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IRRIGATED CORN PRODUCTION STUDIES

Location: Zapotitán Valley, El Salvador

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Introduction

The studies reported here are a continuation of the research in El Salvador to help determine the optimum amounts of fertilizers and irrigation water in crop production. In this study corn was grown. It was planted January 27, 1972 and harvested May 16, 1972.

Objectives

To study corn production as affected by different applications of nitrogen and irrigation water.

Procedure

Design

The experiment was a split design with the water application as the whole plot and fertilizer application as the split plot. The water variables are listed as "A" and the fertilizer variables are listed as "N".

Land preparation and planting

The land for this study was rented from an individual farmer. It had previously been planted to corn and beans and was chosen because of the past production records, depth to water table (below two meters) and proximity to an irrigation canal.

The field was leveled with land plane and the fertilizer plots marked. Fertilizer was applied by hand and then the field was plowed. After plowing, the soil was too dry and powdery for further tractor work so it was necessary to apply about one inch of moisture with sprinklers. After this, it was disced twice and furrows and hills made by tractor. A hand marker was used to mark the spacings down the row where the corn was to be planted. A small hole was then made by hand with a stick, and two kernels of corn seed placed in each hole. After emergence, all doubles were removed and plants were

transplanted in the missing spots, giving an over plant population near 100 percent.

Furrow spacing was 70 cm. and row spacing 20 cm. giving a plant population of 71,000 plants/ha.

The corn used in this trial was the white variety H-5. The corn plants were not "doubled" as is the usual practice in El Salvador.*

Fertilizer, Irrigation & Cultural Practices

The fertilizer variable was nitrogen applied at the rate of:

N-0	0	Kg/ha
N-1	100	" "
N-2	200	" "
N-3	300	" "
N-4	400	" "

Triple superphosphate (P205) was applied to all plots at the rate of 100 Kg/ha

Tensiometers placed at a depth of 18 inches were used to determine irrigation needs. It was decided to irrigate each plot at the following tensiometer readings:

	Tensiometer Reading	App. Atmosphere
A-1	40	0.3
A-2	65	0.6
A-3	70 + 5 days	7-10

Each plot had one tensiometer and was irrigated separately according to the tensiometer reading.

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*Doubling, as practiced in El Salvador, consists of bending or doubling the corn stock so that the ear is upside down. The idea is that this practice aids in drying of the corn.

Table 1. Number of irrigations and amount of water applied to each plot within the three irrigation levels.

		Irrigation Level A-1 (Wet)			
Plot	1	6	8	11	Ave.
Number of irrigations	8	9	7	6	7.5
Net water applied in mm.	240	270	210	180	225
		Irrigation Level A-2 (Medium)			
Plot	2	4	9	12	Ave.
Number of irrigations	7	6	5	4	5.5
Net water applied in mm.	210	180	150	120	165
		Irrigation Level A-3 (dry)			
Plot	3	5	7	10	Ave.
Number of irrigations	3	3	3	2	2.75
Net water applied in mm.	90	90	90	60	72.5

Furrow irrigation was used in these studies. Water was siphoned from the canal and flowed to the plots in 6-inch plastic tubes where it flowed directly into the furrows. Because of the light sandy soils of variable texture, application efficiency was low and it was very difficult to apply the desired amount. Usually, the water was applied until it was determined by visual observations that the entire plot had reached field capacity.

Weed and pest control

Immediately after the corn was planted, Bladex, a commercial herbicide, was applied at the rate of 3 Kg/ha. It was later found that the Bladex had been applied at a rate slightly less than 3 Kg/ha. Weed control was not complete and some hand weeding was necessary.

Insecticides were applied as follows:
February 9 - applied 5% powdered Sevin at the rate of 19.47 Kg/ha.

February 14 - applied Azdrin (5 cc/gal. of water).

February 18 - applied Lannate (5 gm/gal of water).

Results and Discussion

Appendix Table 7 shows the production of shelled corn at standard 12% moisture content in kilograms per hectare, together with the analysis of variance. Table 2 shows the average yield as related to nitrogen fertilization. There was a gradual increase in production from the N-0 to the N-400, with a total difference of 705 Kg/ha. Table 3 shows the average yield as related to irrigation levels.

In the early stages of growth, nitrogen and water stress were apparent both in height of the corn and the color. These differences decreased and at harvest some of the low water and nitrogen plots were green and almost as high as the other plots.

