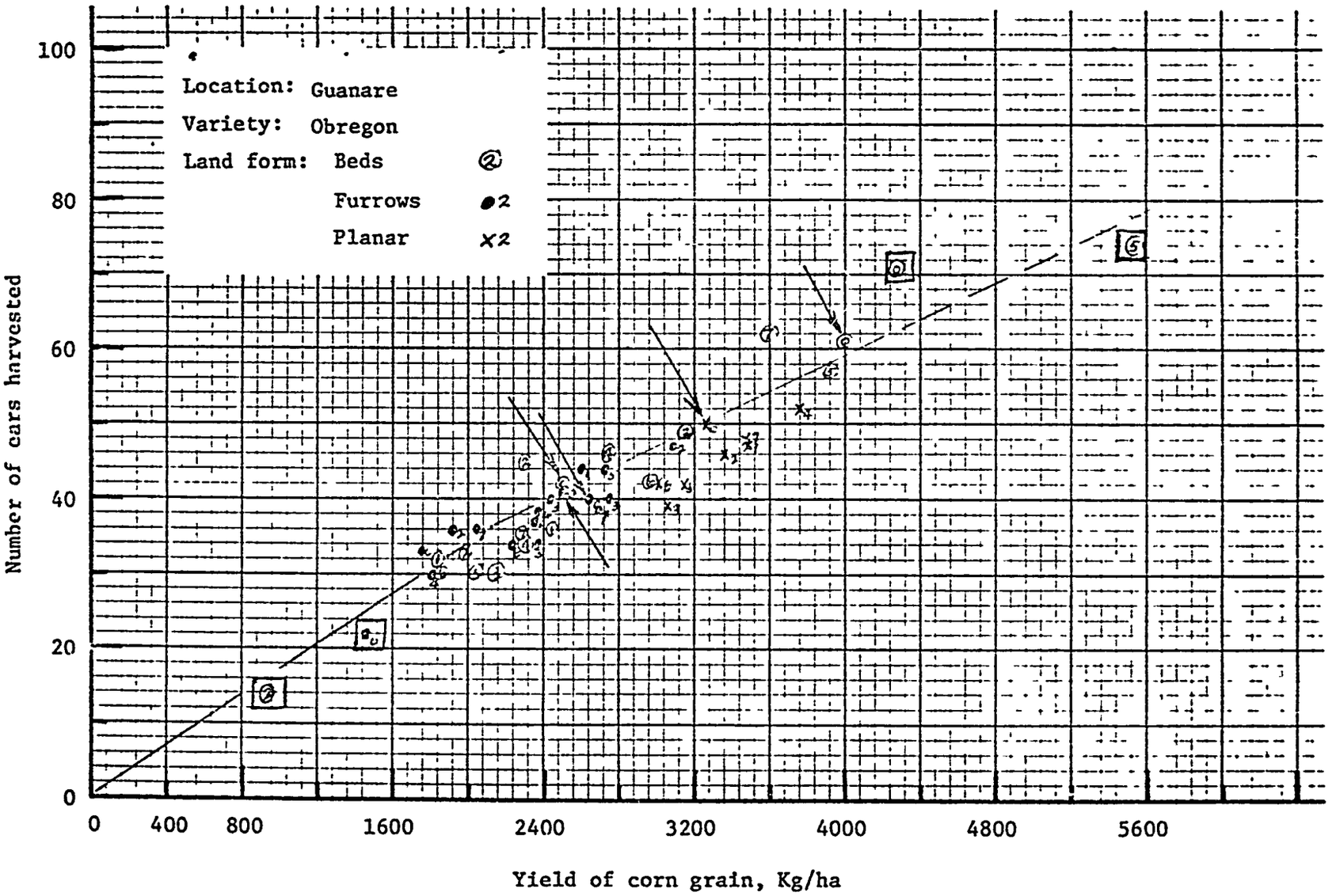


Figure 5. Relationship yield of corn grain to the number of harvested ears. Points in squares are individual points (not averages) to illustrate high and low values.

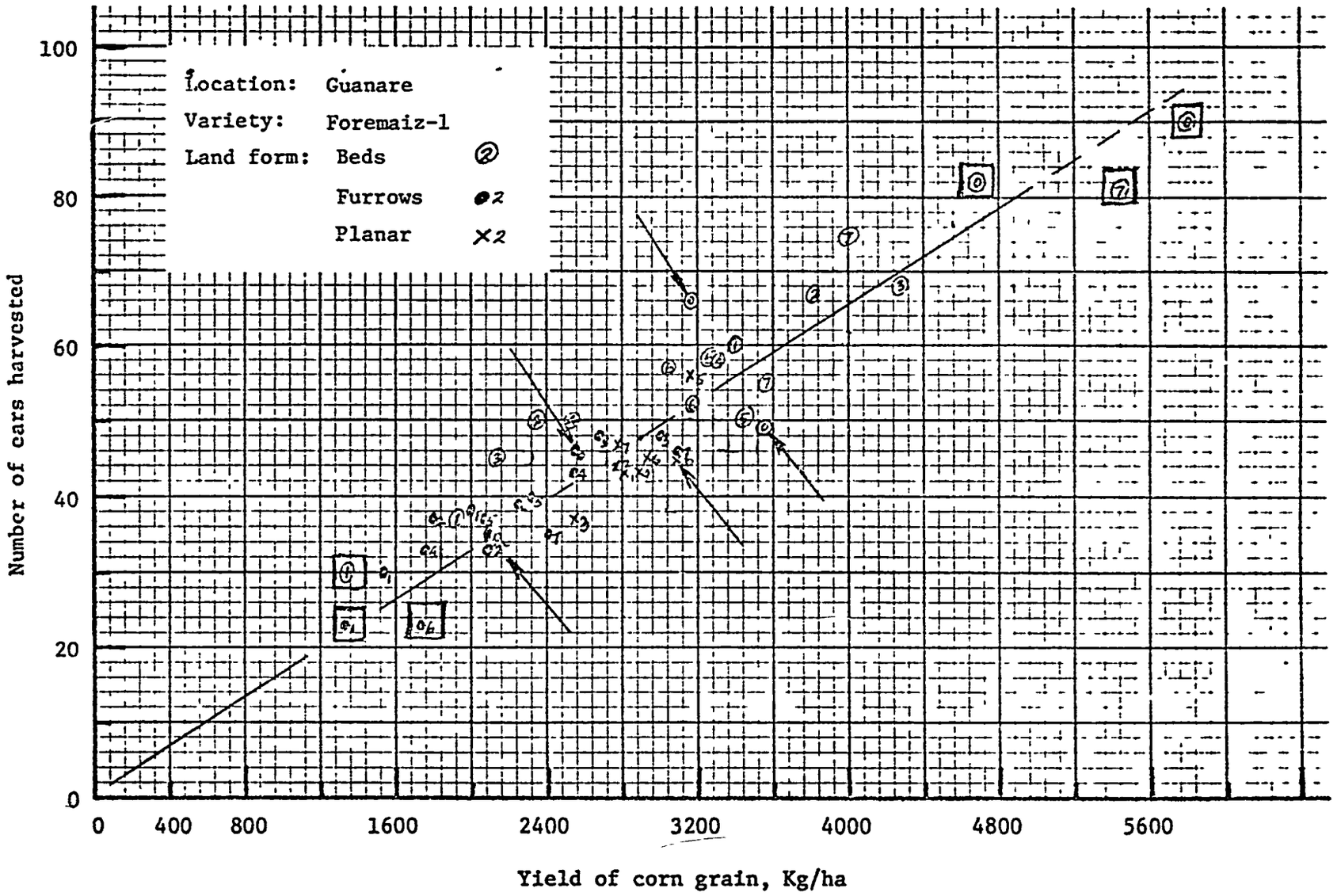


Figure 6. Relationship yield of corn grain to the number of harvested ears. Points in squares are individual points (not averages) to illustrate high and low values.

Table 3. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Beds.

Location Guanare	Soil texture silty clay
Strip code No. GA & GB	Planting date April 23, 1970
Variety Obregon	Grain, % H_2O at harvest 18% = 0.9745
Row width 76 cm	Harvested lot size 14 x 1.56m = 21.28m^2 = x 470

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				x 470
F_0	116	72	9.075	62	51	8.400	8.730	89	61	4,000
F_1	63	27	3.175	61	38	4.850	4.010	62	32	1,835
F_2	68	58	5.775	55	33	4.300	5.035	61	45	2,305
F_3	89	58	8.600	56	40	5.200	6.900	72	49	3,160
F_4	68	46	6.000	Lost by mixed rows			6.000	68	46	2,745
F5	60	41	5.350	91	74	11.800	8.575	75	57	3,925
F_6	72	38	4.300	69	57	8.500	6.400	60	42	2,930
F_7	79	58	6.875	96	67	8.875	7.875	87	62	3,605
									Total	24,505

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 4. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Fur.

Location Guanare	Soil texture silty clay
Strip code No. GC, GD	Planting date April 23, 1970
Variety Obregon	Grain, % H_2O at harvest 18%
Row width 76 cm	Harvested lot size 14m x 1.52 = 21.28m^2 = x 470 for yield

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	50	37	4.625	50	46	6.350	5.485	50	41	2,510
F_1	50	33	4.625	10m without plants in one row 38	42	5.700	5.160	44	37	2,365
F_2	windfall 47	26	2.225	64	47	6.150	4.185	55	36	1,915
F_3	51	44	5.875	one row without plants 30	37	4.825	5.350	40	40	2,450
F_4	windfall 39	30	3.800	one row only 5 plants 35	47	6.575	5.185	67	38	2,375
F_5	48	40	5.500	47	48	6.400	5.950	47	44	2,725
F_6	47	22	3.100	41	44	4.600	3.850	44	33	1,760
F_7	62	38	4.875	28	34	4.075	4.475	45	36	2,050
									Total	18,150

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 5. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Beds.

Location Guanare — Soil texture silty clay

Strip code No. GE, GF — Planting date May 9, 1970

Variety Obregon — Grain, % H_2O at harvest 21%

Row width 1.52 double row — Harvested lot size 14 x 1.52 = 21.28m^2 = x 470

Fert-lizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
	36	28	4.900	42	38	4.025		39	35	x 470
F_0	52	52	8.025	83	41	5.400	5.585	42	42	2,495
F_1	50	42	6.975	31	29	3.975	5.470	40	36	2,445
F_2	47	51	6.925	27	14	2.000	4.460	37	33	1,990
F_3	44	37	6.250	27	24	3.375	4.810	35	30	2,150
F_4	24	25	3.575	42	43	6.775	5.170	33	34	2,310
F_5	35	27	4.150	35	36	5.025	4.585	35	31	2,050
F_6	34	34	5.675	28	26	2.650	4.160	31	30	1,860
F_7	41	38	5.750	31	32	4.550	5.150	36	35	2,300
									Total	17,600

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 6. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Fur.

Location Guanare — Soil texture silty clay

Strip code No. GG, GH — Planting date May 9, 1970

Variety Obregon — Grain, % H_2O at harvest 21%

Row width 76 cm — Harvested lot size 14 x 1.52m = 21.28m^2 = x 470

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
	42	42	6.275	40	35	4.800		41	38	x 470
F_0	35	33	5.500	48	48	7.025	5.900	41	40	2.635
F_1	30	29	3.900	60	60	7.750	5.825	45	44	2.600
F_2	52	47	7.400	50	49	6.450	6.925	51	47	3.090
F_3	43	33	5.625	50	48	6.675	6.150	46	40	2.745
F_4	26	28	4.075	40	32	4.175	4.125	35	30	1.840
F_5	40	38	5.525	40	31	5.025	5.275	40	34	2.355
F_6	39	37	5.625	28	31	4.425	5.025	35	34	2.245
F_7	39	41	6.125	50	37	5.825	5.975	44	39	2.670
									Total	20,180

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations

†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 7. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Planar

Location Guanare — Soil texture silty clay

Strip code No. GI, GJ — Planting date May 9, 1970

Variety Obregon — Grain, % H_2O at harvest 21%

Row width 76 cm — Harvested lot size 14 x 1.52m = 21.28m^2 = x 470

Fert-lizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
	41	32	4.050	53	55	8.450		47	43	x 470
F_0	43	46	7.675	53	54	8.975	7.287	48	50	3,255
F_1	48	37	5.700	57	57	9.900	7.800	32	47	3,485
F_2	40	46	6.800	43	47	8.200	7.500	41	46	3,350
F_3	35	35	6.625	39	43	7.075	6.850	39	39	3,060
F_4	50	52	8.100	51	52	8.775	8.435	50	52	3,765
F_5	37	43	7.375	43	42	6.700	7.035	40	42	3,140
F_6	--	35	6.175	57	51	7.275	6.725	57	43	3,005
F_7	46	43	6.900	48	52	8.675	7.780	47	47	3,475
									Total	26,535

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 8. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Beds.

Location Guanare	Soil texture silty clay
Strip code No. GA & GB	Planting date April 23, 1970
Variety Foremaiz - 1	Grain, % H_2O at harvest 18% = 0.9745
Row width 76 cm	Harvested lot size 14m x 1.56m = 21.24m^2 = x 470

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	97	82	10.100	78	46	3.800	6.950	87	64	3,180
F_1	60	44	5.625	33	30	2.800	4.212	46	37	1,930
F_2	89	66	7.575	77	35	2.675	5.125	83	50	2,350
F_3	87	45	4.325	61	46	5.025	4.675	74	45	2,140
F_4	89	57	7.150	54	43	3.900	5.525	71	50	2,530
F_5	67	56	6.925	67	60	7.350	7.135	67	58	3,270
F_6	62	68	8.675	41	36	5.200	6.935	57	52	3,180
F_7	67	50	6.325	92	66	9.275	7.800	79	55	3,570
									Total	22,150

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 9. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Fur.

Location Guanare — Soil texture silty clay

Strip code No. GC & GD — Planting date April 23, 1970

Variety Foremaiz - 1 — Grain, % H_2O at harvest 18% - 0.9745

Row width 76 cm — Harvested lot size 14m x 1.52 = 21.28m² = x 470

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
Fo	60	44	4.625	54	49	6.575	5.600	55	46	2,565
F_1	57	34	2.725	66	43	6.000	4.350	61	38	2,000
F_2	windfall 28	33	3.775	57	34	5.375	4.575	42	33	2,095
F_3	62	55	6.750	69	41	5.000	5.875	65	48	2,690
F_4	windfall 37	43	4.400	44	43	6.675	5.535	40	43	2,535
F_5	50	40	3.750	45	35	5.225	4.485	47	37	2,055
F_6	38	36	3.825	71	42	6.075	4.950	54	39	2,265
F_7	50	35	3.750	75	57	8.025	5.885	62	46	2,695
									Total	18,900

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 10. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Beds.

Location Guanare	Soil texture silty clay
Strip code No. GE, GF	Planting date May 9, 1970
Variety Foremaiz -1	Grain, % H_2O at harvest 21%
Row width 1.52 for 2 rows	Harvested lot size 14m s 1.52 = 21.28m^2 = x 470 for yield

Fert-lizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
	77	90	12.350	69	58	5.525				x 470
F_0	73	67	9.300	57	32	4.725	7.975	65	49	3,560
F_1	74	72	9.200	57	48	6.025	7.610	65	60	3,400
F_2	77	78	10.000	68	56	7.100	8.550	72	67	3,820
F_3	84	76	11.625	69	60	7.575	9.600	76	68	4,290
F_4	69	64	8.300	54	53	6.525	7.410	61	58	3,310
F_5	69	53	9.450	61	48	5.975	7.710	65	50	3,445
F_6	80	75	10.350	62	40	3.300	6.825	71	57	3,050
F_7	80	81	11.550	97	65	6.350	8.950	88	75	3.995
•										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 11. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Fur.

Location Guanare	Soil texture silty clay
Strip code No. GG, GH	Planting date May 9, 1970
Variety Foremaiz - 1	Grain, % H_2O at harvest 21%
Row width 76 cm	Harvested lot size 14m x 1.52m = 21.28m = x 470

Fert-lizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
	60	59	6.150	69	40	5.100		64	49	x 470
F_0	38	36	3.625	69	34	3.850	4.680	53	35	2,090
F_1	40	38	4.100	39	23	2.875	3,485	39	30	1.555
F_2	41	39	3.950	55	36	4.100	4.025	48	37	1,800
F_3	41	40	5.300	62	56	8.125	6.710	37	48	3,000
F_4	34	31	3.625	58	36	4.275	3.950	46	33	1.765
F_5	46	42	5.425	49	39	4.975	5.200	47	40	2,320
F_6	42	46	5.850	42	23	3.675	4.760	42	34	2,125
F_7	57	34	5.775	43	36	5.050	5.410	50	35	2,415
									Total	17,070

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 12. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Planar

Location Guanare — Soil texture silty clay

Strip code No. GI, GJ — Planting date May 9, 1970

Variety Foremaiz -1 — Grain, % H_2O at harvest 21%

Row width 76 cm — Harvested lot size 14m x 1.52 = 21.28m^2 = x 470

Fert-lizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
	49	49	6.175	74	65	7.625		61	57	x 470
F_0	55	47	6.975	55	46	7.025	6.950	55	46	3,105
F_1	46	36	4.725	48	50	7.850	6.285	47	43	2,810
F_2	53	38	6.225	51	50	6.225	6.225	52	44	2,780
F_3	46	37	5.675	52	37	5.725	5.700	49	37	2,545
F_4	49	40	5.600	66	46	7.300	6.450	57	43	2,880
F_5	53	45	6.525	70	67	8.625	7.075	61	56	3,160
F_6	53	49	7.900	47	41	5.200	6.550	50	45	2,925
F_7	57	39	4.750	78	60	7.725	6.235	67	47	2,785
									Total	22,990

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

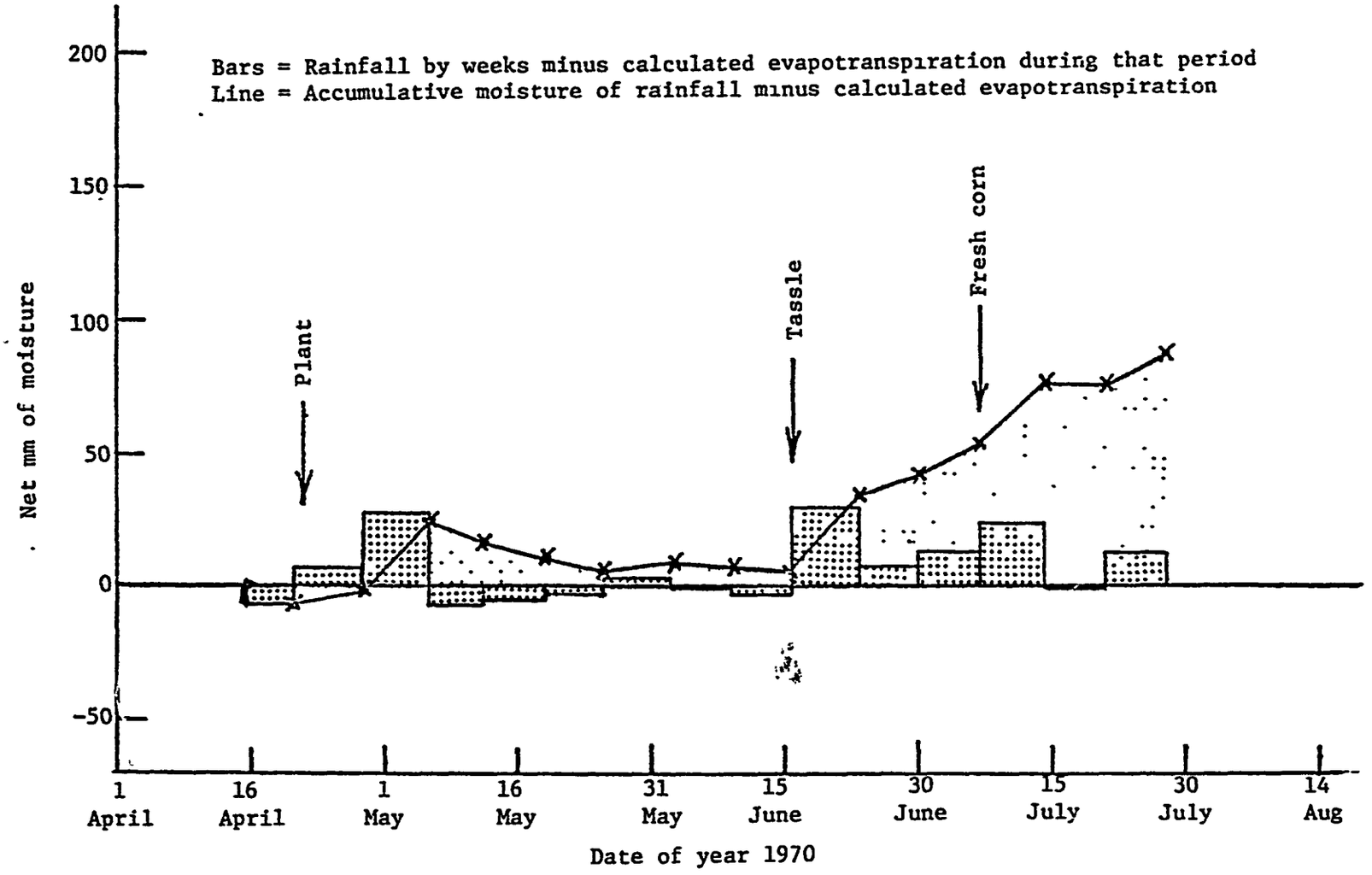


Figure 7. Moisture status for corn in 1970, Guanare, Venezuela. Tabular data in Table 13. Compare also with similar data for Las Majaguas (100 kilometers from Guanare) given in Figure 19 and Table 54.

Table 13. Climatic data for Guanare irrigation system in Portugnesa State, Venezuela. Rainfall intensities greater than 1.0 cm/hr. were considered to have run off of that excess over 1 cm/hr. of rain. In some instances this may underestimate effective rainfall.

Date interval	Rainfall* mm	Class A pan evaporation mm	Evapo-transp. factor+	Calculated evapo-transp.+ mm	Rainfall minus pan evap. mm	Rainfall minus evapo-transp. mm	Rainfall minus evapo-transp., accumul. mm
April 15-21	0	43.6	0.20	8.7	-43.6	-8.7	-8.7
					plant		
April 22-28	16.9	48.5	0.20	9.7	-31.6	+7.2	-1.5
April 29-May 5	17.2	39.8	0.30	11.9	-22.6	27.9	26.4
May 6-12	7.2	41.6	0.41	17.1	-34.4	-9.9	16.5
May 13-19	10.0	32.7	0.50	16.3	-22.7	-6.3	10.2
May 20-26	R-21.0 21.7	40.3	0.65	26.2	-18.6	-4.5	5.7
May 27-June 2	R-10.1 27.2	33.1	0.73	24.2	- 5.9	+3.0	8.7
June 3-9	R-7.0 29.9	37.8	0.83	31.4	- 7.9	-1.5	7.2
June 10-16	19.2	22.4	0.90	22.2	- 3.2	-3.0	4.2
					tassle		
June 17-23	R-46.7 59.6	33.3	0.90	30.0	+26.3	+29.6	33.8
June 24-30	R-7.0 30.7	27.0	0.88	23.7	+ 3.7	+7.0	40.8
July 1-7	36.0	28.5	0.85	24.2	7.5	11.8	52.6
					Fresh corn		
July 8-14	R-28.5 50.5	34.7	0.75	26.0	15.8	24.5	77.1
July 15-21	21.0	32.2	0.66	21.2	-11.2	-0.2	76.9
July 22-28	R-23.8 29.3	31.0	0.58	18.0	+ 1.7	+11.3	88.2

* Listed as runoff estimates (R-21.0) and non-runoff which equals total minus excess rains over intensity of 1 cm/hr.

\+ After Christiansen and Hargreaves (1968). Calculated evapotranspiration by multiplying the factor times class A pan evaporation. These factors determined for temperate U.S. climates appears to underestimate water losses in tropical climates especially in early and late season.

consumptive use value in early growth stages was too low (values of 0.2 and 0.3 times pan evaporation). Experience with cambur (bananas), black bean and corn seemed in all cases to need irrigation more frequently than predicted by consumptive use calculations. This will be discussed in another paper.

All comparisons indicate a drier than previous May and early June for 1970. This dry condition eliminated most problems of excess water during corn development. The result was that flat (planar) plantings was comparable to other plantings. In some instances raised beds may have been drier than planar planting and have suffered some growth retardation. In a wetter season, the use of beds should be superior to planar planting. In 1970, this did not occur.

Added fertilizer after the planting time would have been poorly incorporated into the soil (heavy rains would wash some of it to other sites; no rains would leave it at the surface to undergo losses as gaseous nitrogen. Good response to date applications of fertilizer would not occur until 6 weeks or 4 weeks after the April 23 or May 9 plantings, respectively. This is too late for good response by corn that is close to maturity in just over 8 weeks. The earliest planted corn was shorter than that planted May 9. For corn, this relation is common: Deficient water causes short stalks; deficient nitrogen causes slender stalks.

Parcela 90 Plantings - 1970

Corn production in Parcela 90 was supervised by the same

personnel as that in the Guanare Experiment Station.

The yield data are listed in figures 8-11 and tables 14-25. The figures 8-11 have some deviation in pattern of the plotted data. Yet the two varieties and two planting dates summarized by the points average a yield of about 3600 Kg/ha at a harvested density of about 45,000 plants/ha with one ear per plant results in a yield over 7000 Kg/ha. It is well known that such an extrapolation is not a straight line relationship, but it may be relatively close to a straight line up to densities of 45,000 plants/ha. An illustration of the relation between number of ears picked and yield when stand density is higher is illustrated by the points enclosed in blocks in the graphs. These points are the individual yields for plots with the highest and the lowest yields for that group of plots. The relation is amazingly linear. It is obviously important to make a strong effort to maintain a much higher density than was done in this study. Two densities -- 45,000 and 55,000 plants/ha -- were planned but numbers at harvest were considerably reduced.

To compare land form and fertilizer treatment effects, compare the position of the data points relative to the "control" line, which in drawn through the points of F0 (zero fertilizer). Those points to the right of the line suggest a response to treatment (higher yield per given density of ears harvested). There is no clear effect of land form. However, of plots planted on beds, only 3 averages out of 21 have lower relative yield than the control and 2 of these are essentially the same as the control. In contrast,

14 of the 21 averages planted on the flat (planar) had relative yields less than the controls. Furrow plantings were intermediate with 7 of 21 averages less than the yields of controls.

The effect of fertilizer treatment is also not clear. Except mostly for averages planted on the flat (Fig. 8, 10), the treatments had higher relative yields than the controls. There are several exceptions, but the highest relative yields occur in the treatments with higher levels of nitrogen (treatments 3-7) in which over 70 Kg N/ha is added as split application. In figure 10, fertilizer treatment 7 planted in beds (140 Kg N in 3 split applications) is shown to yield about 1500 Kg/ha more than predicted for a plot on the control plot reference line. This is a 54 % increase. In contrast, treatment 7 planted in planar has an 800 Kg/ha yield reduction compared to the control plot reference line (a 19% reduction). Generally, yield increases over the control plot reference line range from 10% to 20%. Without statistical analysis, such percentage estimates of yield differences should be viewed with caution. It seems reasonably safe to say, after working with the data and from observations of the plots during growth and harvest, that fertilizer additions generally increased yields. At least 70 Kg N/ha seemed to result in increased yields. At densities of 45,000 to 50,000 plants/ha (95-105 plants/plot as used in this study), yields of 6000 to 7000 Kg/ha should be common.

Maintaining a good density is a problem to be solved. Most of the data presented have fewer than 60 ears per plot harvested. This is a loss of about 40% of plants for many plots after they were thinned.

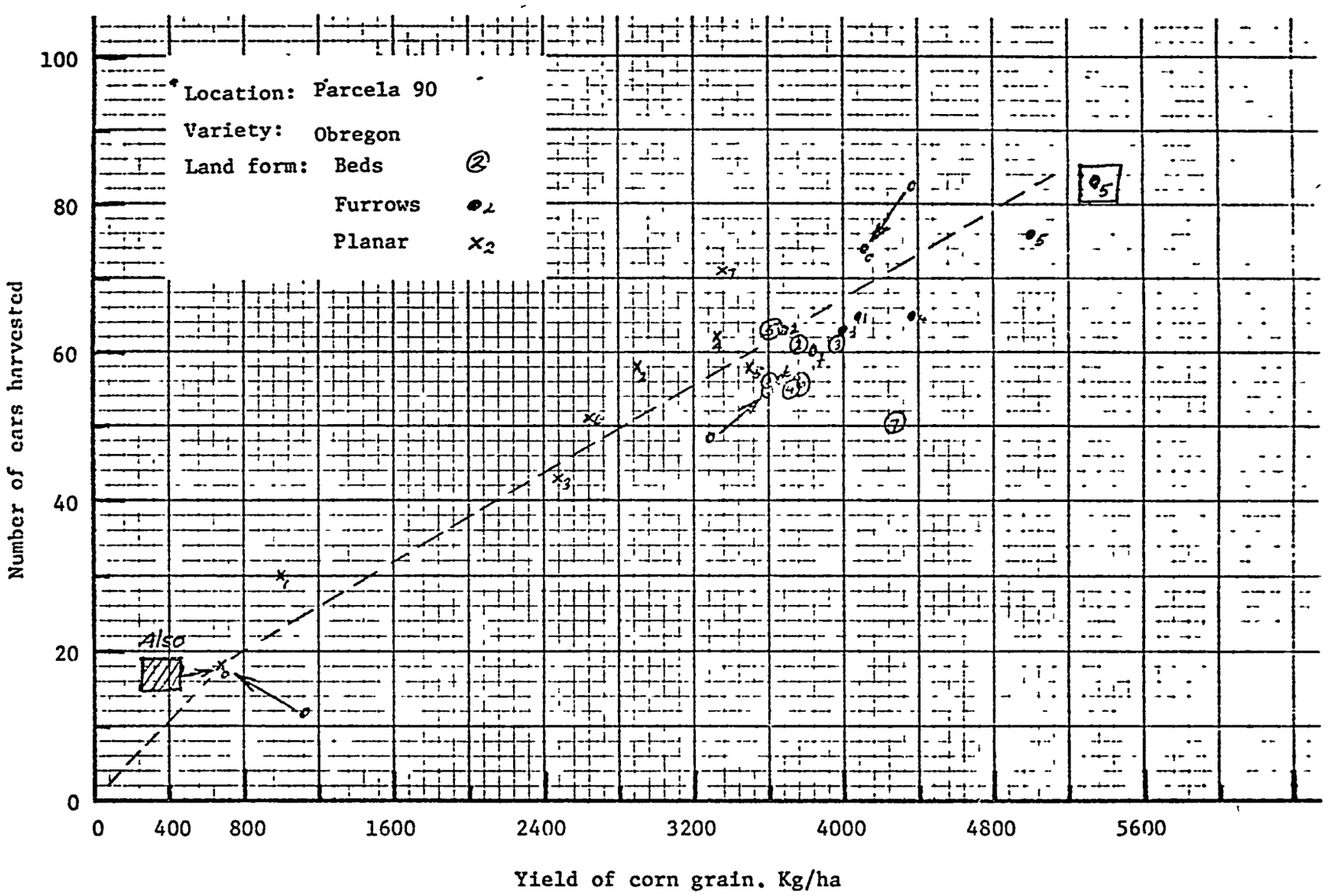


Figure 8 . Relationship yield of corn grain to the number of harvested ears. A value of 50 ears/ha equals 23,500 ears/ha.

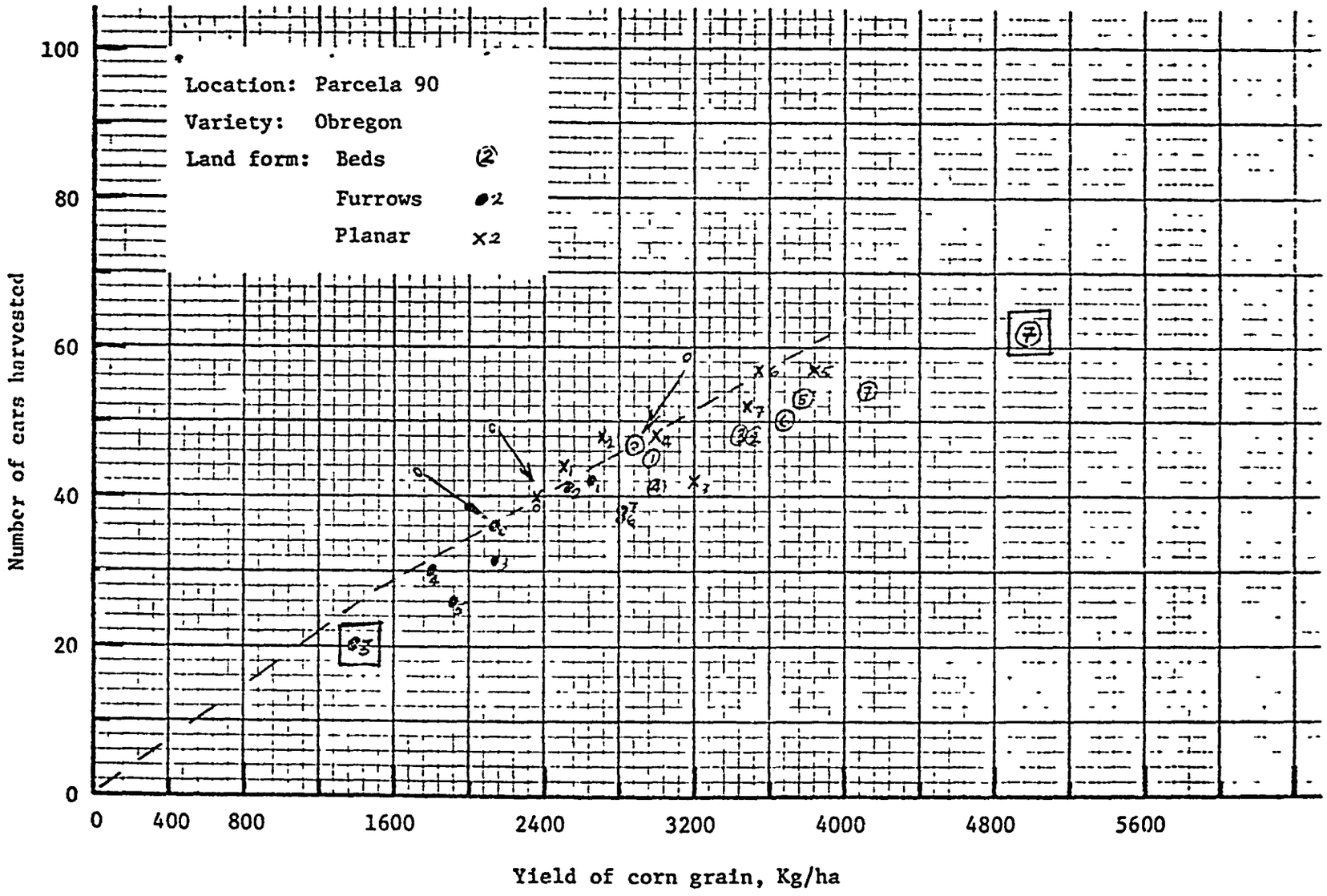


Figure 9. Relationship yield of corn grain to the number of harvested ears. A value of 50 ears/ha equals 23,500 ears/ha.

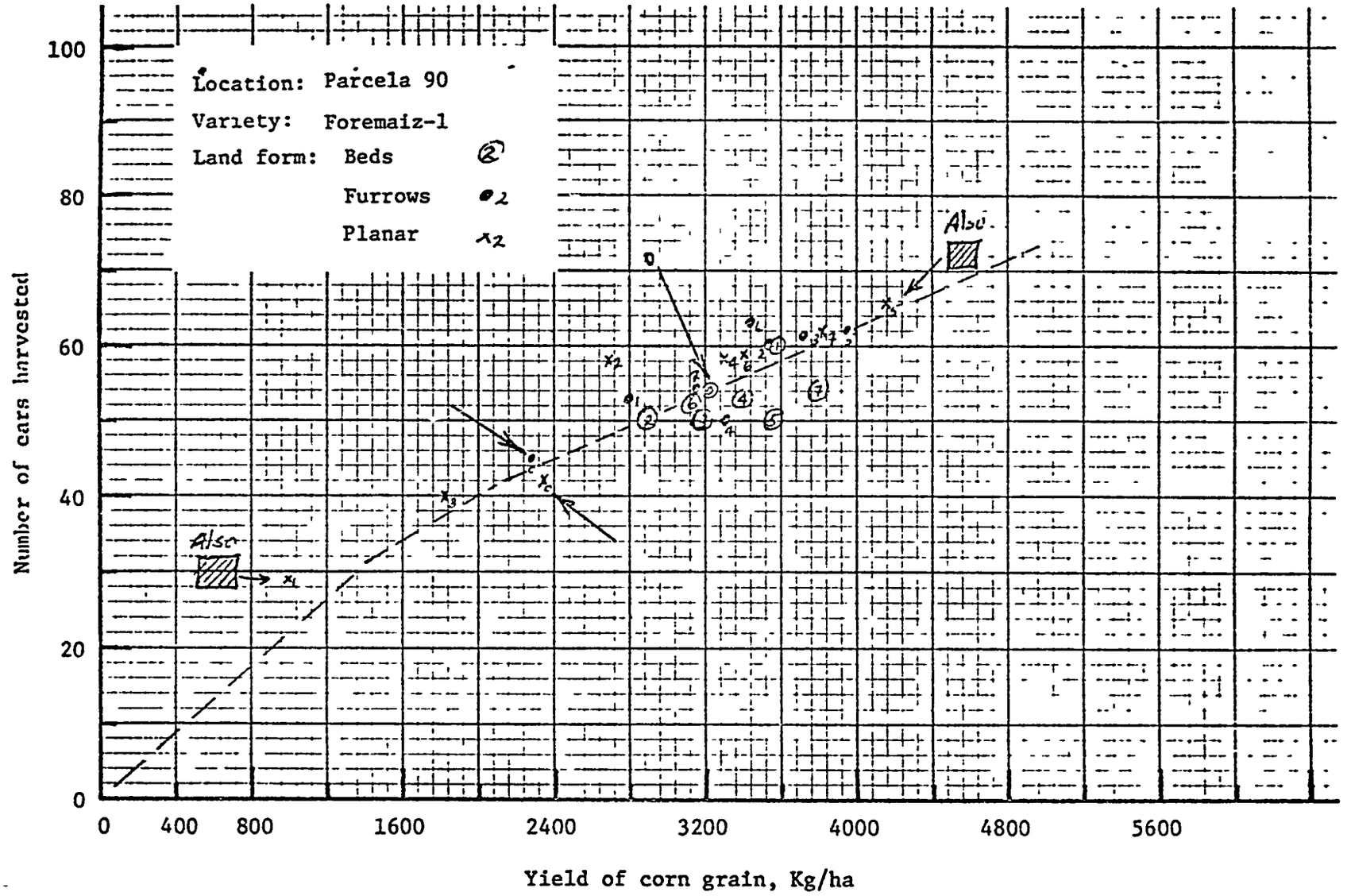


Figure 10. Relationship yield of corn grain to the number of harvested ears. A value of 50 ears/ha equals 23,500 ears/ha.

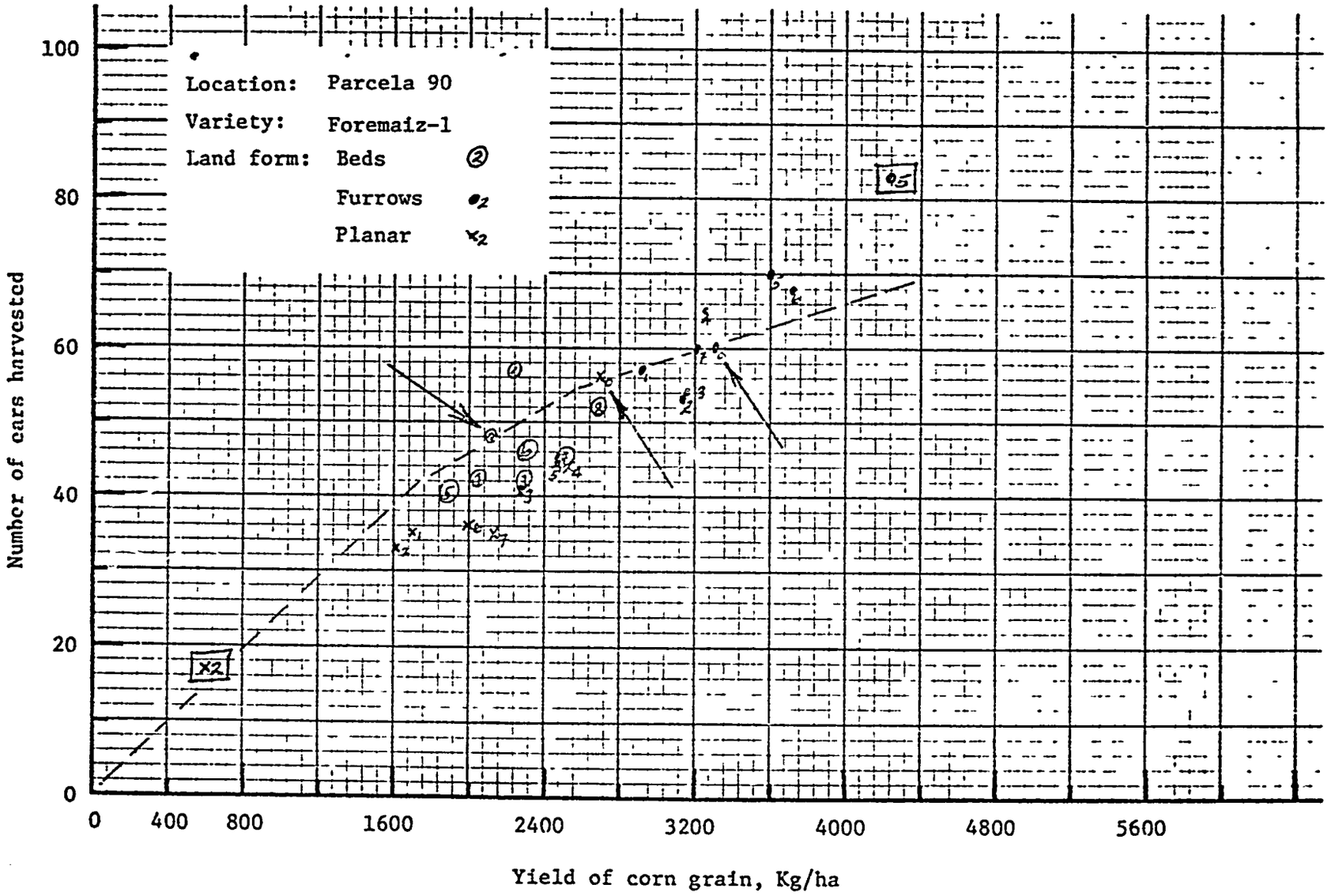


Figure 11. Relationship yield of corn grain to the number of harvested ears. A value of 50 ears/plot equals 23,500 ears/ha.

Table 14. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is planar.

Location	Parcela 90-Guanare	Soil texture	Clay
Strip code No.	NE	Planting date	April 28, 1970
Variety	Obregon	Grain, % H_2O at harvest	16.0
Row width	76 cm	Harvested lot size	14m X 1.52m

Fert-lizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	40	18	1.475					40	18	686
F1	41	30	2.175					41	30	1,002
F2	58	58	6.213					58	58	2,892
F3	65	43	5.338					65	43	2,483
F4	54	62	7.175					54	62	3,340
F5	72	58	7.525					72	58	3,502
F6	68	51	5.675					68	51	2,642
F7	72	71	7.175					72	71	3,340
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 15. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is furrows.

Location	Parcela 90-Guanare	Soil texture	Clay
Strip code No.	NC, ND	Planting date	April 28, 1970
Variety	Obregon	Grain, % H_2O at harvest	16.0
Row width	76 cm	Harvested lot size	14m X 1.52m

Fert-lizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	92	77	9.850	71	59	7.838	8.844	82	74	4,115
F1	72	68	9.050	81	62	8.475	8.763	77	65	4,078
F2	67	59	7.138	85	66	8.688	7.913	76	63	3,686
F3	71	70	9.675	66	56	7.650	8.663	69	63	4,030
F4	81	65	9.338	64	65	9.438	9.388	73	65	4,370
F5	75	68	9.975	73	83	11.600	10,788	74	76	5,015
F6	74	49	7.475	74	62	8.300	7,888	74	56	3,668
F7	79	56	7.975	65	63	8.425	8.200	72	60	3,818
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 16. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is beds.

Location Parcela 90-Guanare	Soil texture Clay
Strip code No. NA, NB)	Planting date April 28, 1970
Variety Obregon	Grain, % H_2O at harvest 16.0
Row width 76 cm	Harvested lot size 14m X 1.52m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	71	64	8.162	54	45	7.375	7.765	62	55	3,615
F1	68	57	7.725	42	55	7.725	7.725	55	56	3,596
F2	71	68	8.975	54	54	7.212	8.099	63	61	3,768
F3	75	72	9.725	42	49	7.300	8.512	59	61	3,964
F4	67	60	8.488	53	50	7.488	7.988	60	55	3,720
F5	59	56	8.700	45	60	6.900	7.800	52	63	3,632
F6	65	62	8.500	50	47	7.575	8.037	58	55	3,74[illegible]
F7	71	69	10,225	51	51	8.175	9.200	61	50	4,28[illegible]
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 17. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is planar.

Location Parcela 90-Guanare	Soil texture Clay
Strip code No. NK , NL	Planting date May 9, 1970
Variety Obregon	Grain, % H_2O at harvest 17.5
Row width 76 cm	Harvested lot size 14m X 1.52m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	44	40	5.713	44	40	4.585	5.149	44	40	2,366
F1	45	46	6.200	42	42	4.675	5.438	43	44	2,500
F2	46	46	5.950	58	50	5.838	5.894	52	48	2,710
F3	41	40	6.725	47	45	7.225	6.975	44	42	3,206
F4	46	44	5.338	58	53	7.838	6.588	52	48	3,028
F5	57	51	7.975	75	63	8.700	8.338	66	57	3,830
F6	54	49	6.675	69	64	8.725	7.700	61	57	3,540
F7	70	46	6.475	58	59	8.650	7.563	64	52	3,478
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 18 Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is

Location Parcela 90-Guanare	Soil texture Clay
Strip code No. NH,NJ	Planting date May 9, 1970
Variety Obregon	Grain, % H_2O at harvest 17.0
Row width 76 cm	Harvested lot size 14m x 1.52m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	67	30	3.925	44	43	5,388	4.657	50	36	2,150
F1	36	30	5.875	47	45	5.700	5.700	41	42	2,670
F2	45	31	3.138	50	52	7.888	5.508	47	41	2,540
F3	40	20	2.988	43	43	6.188	4.588	41	31	2,117
F4	42	33	3.250	32	29	4.550	3.900	37	30	1,800
F5	52	18	3.500	39	34	4.850	4.175	45	26	1,927
F6	42	28	4.200	49	47	8.025	6.113	45	37	2,820
F7	44	32	4.850	44	44	7.375	6.113	44	38	2,820

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 19. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is beds.

Location Parcela 90-Guanare	Soil texture Clay
Strip code No. NF, NG	Planting date May 9, 1970
Variety Obregon	Grain, % H_2O at harvest 17.5
Row width 76 cm	Harvested lot size 14m X 1.52m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	61	44	6.138	69	51	6.438	6.288	65	47	2,890
F1	50	44	6.725	51	42	6.275	6.500	51	45	2,986
F2	48	41	6.188	54	56	8.138	7.663	51	48	3,522
F3	50	46	7.600	57	50	7.438	7.519	53	48	3,457
F4	46	38	6.313	48	44	6.713	6.513	47	41	2,996
F5	50	49	8.375	49	57	8.075	8.225	49	53	3,780
F6	49	47	7.400	44	54	8.600	8.000	46	50	3,678
F7	51	47	7.100	55	61	10.850	8.975	53	54	4,125
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 20. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is planar.

Location	Parcela 90-Guanare	Soil texture	Clay
Strip code No.	NE	Planting date	April 28, 1970
Variety	Foremaiz-1	Grain, % H_2O at harvest	16.0
Row width	76 cm	Harvested lot size	14m X 1.52m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	85	42	5.025					85	42	2,338
F1	62	29	2.125					62	29	988
F2	72	58	5.788					72	58	2,694
F3	76	40	3.913					76	40	1,822
F4	78	59	7.138					78	59	3,320
F5	70	66	8.950					70	66	4,165
F6	78	59	7.325					78	59	3,410
F7	82	62	8.200					82	62	3,818
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 21. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is furrows.

Location Parcela 90-Guanare	Soil texture Clay
Strip code No. NC, ND	Planting date April 28, 1970
Variety Foremaiz-1	Grain, % H_2O at harvest 16.0
Row width 76 cm	Harvested lot size 14m X 1.52m

Fertilizer[1]	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	78	62	6.500	36	28	3.375	4.938	58	45	2,296
F1	65	52	5.650	57	54	6.375	6.013	61	53	2,800
F2	56	61	7.950	70	59	7.250	7.600	63	60	3,538
F3	82	67	8.425	57	56	7.488	7.957	69	61	3,710
F4	69	53	6.413	65	48	7.900	7.157	67	50	3,314
F5	78	65	8.300	66	59	8.625	8.463	72	62	3,940
F6	70	64	7.975	71	62	6.800	7.388	70	63	3,440
F7	68	55	6.250	54	53	7.275	6.763	61	54	3,148
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations

[1]Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 22. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is beds.

Location Parcela 90-Guanare	Soil texture Clay
Strip code No. NA, NB	Planting date April 28, 1970
Variety Foremaiz - 1	Grain, % H_2O at harvest 16.0
Row width 76 cm	Harvested lot size 14m X 1.52m

Fert-lizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	67	62	7.212	45	45	6.663	6.938	56	54	3,228
F1	69	59	7.375	57	60	8.075	7.725	63	60	3,595
F2	63	49	6.237	51	42	6.213	6.225	57	50	2,900
F3	75	57	7.612	46	42	6.100	6.856	56	50	3,194
F4	53	56	7.213	50	56	7.325	7.269	52	53	3,385
F5	42	52	7.375	54	47	7.900	7.638	48	50	3,555
F6	62	59	6.825	57	45	6.625	6.725	60	52	3,132
F7	59	50	7.500	63	58	8.875	8.188	61	54	3,810
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 23. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is planar.

Location Parcela 90-Guanare	Soil texture Clay
Strip code No. NK, NL	Planting date May 9, 1970
Variety Foremaiz - 1	Grain, % H_2O at harvest 17.5
Row width 76 cm	Harvested lot size 14m X 1.52m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	80	81	8.900	74	31	3.775	6.338	77	56	2,914
F1	46	46	5.250	33	24	2.125	3.688	39	35	1,695
F2	74	50	5.700	24	17	1.325	3.513	49	33	1,615
F3	63	51	7.050	31	23	2.825	4.938	47	41	2,268
F4	73	57	6.875	40	31	4.200	5.538	56	44	2,545
F5	57	64	7.750	28	26	3.075	5.413	42	45	2,488
F6	42	36	4.225	35	37	4.475	4.350	38	36	2,000
F7	41	41	4.700	28	30	4.625	4.668	34	35	2,146
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 24. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is furrows.

Location Parcela 90-Guanare	Soil texture Clay
Strip code No. NH, NJ	Planting date May 9, 1970
Variety Foremaiz-1	Grain, % H_2O at harvest 17.5
Row width 76 cm	Harvested lot size 14m X 1.52m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	66	62	6.588	62	58	7.825	7.206	64	60	3,313
F1	67	47	5.125	60	67	7.600	6.363	64	57	2,925
F2	56	50	5.838	58	56	7.800	6.819	57	53	3,134
F3	50	51	6.088	58	57	7.700	6.894	54	54	3,168
F4	80	72	5.725	63	59	8.413	7.069	71	65	3,248
F5	84	57	6.475	74	83	9.200	7.838	79	70	3,600
F6	65	67	7.375	65	69	8.825	8.100	65	68	3,724
F7	86	60	5.250	63	60	8.80	7.025	74	60	3,230
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations

†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 25. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is beds.

Location Parcela 90-Guanare	Soil texture Clay
Strip code No. NF, NG	Planting date May 9, 1970
Variety Foremaiz-1	Grain, % H_2O at harvest 17.5
Row width 76 cm	Harvested lot size 14m X 1.52m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	58	53	5.313	66	43	3.925	4.619	62	48	2,120
F1	63	59	5.700	71	56	4.050	4.875	67	57	2,240
F2	58	53	6.188	66	52	5.550	5.869	62	52	2,696
F3	61	40	4.800	71	45	5.238	5.019	66	42	2,306
F4	51	40	5.063	63	45	3.863	4.463	57	42	2,050
F5	47	38	4.225	67	42	4.000	4.113	57	40	1,890
F6	62	52	4.600	71	40	5.475	5.038	67	46	2,314
F7	54	42	4.875	46	48	6.225	5.550	50	45	2,550
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Tables 26 and 27 illustrate differences in number of plants from thinning time to harvest. Several of the best and of the poorest borders are listed with numbers for each plot and variety. The remaining borders have only totals for the border for each variety.

It is evident that important losses of 25 to 55% occur in the number of plants between age one month and harvest time (5 months). Border NE (planted on the flat) was thinned to 47,500 plants/ha but at harvest had only 28,500/ha. Harvested ears were yet less, only 22,800/ha.

Table 27 tabulates totals for all borders with the number of harvested ears included. The most noticeable factor is the low number of plants at thinning time for borders NF - NK. These are all May 9 plantings, 2 weeks later than borders NA - NE. The 4 weeks following May 9 were abnormally dry resulting in poor stands, not thick enough to thin. Even with thin stands of 30,000 plants/ha, there were plant losses by harvest time of 20% and 30% in many of the borders. There seemed to be little effect of land form or fertilizer treatment on these losses.

Table 26. Differences in counted corn plants per plot at thinning (Thin.) and at harvest (Harv.) in Parcela 90, Portuguesa State, Venezuela. Two good borders and two poor borders shown.

Plot sequence	Border NC		Border NE		Border NF		Border NJ	
	No. of plants*		No. of plants		No. of plants		No. of plants	
	Thin.	Harv.	Thin.	Harv.	Thin.	Harv.	Thin.	Harv.
1 Top	103	73	103	52	78	42	36?	47?
2	103	78	103	53	85	45	44?	40
3	103	88	103	57	42	49?	60	39
4	103	84	103	68	73	40	50	49
5	103	75	103	72	91	50	40	41
6	103	74	103	68	81	44	40?	45?
7	103	72	103	41	96	50	46	51?
8 Bottom	103	79	103	72	58	51	44	33
Total	824	623	824	483	604	371	360	345

*96 plants/plot equals 45,000 plants/ha.; 106 = 50,000.

Table 27. Differences in counted corn plants per border (8 plots) at thinning (Thin.) time and at harvest (Harv.) and of ears harvested in Parcela 90, Portuguesa State, Venezuela.

Border identity	Variety Obregon			Variety Goremaiz-1		
	No. of plants		Ears	No. of plants		Ears
	Thin.	Harv.	Harv.	Thin.	Harv.	Harv.
NA Beds	810	566	530	785	485	447
NB Beds	650	396	411	665	440	405
NC Furrows	824	623	549	824	548	479
ND Furrows	824	604	540	824	538	429
NF Planar	824	483	386	824	570	(FO lost) 406
NF Beds	604	371	340	451	431	366
NG Beds	527	436	430	705	522	368
NH Furrows	515	388	217	577	486	403
NK Planar	484	412	364	657	476	431
NJ Furrows	360	345	338	583	511	516

Equivalent densities of numbers per border:

814 = 47,000/ha 594 = 35,000/ha
703 = 41,500/ha 508 = 30,000/ha

Sabaneta Plantings 1970

Sabaneta corn trials were supervised by R. W. Miller and Evaristo Martinez, the parcela engineer. Field work and Production was supervised primarily by E. Martinez and Perito Chapon.

The results of the corn harvest are shown in figures 12,13, and 14 and details are given in tables 28 through 43. The results are similar to those of other stations, i.e., yields are dependent on densities (number of ears harvested), and there is no clear effect of fertilized applications. There is also no clear influence of land form although more average values for furrow plantings are to the left of the line (lower yield for a given number of ears) than for other land forms.

Yields are generally good if harvest densities were good. Thinning to 45,000 plants per hectarea would be 95 to 96 plants per harvested lot. These should, as a minimum, produce 90 to 100 ears (many plants produce a second good ear). The data in figure 14 indicate good yields of 7000 to 3000 Kg/ha are common if the number of harvested ears are near 45,000 to 50,000/ha. Even unfertilized plots yield well. In 1969 a large 2 hectarea planting unfertilized on the same land area had a yield of near 4600 Kg/ha. However, density was not measured. Portions of the field had heavy lodging and blowdown. Undoubtedly, yields could have been somewhat higher. It seems realistic to predict common yields of 6000 to 8000 Kg/ha with proper density and some fertilizer additions.

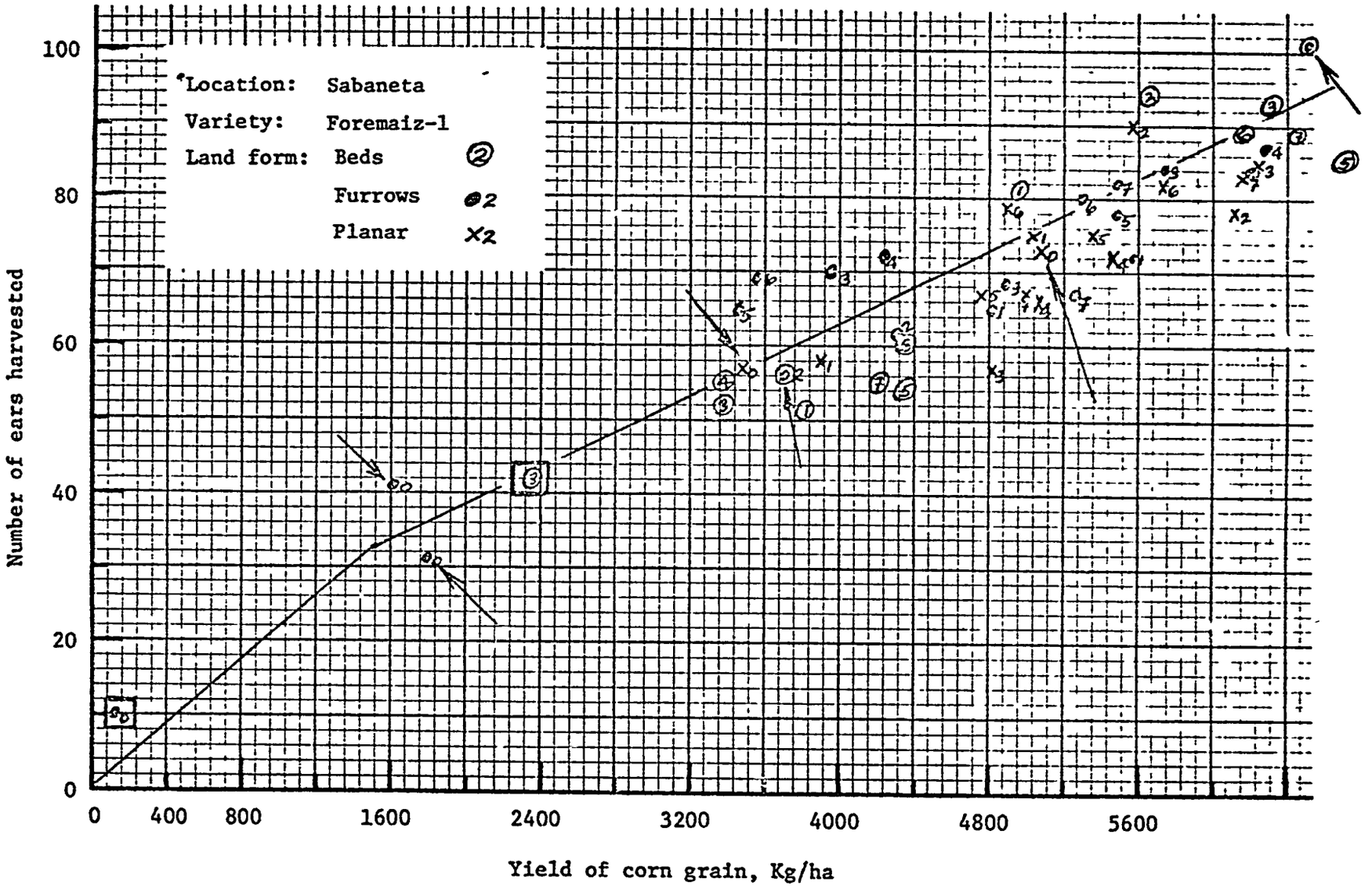


Figure 12. Relationship yield of corn grain to the number of harvested ears. Points in squares are individual points (not averages) to illustrate extremes. Arrows show control plots.

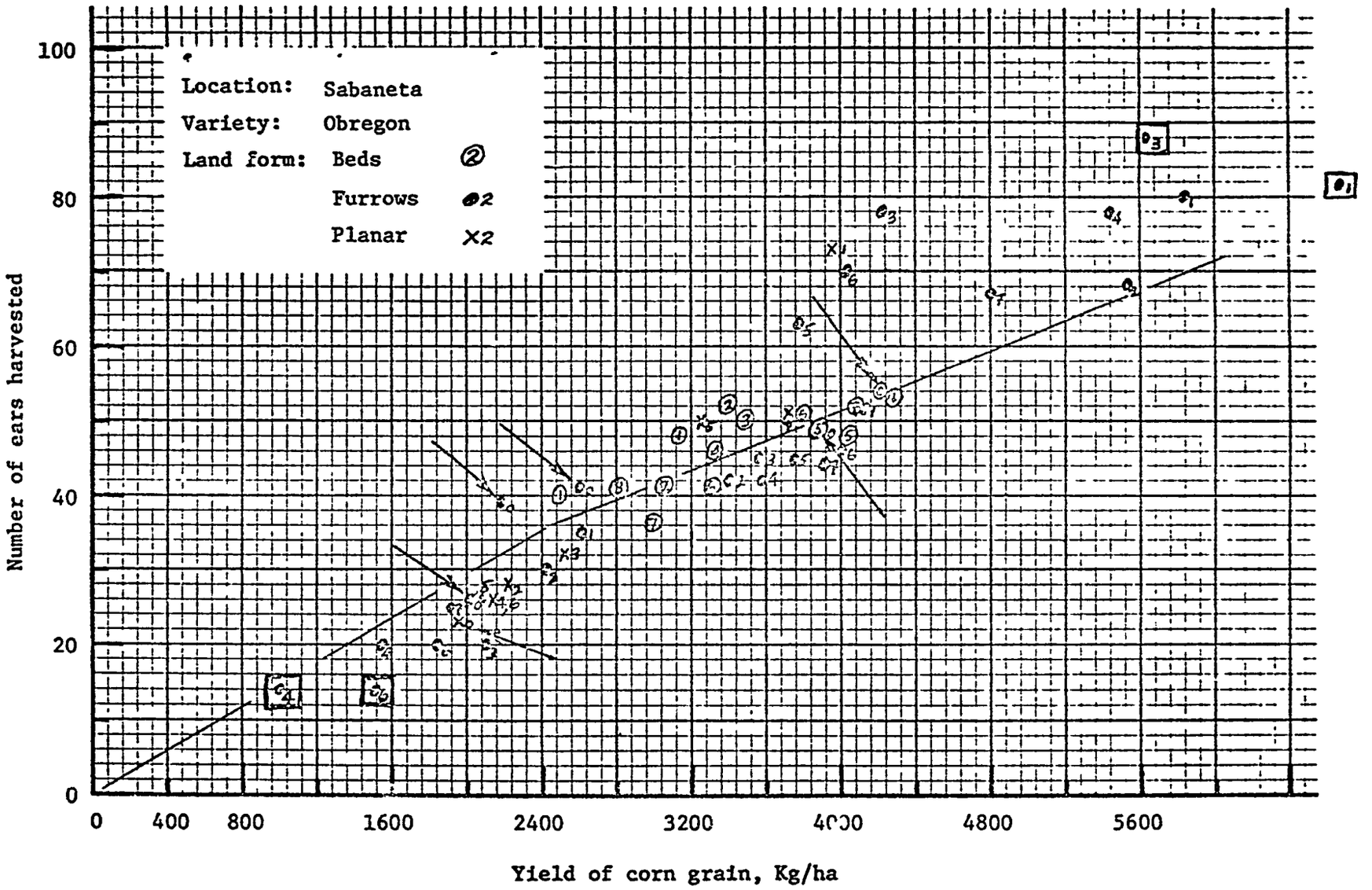


Figure 13. Relationship yield of corn grain to the number of harvested ears. Points in squares are individual points (not averages) to illustrate extremes. Arrows show control plots.

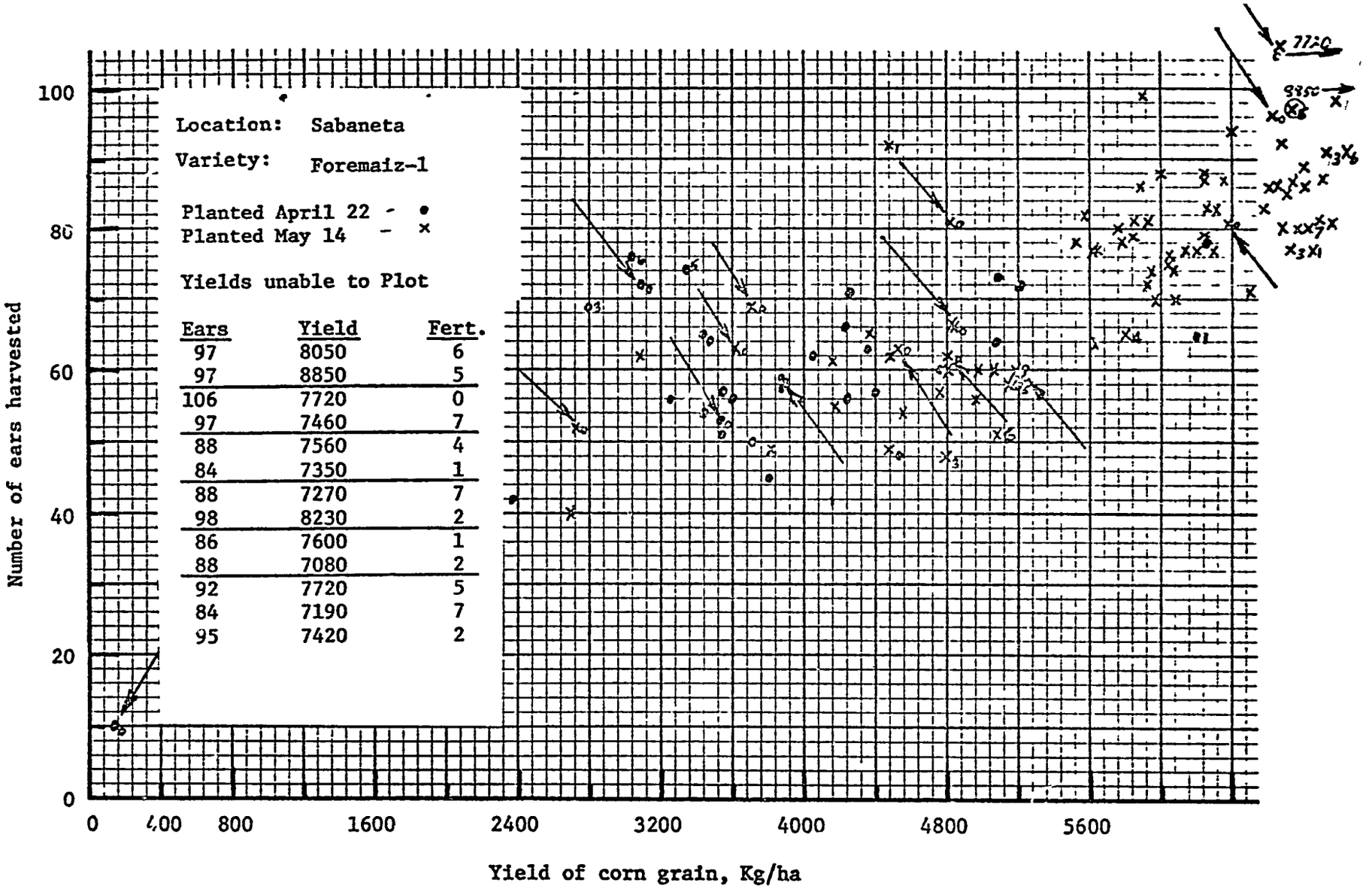


Figure 14. Relationship yield of corn grain to the number of harvested ears. Individual plot data. Arrows indicate control (0 fertilizer) plots.

Table 28. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is beds.

Location Sabaneta	Soil texture Loam
Strip code No. SA, SB	Planting date April 22
Variety Foremaiz - 1	Grain, % H_2O at harvest 16.0
Row width 1.40m for 2 rows	Harvested lot size 14m x 1.40

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	65	53	7.000	54	59	7.650	7.325	60	56	3706
F_1	50	45	7.500	62	58	7.650	7.575	56	51	3833
F_2	62	48	8.950	56	64	6.850	7.400	59	56	3700
F_3	58	42	4.675	63	63	8.575	6.625	60	52	3352
F_4	63	54	6.800	60	56	6.450	6.625	61	55	3352
F_5	47	51	7.000	63	58	10.275	8.637	55	54	4370
F_6	62	64	10.050	63	56	7.100	8.575	62	60	4339
F_7	57	60	9.400	48	50	7.300	8.350	52	55	4225

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 29. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is furrows.

Location Sabaneta

Strip code No. SC, SD

Variety Foremaiz - 1

Row width 70 cm

Soil texture Loam

Planting date April 22, 1970

Grain, % H_2O at harvest 16.0

Harvested lot size 14m x 1.40m = 19.60m^2 = x 510

Fert-lizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	77	10	0.300	86	72	6.100	3.200	81	41	1619
F_1	79	65	6.800	73	65	12.250	9.525	76	65	4820
F_2	69	66	8.350	63	57	8.700	8.525	66	61	4314
F_3	77	69	5.375	82	72	10.300	7.837	82	70	3966
F_4	82	73	8.350	89	71	8.425	8.387	89	72	4243
F_5	65	57	7.050	77	74	6.600	6.827	71	65	3454
F_6	83	62	8.000	83	76	6.000	7.000	83	69	3542
F_7	74	56	8.375	88	78	12.400	10.387	81	67	5256

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations

†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

The bad sandy and packed area hit Rep. 1 in F_0, F_3, F5; and Rep. 2, F_5, F_6, F_4.

Table 30. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is beds.

Location Sabaneta	Soil texture Loam
Strip code No. SE, SF	Planting date May 14, 1970
Variety Foremaiz - 1	Grain, % H_2O at harvest 18.0
Row width 76 cm	Harvested lot size 14m x 1.52 = 21.28 = x 470

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	81	66	9.575	91	81	12.600	11.087	86	73	5078
F_1	86	65	8.600	88	86	13.400	11.000	87	75	5038
F_2	100	86	11.600	77	94	12.625	12.112	88	90	5547
F_3	83	77	13.350	93	91	13.950	13.625	93	85	6240
F_4	76	70	12.000	85	75	11.900	11.950	80	72	5473
F_5	78	57	9.400	87	78	11.400	10.400	78	67	4763
F_6	98	74	11.725	76	90	14.100	12.762	94	82	5745
F_7	100	80	13.750	81	86	13.150	13.450	90	83	6160

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 31. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is beds.

Location Sabaneta	Soil texture Loam
Strip code No. SG, SH	Planting date May 14, 1970
Variety Foremaiz - 1	Grain, % H_2O at harvest 18.0
Row width 76 cm	Harvested lot size 14 x 1.52 = 21.28 = x 470

Fertlizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	110	96	13.100	94	106	15.250	14.175	102	101	6492
F_1	89	71	12.825	112	92	8.850	10.837	100	81	4963
F_2	110	99	11.675	96	89	13.050	12.362	103	94	5662
F_3	104	98	13.950	75	89	13.700	13.825	89	93	6332
F_4	100	87	13.600	100	80	13.350	13.475	100	83	6182
F_5	95	74	11.975	102	97	17.475	14.725	98	85	6744
F_6	94	82	11.000	93	97	15.900	13.450	93	89	6160
F_7	98	81	13.450	102	97	14.750	14.100	100	89	6458

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 32. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is furrows.

Location Sabaneta — Soil texture Loam

Strip code No. SI,SJ — Planting date May 14, 1970

Variety Foremaiz - 1 — Grain, % H_2O at harvest 18.0

Row width 76 cm — Harvested lot size 14m x 1.52 = 21.28m^2 = x 470

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	53	-	0.800	82	63	7.150	3.975	67	31	1825
F_1	83	60	9.825	93	84	14.500	12.162	93	72	5570
F_2	87	87	13.400	88	81	11.550	12.475	87	84	5734
F_3	77	54	8.950	91	83	12.400	10.675	84	68	4891
F_4	81	88	14.925	92	87	12.525	13.725	86	87	6286
F_5	66	72	11.700	91	87	12.275	11.987	78	78	5488
F_6	90	80	11.425	91	81	11.700	11.562	90	80	5295
F_7	80	78	10.925	88	86	13.050	11.987	84	82	5500

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Rep. 1 (SI) had very poor soil at sites F0, F3 and (?) F5
Rep. 2 (SJ) had very poor soil at sites F5, F6 and (?) F4
} is far enough away for smaller effect than in SC, SD.

Table 33. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is furrows.

Location Sabaneta	Soil texture Loam
Strip code No. SK,SL	Planting date May 14, 1970
Variety Foremaiz - 1	Grain, % H_2O at harvest 18.0
Row width 76 cm	Harvested lot size 14m x 1.52 m.

Fert-lizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	85	69	7.300	58	62	9.475	8.387	71	65	4340
F_1	75	77	12.450	75	81	13.700	13.075	75	79	5988
F_2	75	80	13.125	100	98	16.250	14.687	87	88	6727
F_3	64	70	11.750	84	-	12.000	11.875	74	70	5439
F_4	83	88	11.875	68	77	12.250	12.062	75	82	5524
F_5	58	58	10.150	82	92	13.150	11.650	70	75	5336
F_6	73	51	11.100	51	58	10.250	10.675	62	54	4689
F_7	86	88	14.350	76	79	12.325	13.337	81	83	6108

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 34. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Planar

Location Sabaneta	Soil texture Loam
Strip code No. SP,SQ	Planting date May 14, 1970
Variety Foremaiz -1	Grain, % H_2O at harvest 18.0
Row width 76 cm	Harvested lot size 14m x 1.52m

Fert-lizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	66	81	9.500	54	64	10.925	10.212	60	72	4677
F_1	70	86	15.000	59	76	13.200	14.100	64	81	6458
F_2	84	88	14.000	66	76	11.950	12.975	75	72	5943
F_3	46	56	9.750	75	83	12.950	11.350	60	68	5198
F_4	65	77	12.100	48	65	11.475	11.787	56	71	5398
F_5	75	92	15.275	70	62	6.100	10.187	72	77	4675
F_6	47	60	10.025	60	85	13.000	11.512	53	72	5272
F_7	62	84	14.200	58	64	11.100	12.650	60	74	6793

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 35 Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Planar

Location Sabaneta	Soil texture Loam
Strip code No. SM,SN	Planting date May 14, 1970
Variety Foremaiz - 1	Grain, % H_2O at harvest 18.0
Row width 67 cm	Harvested lot size 14m x 1.52m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	100	52	5.350	61	63	9.850	7.600	80	57	3480
F_1	74	77	11.120	35	40	5.900	8.510	54	58	3895
F_2	83	95	16.200	69	62	10.500	13.350	76	78	6114
F_3	68	48	10.475	72	66	10.600	10.537	70	57	4826
F_4	79	83	13.750	52	49	8.350	11.050	65	66	5061
F_5	60	88	13.600	65	62	9.775	11.687	62	75	5353
F_6	69	77	12.250	66	61	9.100	10.675	67	79	4896
F_7	75	79	12.725	52	55	9.100	10.912	63	67	5002

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 36. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Beds

Location Sabaneta	Soil texture Loam
Strip code No. SA, SB	Planting date April 22, 1970
Variety Obregon	Grain, % H_2O at harvest 16.0
Row width 1.40m for 2 rows	Harvested lot size 14m x 1.40

Fertlizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	59	61	8.575	60	48	8.100	8.338	59	54	4219
F_1	51	52	6.900	60	44	5.575	6.238	55	48	3156
F_2	47	48	6.700	44	56	6.750	6.725	45	52	3403
F_3	43	32	4.100	61	69	9.750	6.925	52	50	3504
F_4	46	42	5.950	63	50	7.250	6.600	54	46	3340
F_5	41	45	6.250	43	54	9.100	7.650	42	49	3871
F_6	58	58	9.100	58	46	5.850	7.475	58	52	3782
F_7	50	-	-	67	52	8.070	8.070	67	52	4083

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 37. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Furrows.

Location Sabaneta	Soil texture Loam
Strip code No. SC, SD	Planting date April 22, 1970
Variety Obregon	Grain, % H_2O at harvest 16.0
Row width 70 cm	Harvested lot size 14m x 1.40m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	116	9	0.500	77	69	8.125	4.312	96	39	2182
F_1	81	78	10.00	76	82	13.175	11.587	78	80	5863
F_2	102	80	10.450	79	57	11.400	10.925	90	68	5528
F_3	89	68	5.650	90	88	11.100	8.375	89	78	4238
F_4	87	71	10.800	85	85	10.725	10.762	86	78	5446
F_5	88	72	9.675	63	55	5.300	7.489	75	63	3788
F_6	84	73	10.050	63	67	5.900	7.975	73	70	4035
F_7	76	67	9.500	76	67	9.500	9.500	76	67	4807

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

The very poor, sandy area included in Rep. 1, F_0, F_3, F_5 (?) and in Rep. 2, F_5, F_6, and (?) F4.

Table 38. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Beds

Location Sabaneta	Soil texture Loam
Strip code No. SE, SF	Planting date May 14, 1970
Variety Obregon	Grain, % H_2O at harvest 18.0
Row width 76 cm	Harvested lot size 14m x 1.52 = 21.28m^2

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	42	41	7.250	50	57	9.725	8.487	46	49	3887
F_1	45	44	7.525	27	36	3.350	5.437	36	40	2490
F_2	37	38	6.850	33	44	6.525	6.687	35	41	3063
F_3	36	49	6.700	32	33	5.650	6.175	34	41	2828
F_4	39	42	7.875	51	64	10.850	9.362	45	53	4289
F_5	46	50	8.650	48	46	8.950	8.800	47	48	4030
F_6	43	38	7.250	29	44	7.150	7.200	36	41	3298
F_7	37	27	5.400	33	46	7.750	6.575	35	36	3011

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigating
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 39. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Beds

Location Sabaneta	Soil texture Loam
Strip code No. SG, SH	Planting date May 14, 1970
Variety Obregon	Grain, % H_2O at harvest 18.0
Row width 76 cm	Harvested lot size 14 x 1.52 = 21.28m^2 = y 470

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	44	50	7.800	27	28	6.100	6.950	35	39	3183
F_1	27	32	6.200	46	47	6.675	6.437	36	39	2948
F_2	43	55	7.700	32	36	6.375	7.037	37	45	3223
F_3	38	57	9.025	25	35	6.475	7.750	31	46	3550
F_4	48	52	9.425	42	45	7.800	8.612	45	48	3944
F_5	37	55	9.250	48	51	9.450	9.350	42	53	4282
F_6	38	44	8.375	46	50	8.600	8.488	42	47	3888
F_7	27	37	4.750	27	38	6.800	5.775	27	37	2645

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 40. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Furrow.

Location Sabaneta — Soil texture Loam

Strip code No. SI, SJ — Planting date May 14, 1970

Variety Obregon — Grain, % H_2O at harvest 18.0

Row width 76 cm — Harvested lot size 14m x 1.52 = 21.28m^2 = x 470

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	51	39	4.600	46	44	6.800	5.700	48	41	2611
F_1	49	55	8.925	46	50	9.000	8.962	47	52	4105
F_2	43	44	8.000	37	39	6.900	7.450	40	42	3412
F_3	46	48	7.700	40	42	7.875	7.787	43	45	3566
F_4	38	39	7.600	47	45	8.025	7.812	42	42	3578
F_5	46	44	7.975	43	46	8.400	8.188	44	45	3750
F_6	48	47	9.025	41	46	8.450	8.737	44	46	4002
F_7	48	52	9.475	39	36	7.600	8.537	43	44	3910

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations

†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 41. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Furrow

Location Sabaneta	Soil texture Loam
Strip code No. SK, SL	Planting date May 14, 1970
Variety Obregon	Grain, % H_2O at harvest 18.0
Row width 76 cm	Harvested lot size 14m x 1.52m

Fertlizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	27	26	3.450	23	26	5.550	4.500	25	26	2061
F_1	35	42	6.800	25	28	4.650	5.725	30	35	2622
F_2	34	34	6.000	29	26	4.600	5.300	31	30	2427
F_3	14	20	5.450	23	20	3.775	4.612	18	20	2112
F_4	26	27	4.750	12	14	2.000	3.375	19	20	1546
F_5	21	22	4.250	31	30	4.850	4.550	26	26	2084
F_6	21	27	5.050	18	14	3.000	4.025	19	20	1843
F_7	16	32	5.250	19	18	3.150	4.200	17	25	1924

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 42. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Planar.

Location Sabaneta	Soil texture Loam
Strip code No. SM, SN	Planting date May 14, 1970
Variety Obregon	Grain, % H_2O at harvest 18.0
Row width 76 cm	Harvested lot size 14m x 1.52m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	39	36	4.500	23	11	4.000	4.250	31	23	1947
F_1	35	70	6.825	85	77	10.450	8.637	60	73	3956
F_2	26	24	4.650	32	33	5.100	4.875	29	28	2233
F_3	20	24	3.750	37	40	7.275	5.512	28	32	2524
F_4	29	31	6.000	24	21	3.350	4.675	26	26	2141
F_5	19	22	3.875	93	78	10.350	7.112	56	50	3257
F_6	21	23	4.400	29	30	5.050	4.725	25	26	2164
F_7	34	34	7.100	74	68	9.150	8.125	54	51	3721

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 43. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is Planar.

Location Sabaneta	Soil texture Loam
Strip code No. SP, SO	Planting date May 14, 1970
Variety Obregon	Grain, % H_2O at harvest 18.0
Row width 76 cm	Harvested lot size 14m x 1.52m

Fert-lizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F_0	39	42	6.500	30	33	6.650	6.575	34	37	3011
F_1	29	29	5.800	34	40	6.250	6.025	31	34	2759
F_2	22	24	4.900	40	27	5.300	5.100	31	25	2336
F_3	22	24	3.550	36	43	7.150	5.350	29	33	2450
F_4	23	21	3.275	25	24	4.300	3.785	24	22	1734
$F_5$1	28	34	6.700	32	34	4.250	5.475	30	34	2508
F_6	25	26	4.875	30	33	5.500	5.187	27	29	2376
F_7	18	18	3.300	33	35	5.800	4.550	25	26	2084

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting; rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Las Majaguas Plantings - 1970

Supervision of the Las Majaguas corn trials was by R. W. Miller and A. Bustillos, the parcela engineer. Field work and production was supervised primarily by Ing. Bustillos and perito A. Guilarte.

The results of corn harvest are shown in figures 15-18 and details in tables 44 through 53. The average number of ears per plot seem at first impression to be greater than in the other field studies. This is not correct. The sample plots in La Majaguas were larger than in the other fields (90cm row spacing x 14m length). Harvested ears were equivalent to a plant density nearer 25,000 to 30,000 plants/ha than to the "standard" 45,000 planned and the 55,000 higher density comparison plots.

In figure 15, the shape of the line through the origin and the three control plots has a more marked curvature than has been evident in the other trials. It is even markedly different from the Foremaiz-1 variety planted in the same subplots (compare with fig. 16). No explanation is proposed for this. The points enclosed in blocks are individual plot yields with a low number of harvested ears. These are plotted to illustrate the fit of points to the control plot reference line. Individual plot data used for the averages plotted in figure 16 are plotted individually in figure 17. The straight line relationship is unexpectedly good. One interpretation of this relation is that at the densities harvested (less than 35,000 ears/ha), plant competition is not sufficient to have much influence on plant growth. A similar plot (fig. 18) of individual plot data for the variety Obregon has

the more expected curvilinear pattern, but with a heavy scatter of points at higher yield levels.

There is a dominance of plots from planting in 2-row beds to the right of the arbitrarily drawn line. This indicates higher yields per given density for plantings in such beds. In contrast, planting in furrows caused lower relative yields. Visual growth of the corn in these plots verify the harvest data. For example, one half of the furrowed plots were lost because of poor drainage. Very little loss of plants were noticed nor was much replanting necessary in the plots planted with the 2-row beds.

The effect of fertilizer is not at all evident. The soils of this field have a low phosphorus availability test. It may be that both phosphorus and nitrogen must be added to obtain obvious growth responses. No plots were tried to test this. Also yields of Foremaiz-1 exptrapolate at a density of 28,000 ears/ha to have a yield near 3600 Kg/ha. Obregon had a lower yield, about 2,900 Kg/ha at that density.

The climate data for Las Majaguas during corn growth is shown in figure 19 and table 54. It is evident that there was no shortage of moisture during corn growth. Rainfall exceeded total pan evaporation in all but two time intervals. Excess water was a problem in some plots, particularly those toward the bottom half of the field. Low numbers of harvested ears in the plots intended to have 55,000 plants/ha are evidences of these problems of drainage. This wetness is probably the reason that yields of plots with beds are more often larger than

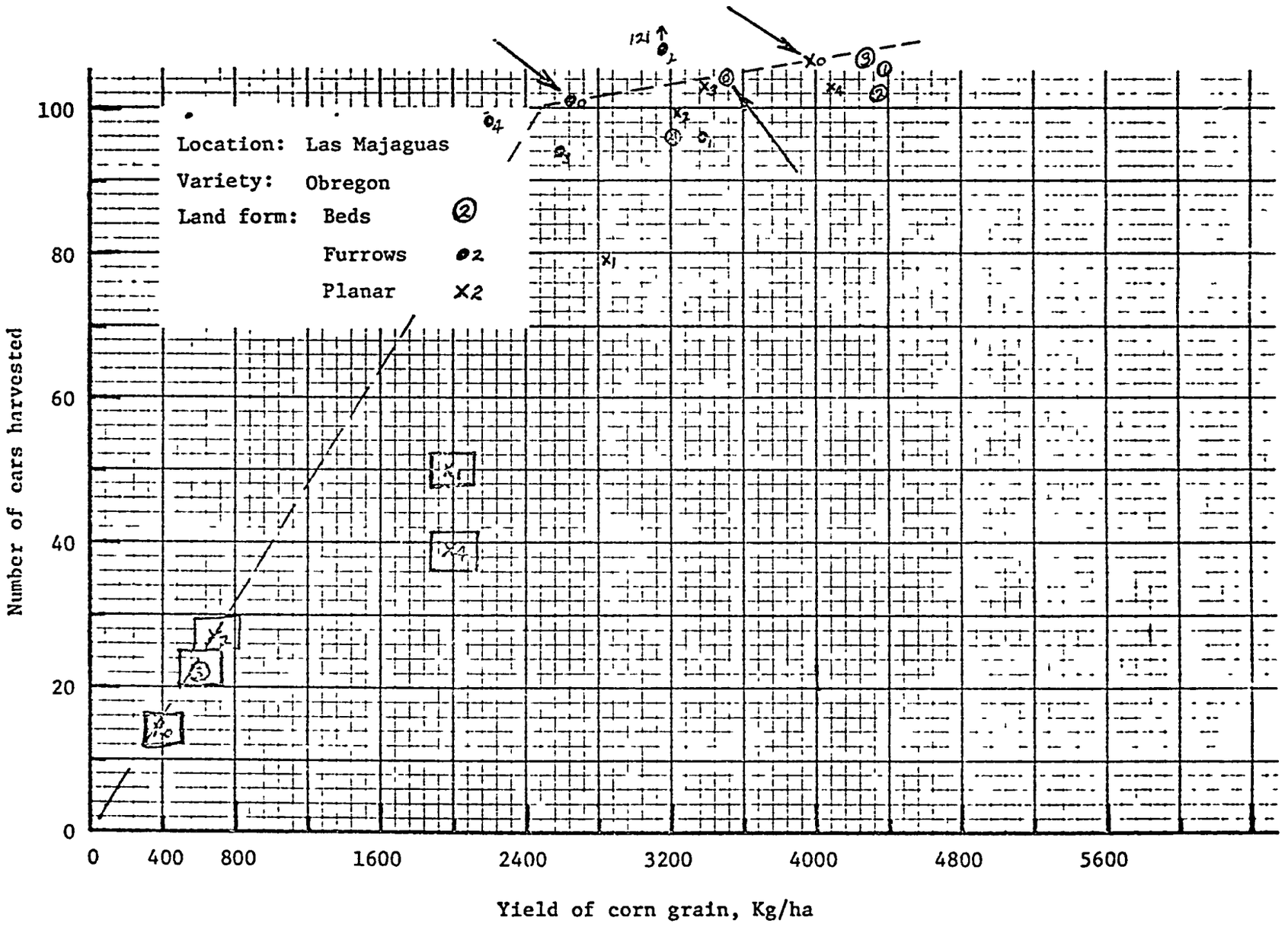


Figure 15. Relationship yield of corn grain to the number of harvested ears. A value of 100 ears/plot equals 30,900 ears/ha.

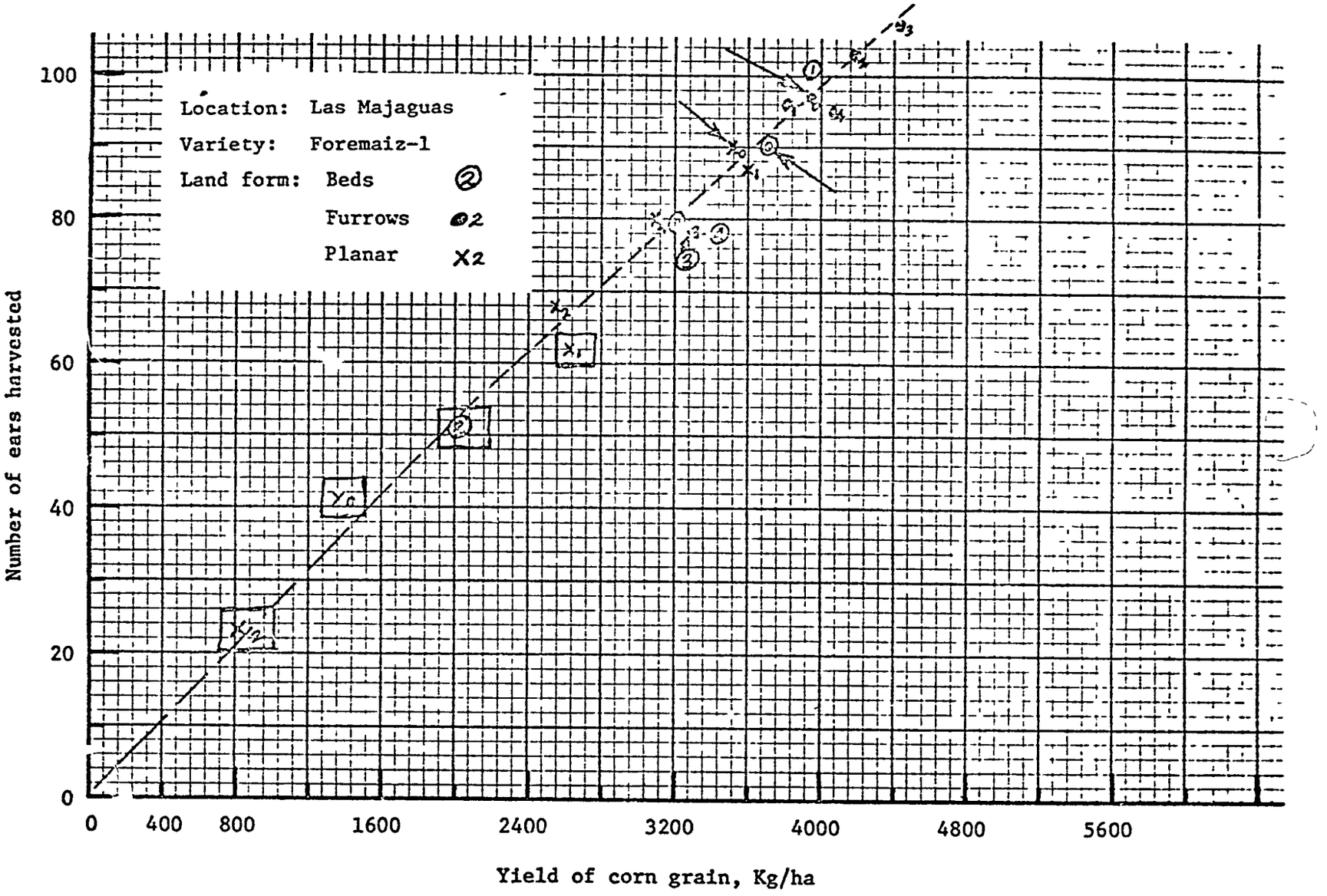


Figure 16. Relationship yield of corn grain to the number of harvested ears. A value of 100 ears/plot equals 30,900 ears/ha.

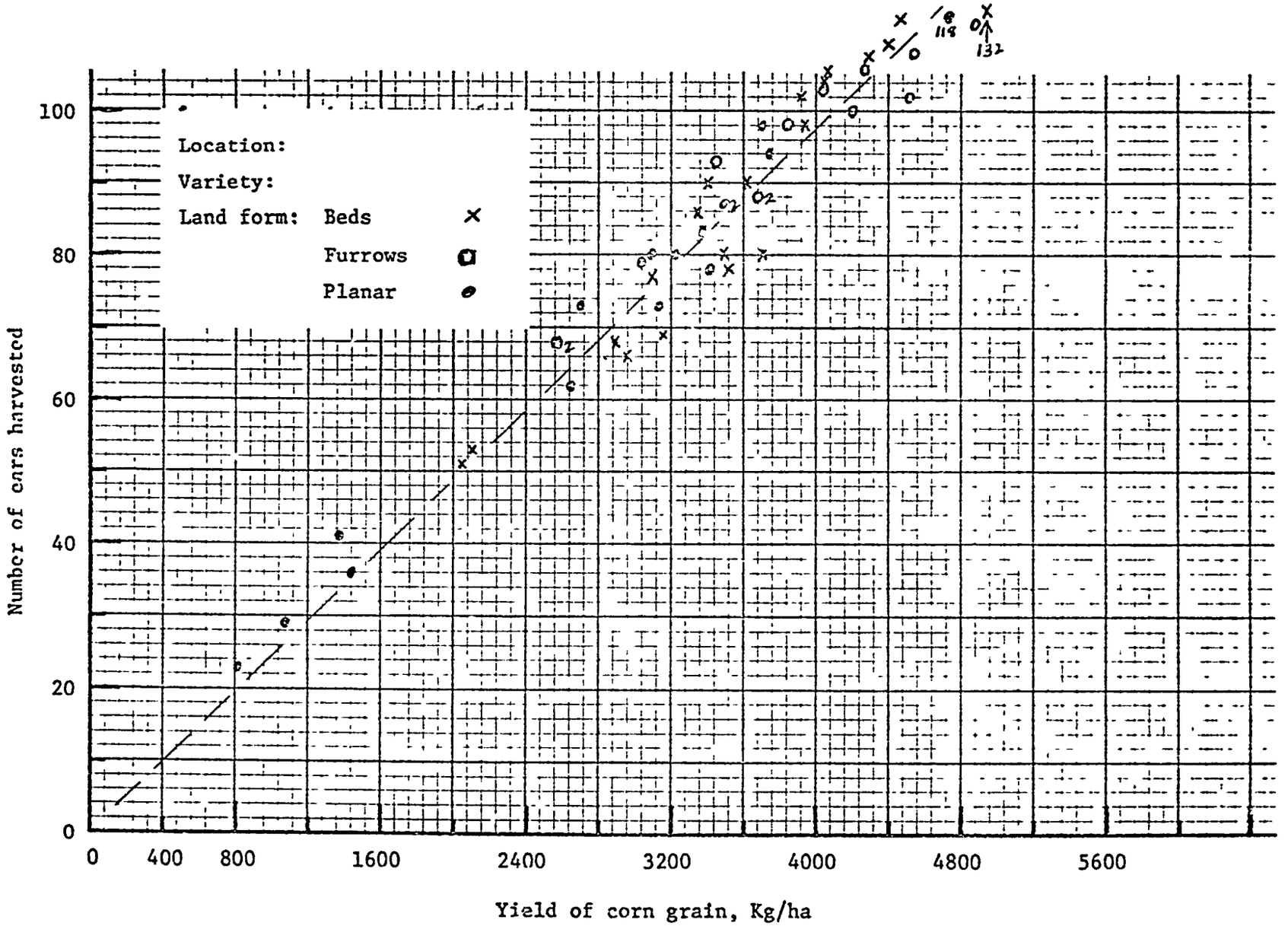


Figure 17. Relationship yield of corn grain to the number of harvested ears. Individual plot yields. A value of 100 ears/plot equals 30,900 ears/ha.

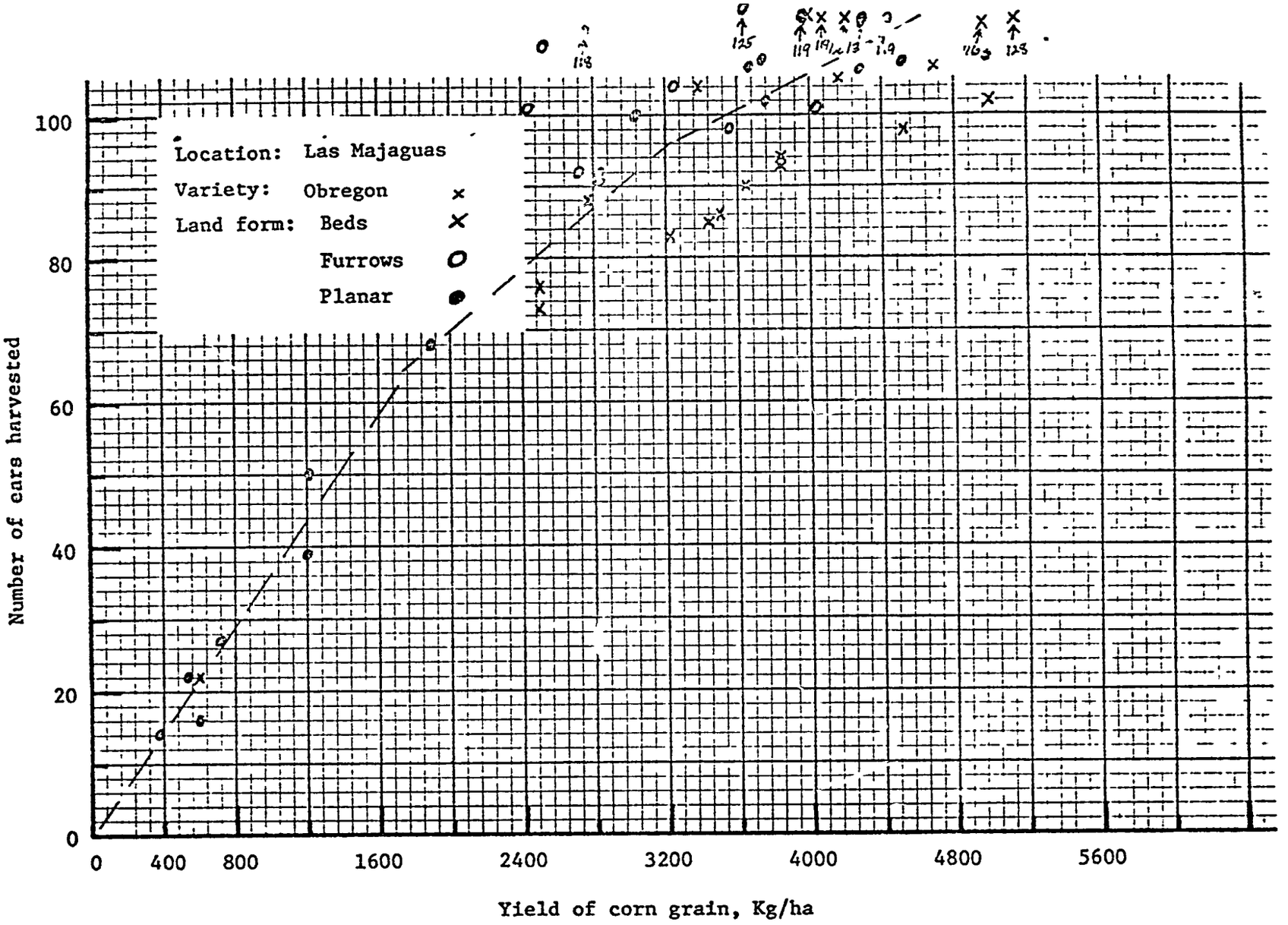


Figure 18. Relationship yield of corn grain to the number of harvested ears. Individual plot yields. A value of 100 ears/plot equals 30,900 ears/ha.

Table 44. Tabulation of all yields for fertilizer treatments on corn having the land form* of beds.

Variety Obregon, Row width 90 cm, Location Las Majaguas, Soil texture Loamy Clay

Plot code No.	Fertilizer-	Data of Replications										Average ears No./ha	Yield Average 15% H_2O Kg/ha
		Planting date May 5, 1970				Ave. Yield, Kg	Planting date May 5, 1970 ±				Ave. Yield, Kg		
		Replicate 1		Replicate 2			Replicate 1		Replicate 2				
		Number of ears	Yield, Kg	Number of ears	Yield, Kg		Number of ears	Yield, Kg	Number of ears	Yield, Kg			
	F0	120	14.000	88	9.200	11.600	102	16.600	105	13.800	15.200	32,100	4,030
	F1	94	12,800	116	16.500	14.650	93	12.800	119	13.500	13.150	32,600	4,180
	F2	98	15.000	107	15.500	15.250	90	12.100	73	8.300	10.200	28,400	3,830
	F3	128	17.000	86	11.600	14.300	85	11.400	22	2.000	6.700	24,700	3,160
	F4	117	13.100	76	8.300	10.700	83	10.700	104	11.200	10.950	29,300	3,260
	Total												

*Beds (camas) of 2-rows wide, furrows (fur.) 76 cm wide, and planted on the flat (planar).
-Fo = no fertilizer, in sequence F1 - F5 = 30, 60, 100, 140, 180 Kg N per hectarea. F6 = 100 Kg N with 40 Kg at flowering (tassle); F7 = 140 Kg N with 40 Kg at tassle. F2 - F5 had 30 Kg at seeding, the rest after 35 days. Also, F6 and F7 had 30 Kg at seeding, rest except 40 Kg at 35 days after seeding.
± Planted for density of 55,000 plants/ha.

Table 45. Tabulation of all yields for fertilizer treatments on corn having the land form* of planar.

Variety Obregon, Row width 90 cm, Location Las Majaguas, Soil texture Loamy clay

Plot code No.	Fertilizer-	Data of Replications										Average ears No./ha	Yield Average 15% H_2O Kg/ha
		Planting date May 5, 1970					Planting date May 5, 1970 ‡						
		Replicate 1		Replicate 2		Ave. Yield, Kg	Replicate 1		Replicate 2		Ave. Yield, Kg		
		Number of ears	Yield, Kg	Number of ears	Yield, Kg		Number of ears	Yield, Kg	Number of ears	Yield, Kg			
	F0	106	14.200	108	12.400	13.300	14	1.300	16	2.000	1.650	18,800	2,250
	F1	108	15.000	50	4.000	9.500	68	6.300	135	14.300	10.300	27,850	2,980
	F2	92	9.400	107	12.200	10.800	27	2.400	98	11.800	7.100	25,000	2,695
	F3	100	10.100	102	12.500	11.300	21	1.800	119	14.800	8.300	26,700	2,945
	F4	99	10.800	108	16.500	13.650	119	13,200	39	4.000	8.600	26,600	3,355
	Total												

*Beds (camas) of 2-rows wide, furrows (fur.) 76 cm wide, and planted on the flat (planar).

-Fo = no fertilizer, in sequence F1 - F5 = 30, 60, 100, 140, 180 Kg N per hectarea. F6 = 100 Kg N with 40 Kg at flowering (tassle); F7 = 140 Kg N with 40 Kg at tassle. F2 - F5 had 30 Kg at seeding, the rest after 35 days. Also, F6 and F7 had 30 Kg at seeding, rest except 40 Kg at 35 days after seeding.

‡Planted for density of 55,000 plants/ha.

Table 46. Tabulation of all yields for fertilizer treatments on corn having the land form* of beds.

Variety Foremaiz-1, Row width 90 cm, Location Las Majaguas, Soil texture Loamy clay

Plot code No.	Fertilizer+	Data of Replications										Average ears No./ha	Yield Average 15% H_2O Kg/ha
		Planting date May 5, 1970					Planting date May 5, 1970 ‡						
		Replicate 1		Replicate 2		Ave. Yield, Kg	Replicate 1		Replicate 2		Ave. Yield, Kg		
		Number of ears	Yield, Kg	Number of ears	Yield, Kg		Number of ears	Yield, Kg	Number of ears	Yield, Kg			
	F0	102	13.000	78	11.700	12.350	108	14.150	53	7.000	10.575	26,200	3,445
	F1	104	13.400	98	13.100	13.250	132	16.400	69	10.500	13.450	31,200	4,015
	F2	90	12.000	68	9.600	10.300	105	13.500	51	6.800	10.150	24,200	3,075
	F3	80	11.600	77	10.300	10.950	114	14.800	86	11.100	12.950	27,500	3,595
	F4	80	12.300	76	10.100	11.200	110	14.600	90	11.300	12.950	27,500	3,630
	Total												

*Beds (camas) of 2-rows wide, furrows (fur.) 76 cm wide, and planted on the flat (planar).

+Fo = no fertilizer, in sequence F1 - F5 = 30, 60, 100, 140, 180 Kg N per hectarea. F6 = 100 Kg N with 40 Kg at flowering (tassle); F7 = 140 Kg N with 40 Kg at tassle. F2 - F5 had 30 Kg at seeding, the rest after 35 days. Also, F6 and F7 had 30 Kg at seeding, rest except 40 Kg at 35 days after seeding.

‡Planted for a density of 55,000

Table 47. Tabulation of all yields for fertilizer treatments on corn having the land form* of planar.

Variety Foremaiz-1, Row width 90 cm, Location Las Majaguas, Soil texture Loamy Clay

Plot code No.	Fertilizer†	Data of Replications										Average ears No./ha	Yield Average 15% H_2O Kg/ha
		Planting date May 5, 1970					Planting date May 5, 1970 ‡						
		Replicate 1		Replicate 2		Ave. Yield, Kg	Replicate 1		Replicate 2		Ave. Yield, Kg		
		Number of ears	Yield, Kg	Number of ears	Yield, Kg		Number of ears	Yield, Kg	Number of ears	Yield, Kg			
	F0	98	12.300	83	11.200	11.750	36	4.800	41	4.500	4.650	19,800	2,465
	F1	87	11.600	87	12.400	12.000	94	12.400	62	8.800	10.400	25,450	3,370
	F2	68	8.500	68	8.500	8.500	23	2.700	29	3.600	3.150	15,280	1,750
	F3	80	10.300	78	11.400	10.650	79	10.100	73	10.500	10.300	23,900	3,130
	F4	87	11.600	73	9.000	10.300	80	10.700	118	15.800	8.050	27,700	2,760
	Total												

*Beds (camas) of 2-rows wide, furrows (fur.) cm wide, and planted on the flat (planar).

†Fo = no fertilizer, in sequence F1 - F5 = 30, 60, 100, 140, 180 Kg N per hectarea. F6 = 100 Kg N with 40 Kg at flowering (tassle); F7 = 140 Kg N with 40 Kg at tassle. F2 - F5 had 30 Kg at seeding, the rest after 35 days. Also, F6 and F7 had 30 Kg at seeding, rest except 40 Kg at 35 days after seeding.

‡Planted for a density of 55,000 plants/ha.

Table 48. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is beds.

Location Las Majaguas	Soil texture Loamy Clay
Strip code No. --	Planting date May 5, 1970
Variety Obregon	Grain, % H_2O at harvest 18.0
Row width 90 cm	Harvested lot size 18m X 1.80m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	125	120	14.000	104	88	9.200	11.600	114	104	3,473
F1	98	94	12.800	125	116	16.500	14.650	111	105	4,380
F2	101	98	15.000	100	107	15.500	15.250	111	102	4,565
F3	104	128	17.000	98	86	11.600	14.300	101	107	4,281
F4	130	117	13.100	88	76	8.300	10.700	109	96	3,203

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 49. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is furrows.

Location Las Majaguas	Soil texture Loamy Clay
Strip code No. --	Planting date May 5, 1970
Variety Obregon	Grain, % H_2O at harvest 18.0
Row width 90 cm	Harvested lot size 18m X 1.80m

Fertlizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	108	111	8.300	81	91	9.400	8.850	97	101	2,649
F1	105	92	9.000	121	101	13.400	11.200	113	96	3,352
F2	107	118	9.100	120	125	12.100	10.600	113	121	3,173
F3	89	85	6.500	100	104	10.800	8.650	94	94	2,589
F4	109	88	6.600	117	108	8.100	7.350	113	98	2,199
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 50. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is planar.

Location Las Majaguas	Soil texture Loamy Clay
Strip code No.	Planting date May 5, 1970
Variety Obregon	Grain, % H_2O at harvest 18.0
Row width 90 cm	Harvested lot size 18m X 1.80m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	105	106	14.200	100	108	12.400	13.300	102	107	3,982
F1	101	108	15.000	75	50	4.000	9.500	88	79	2,844
F2	102	92	9.400	102	107	12.200	10.800	102	99	3,233
F3	108	104	10.100	98	102	12.500	11.300	103	103	3,383
F4	93	99	10.800	91	108	16.500	13.650	92	103	4,086
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 51. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is beds.

Location Las Majaguas	Soil texture Loamy Clay
Strip code No. --	Planting date May 5, 1970
Variety Foremaiz-1	Grain, % H_2O at harvest 18.0
Row width 90 cm	Harvested lot size 18m X 1.80m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	105	102	13,000	89	78	11.700	12.350	97	90	3,697
F1	105	104	13.400	105	98	13.100	13.250	105	101	3,947
F2	105	90	12.000	70	68	9.600	10.300	87	79	3,233
F3	86	80	11.600	86	77	10.300	10.950	86	78	3,278
F4	105	80	12.300	80	76	10.100	11.200	92	78	3,446

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 52. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is furrows.

Location Las Majaguas	Soil texture Loamy Clay
Strip code No.	Planting date May 5, 1970
Variety Foremaiz-1	Grain, % H_2O at harvest 18.0
Row width 90 cm	Harvested lot size 16m X 1.80m

Fertilizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	100	106	14.200	105	88	12.200	13.200	102	97	3,951
F1	101	93	11.500	125	100	14.000	12.750	113	96	3,816
F2	102	98	12.800	120	108	15.150	13.975	111	103	4,183
F3	103	103	13.400	125	111	16.200	14.800	114	107	4,430
F4	92	88	12.200	120	102	15.000	13.600	106	95	4,071
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

Table 53. Data on corn yields during the rainy season 1970 in Portuguesa State, Venezuela. Land form* is planar.

Location Las Majaguas	Soil texture Loamy Clay
Strip code No. --	Planting date May 5, 1970
Variety Foremaiz-1	Grain, % H_2O at harvest 18.0
Row width 90 cm	Harvested lot size 18m X 1.80m

Fertlizer†	Replicate 1			Replicate 2			Ave. yield of 2 reps Kg/lot	Ave. plants per lot	Ave. ears per lot	Ave. yield at 15% moisture Kg/ha
	No. of plants	No. of ears	Yield, Kg	No. of plants	No. of ears	Yield, Kg				
F0	100	98	12.300	102	83	11.200	11.750	101	90	3,517
F1	98	87	11.600	98	87	12.400	12.000	98	87	3,592
F2	71	68	8.500	78	68	8.500	8.500	74	68	2,544
F3	92	80	10.300	76	78	11.400	10.650	84	79	3,248
F4	89	87	11.600	76	73	9.00	10.300	82	80	3,083
Total										

*Beds = 2 rows-wide ridges, Fur. = furrows normal, planar = flat, no corrigations
†Fo = no fertilizer; in sequence F1 - F7 = 30, 60, 100, 140, 180, 100, 140 Kg N per hectarea. F1-F5 had 30 Kg N at planting, rest at 35 days. F6, F7 had 30 Kg N at planting, 40 Kg at tassle, rest 35 days after planting.

the control plot reference line. Plantings in furrows and planar plantings had poorer yields than plantings in beds.

The Las Majaguas data illustrate, as did the other field studies, the important contribution to yield of stand density and thus final ears/ha that are harvested. With better densities than harvested in this in this study, fertilizer needs should be more evident. Some of the individual plot data are indicative of yield possibilities.

Fert.	Variety	Land form	Population/ha	Yield, Kg/ha
F4	Obregon	Planar	36,700	4,940
F3	Obregon	Beds	47,400	5,090
F1	Obregon	Planar	40,000	4,490
F4	Foremaiz-1	Beds	29,800	3,680
F3	Foremaiz-1	Furrows	41.100	4,850

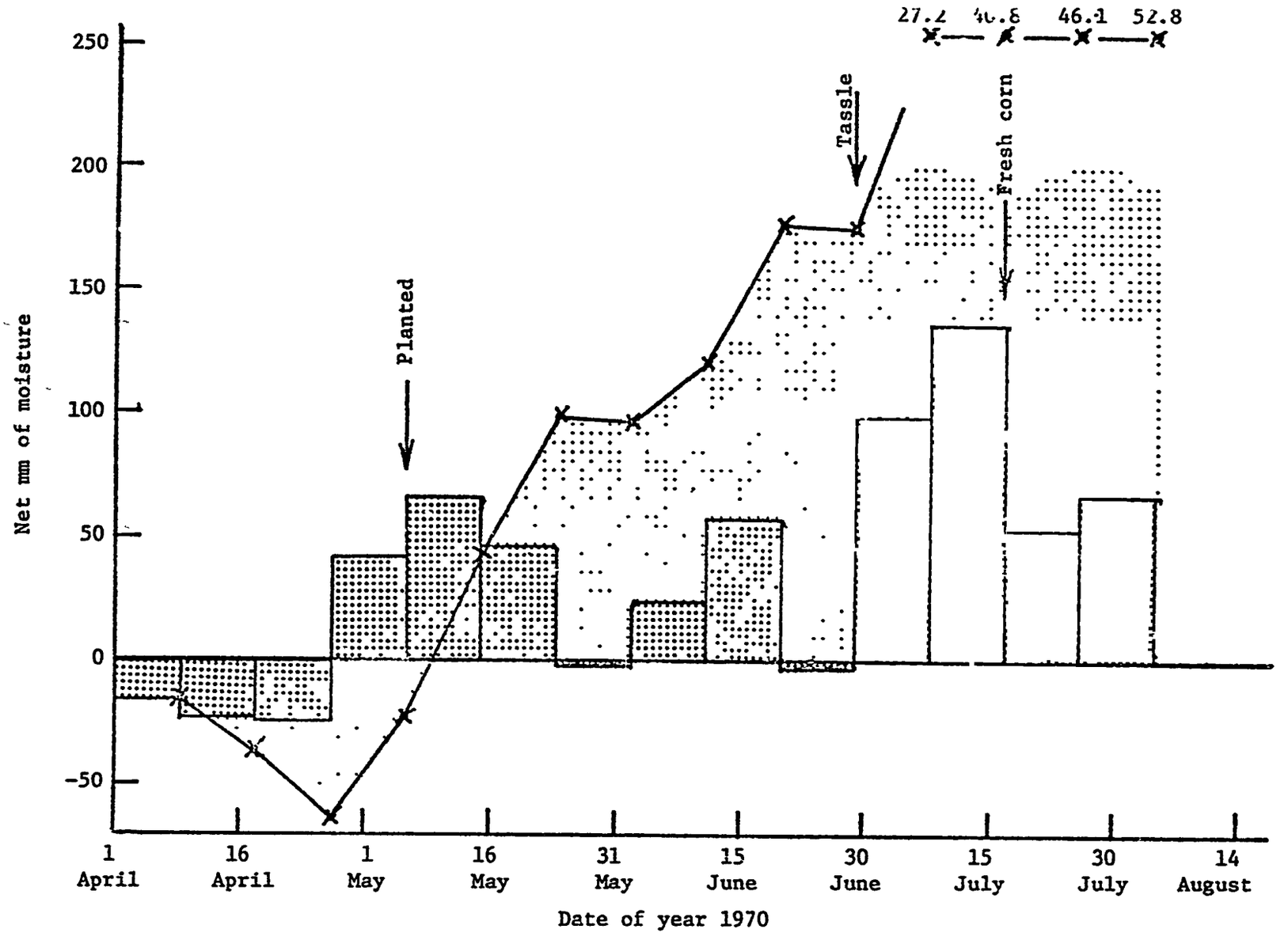


Figure 19. Moisture status for corn in 1970, Las Majoguas, Venezuela. Tabular data in Table 54 compares with Figure 7 and Table 13. Bars are rainfall minus calculated evapotranspiration. The line graph is accumulative moisture of rainfall minus calculated evapotranspiration.

Table 54. Climatic data for Las Majaguas irrigation system in Portuguesa state, Venezuela. No rainfall intensity data was measured and water runoff was not measured. Some measurements of the effective rainfall will be overestimated by the amount of runoff not determined.

Date interval	Rainfall* mm	Class A pan evaporation mm	Evapotransp. factor+	Calculated evapotransp.+ mm	Rainfall minus pan evap. mm	Rainfall minus evapotransp. mm	Rainfall minus evapotransp., accumul. mm
April 1-9	10.7	90.6	0.30	27.2	-79.9	-16.5	-16.5
April 10-18	0	74.1	0.30	22.2	-74.1	-22.2	-38.7
April 19-27	2.6	91.0	0.30	27.3	-88.4	-24.7	-63.4
April 28-May 6	53.7	43.4	0.30	13.0	10.3	40.7	-22.7
					Planted		
May 7-15	90.7	52.9	0.30	15.9	37.8	74.8	52.1
May 16-24	70.4	47.6	0.50	23.8	22.8	46.6	98.7
May 25-June 2	20.1	34.6	0.65	22.5	-14.5	- 2.4	96.3
June 3-11	53.5	37.3	0.80	29.8	16.2	23.7	120.0
June 12-20	78.8	24.4	0.90	22.0	54.4	56.8	176.8
June 21-29	26.3	32.1	0.90	28.9	- 6.2	- 2.6	174.2
					Tassle		
June 30-July 8	125.4	32.3	0.85	27.4	93.1	98.0	272.2
July 9-17	149.5	18.5	0.75	13.8	131.0	135.7	407.9
					Fresh Corn		
July 18-26	77.8	40.6	0.60	24.4	37.2	53.4	461.3
July 27-Aug. 4	84.3	34.9	0.50	17.4	49.4	66.9	528.2

* After Christiansen and Hargreaves (1968). These factors determined for temperate U.S. climates appears to underestimate water losses in early season and late season

\+ Calculated by multiplying the evapotranspiration factor times class A pan evaporation.

SUMMARY AND CONCLUSIONS

Corn trials were run at 4 experimental forms with trials in (1) 2 varieties, (2) 3 land forms for drainage comparisons, (3) 8 fertilizer levels or application variations, and (4) 2 planting dates. Highly variable numbers of ears/ha harvested made statistical analysis of the data seem futile. A covarient analysis could have been used, but this requires the prediction of a curve of "ears harvested" versus "yield". The use of statistics on this presumption did not seem to justify the time nor cost. Graphical presentation serves almost the same purpose.

The conclusions that seem evident from the data are itemized in the following statements.

1. Corn yields in Los Llanos with the varieties Obregon and Foremaiz-1 are more affected by density of harvested plots than by fertilizer treatments on the "normal, recent" soils in the irrigation systems.
2. The only site to have enough rain to test drainage variations (land form effects) was Las Majaguas. In this site, beds retained good initial stands of corn. Planar plots required extensive replanting. The worst losses were in plots having furrows.
3. Slight effects from fertilizers are evident, with the higher fertilizer level plots more frequently having a higher "yield/ears harvested" value.

4. If the density of ears harvested is considered, the total average yields obtained and predicted are:

	Densities, in thousands/ha			
	25	30	40	50
Yield obtained, Kg/ha	4000	5000		
Yield predicted, Kg/ha	--	--	6000	7000

Las Majaguas soil would not be this high, but the trial there was on 90cm row widths, not 76cm as in the other stations.

5. Obregon has a little larger yield/number of ears ratio than does Foremaiz-1.

6. Obregon in Sabaneta appeared to be the best yielding plots of the four stations. Several individual plots had yields over 7000 Kg/ha and a few exceeded 8000 Kg/ha.

It seems to the writer that future corn studies or commercial production must include three important items. First, plant to maintain a high harvest density approaching 50,000 to 60,000/ha. Second, maintain weed control for at least two months. Third, fertilize at planting or within 3 weeks and incorporate fertilizer in the soil. Rates higher than 60 to 80 Kg N/ha are yet to be shown to be economical in commercial planting methods in use. Even Yields at these lower rates have not been well documented, but experience and my observations would make me recommend these levels for densities over 40,000 plants/ha. The writer also believes that higher N levels will be beneficial in some soils under good management, high densities and with phosphorus also added.

Losses of grain during the mid-July to late September drying period needs serious study. I believe there are often 10 to 25% losses occurring in the last 6 weeks as a result of several factors - blow down, mildew, birds, insects and germination. Such losses might justify earlier harvests and drying in sheltered areas are even forced warm-air drying.

COMMENTARY ON THE STUDIES AND SUGGESTIONS ON FUTURE RESEARCH

Changes Needed in the Design

The thinning is better if it is finished within two weeks of germination. Fertilizer needs to be incorporated into the soil. I believe a larger portion should be applied at seeding time. Perhaps 2/3 of N and all of P at planting; 1/3 of N at about 6 to 7 weeks after planting or possibly a week earlier.

More detailed counts and observation should be made on plant mortality as growth and drying stages progress. Loss estimates or measurements should be categorized into such areas as (1) ear worm or insect, (2) bird, (3) fungus, (4) lodging, and (5) other.

The use of only nitrogen fertilizer is believed to be a mistake without prior knowledge that phosphorus is not needed. Phosphorus, and in many cases potassium, should be included in at least some trials in future studies.

Management Problems

The experimental planner is the man usually with the most interest and the most knowledge. It is necessary that he spend considerable time in the field observing conditions, checking dates of operations and making notes on the study area and quality of measurements taken by workers. Even though dates were specific for thinning, one of the three locations was at least a week late performing this operation. Fertilizer applications were not all on schedule, and its precision of application is not known in many instances. Measurements should be

spot checked to verify accuracy of the data. Field presence of the project leader at the initiation of several important steps (first irrigation, planting, drainage measurements, harvest, others) is essential to an assurance of quality information. Often changes in the design should or must be made as a result of an unforseen condition during one or more of these operations.

Future Research Needs in Corn

I would list the following simple studies in order of importance for immediate study.

1. Density - fertility - yield relations.
2. Grain losses during the "mature" to "dry" corn period (July to harvest).
3. Drainage improvement using simple equipment and systems.
4. A study of the relative amounts of N, P, K, S and lime useful in increasing yields.

With M. A. C. screening varieties and doing much other work, M.O.P. should be concerned with immediate ways to improve yields. I believe this will result most by maintaining optimum densities. For this reason I suggest density with limited fertilizer trials as number one. The two other major factors related to density at harvest are the losses from several causes during maturing and drying and damage from poor drainage. The latter should involve simple operations such as 2-row beds with a slight convex surface to eliminate ponding. I suggest furrowing shovels with adjustable wings to contour the bed as furrowing is done. To leave the bed center depressed is to accentuate

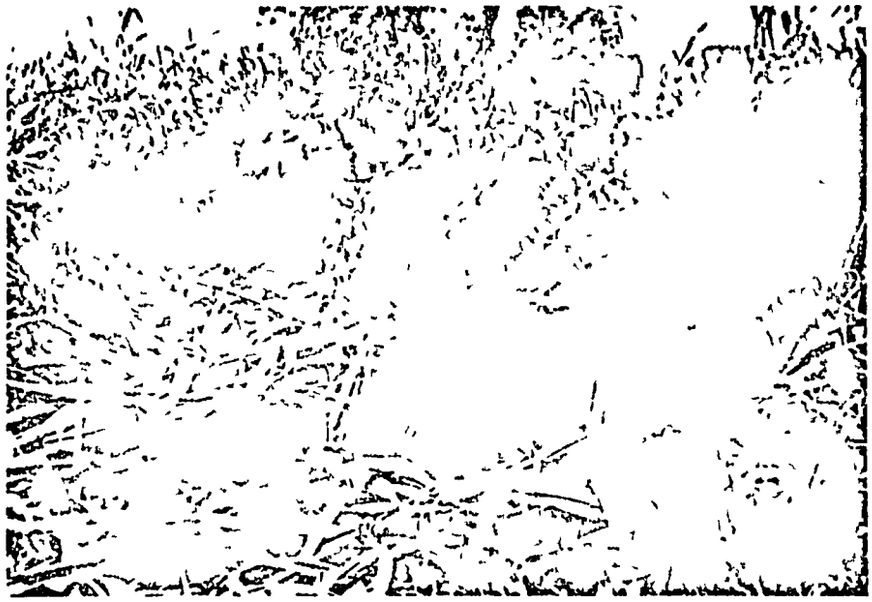


Figure 20. An example of types of losses that occur during the drying stage of corn in Los Llanos, Venezuela. The photo is of corn in August 29, 1969 in Sabaneta (Bocono system) about halfway timewise between mature corn and harvest time for dry corn. Planted in late April and harvested in early October. This field yielded 4600 kg/ha even with such lodging. Harvest by hand is more complete than machine harvest on fields like this. However, if many rains fall in August and September, as often occurs, considerable rotting, mold and germination losses occur in such fields.

the problem of drainage.

In all this discussion insect and weed control is assumed taken care of. There are known chemicals which will do a good job in most cases.

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