Table 2. Yield of shelled corn at 12% moisture as related to nitrogen fertilization.

Nitrogen Rate Kg/ha.				
0	100	200	300	400
Average Yield Kg/ha.				
4542	4802	4938	5038	5247

Table 3. Yield of shelled corn at 12% moisture as related to irrigation level.

Irrigation Level		
A-1	A-2	A-3
Average Yield Kg/ha.		
5243	5130	4367

This may have been the result of the roots reaching underground sources of water and nitrogen or may have been due to underground horizontal movement of water, which points up the need for studies of underground movement of water in the Zapotitán Valley. Another factor is the amount of rainfall during April, as shown in Table 1. This unusual amount, together with a high relative humidity which averaged 72% for the entire month, reduced the number of irrigations and no doubt supplied much of the needed crop moisture.

During the early stages of growth it appeared as though "field effects" were going to have considerable impact upon production. In the lower portion of replications 1 and 2 was an area of fine sand which had less corn growth. In the center of replications 3 and 4 was an area in which several of the corn plants died shortly after emergence. The plots mostly affected are circled in Appendix Table 7.

It can be noted that in some of the affected plots the production was high (A-2, N-4, Rep. 3). This may be due to plant population. We may not have planted the optimum population which points out the need for studies on plant population.

Table 4. Rainfall at Zapotitán during April 1972.

Date:	10	13	15	17	18	20	21	22	23	27	Total
Rainfall in mm:	21.5	1.5	0.4	8.6	0.1	7.1	2.7	14.7	3.7	4.7	65.0

Also as shown in Tables 5 and 6 the percent of corn stocks at harvest and the percent of stocks producing an ear of corn did not vary greatly between nitrogen or water levels. However, from the total plant population at planting, of 71,000 plants per hectare, 65% produced an ear of corn.

In general the plots in Reps. 1 and 2 received more water than those in Reps. 3 and 4. This was due primarily to differences in soil texture and water holding capacity. There is a possibility that the corn in Reps. 3 and 4 was receiving moisture from an underground source.

Table 5. Number and percent of corn plants and ears at harvest as related to irrigation rates.

Irrigation rate	Number of plants*	Percent of plants*	Number of ears	Percent of plants producing ears**
A-1	3187	79%	2735	85%
A-2	3127	78%	2732	87%
A-3	3050	76%	2401	78%
Total	9364		7868	
Ave.	3121	77%	2623	83%

* Based upon a potential plant population of 4000.

** A few plants produced two ears. Some produced none.

Table 6. Number and percent of corn plants and ears at harvest as related to the amount of nitrogen applied.

Nitrogen	Number of plants*	Percent of plants*	Number of ears	Percent of plants producing ears**
N-0	1852	77%	1637	88%
N-1	2009	84%	1632	81%
N-2	1829	76%	1554	85%
N-3	1780	74%	1368	82%
N-4	1894	79%	1577	83%
Total	9364		7868	
Ave.	1873	78%	1534	84%

* Based on a potential plant population of 2400.

** A few plants produced two ears. Some produced none.

Conclusions

The average production of corn in this experiment varied from 4542 Kg/ha. for the N-0 rate to 5247 Kg/ha. for the N-400 rates. This is considerably higher than the average high of 3700 Kg/ha. in the country. The trend was an increase in production from both the nitrogen rate and amount of water applied, however, there were no statistical differences in yield among irrigation methods or fertilizer rates.

Field effects probably affected the overall production as only 65% of the seeds planted produced an ear of corn. Plant population may also have been a major factor and the optimum population may be somewhat different than 71,000 plants per hectare as used in this experiment.

Variability in soil texture affected the number of irrigations, and the unexpected rainfall in April tended to even out the results between the dry and wet plots.

Table 7a. Production of shelled corn at standard moisture content in Kg/ha. and analysis of variance.

Treatment Water	Nitrogen	Replications 1	2	3	4	Total
	N-0	5639	4383	4188	5701	19,911
	N-1	6446	5627	4282	5616	21,971
A-1	N-2	6950	6302	(4487)	4657	22,396
	N-3	(4077)	6565	(41[illegible])	5650	20,480
	N-4	4997	3352	6574	5181	20,104
	Total	28,109	26,229	23,719	26,805	104,862
	N-0	4780	4158	4557	4921	18,416
	N-1	4859	4888	6693	3325	19,765
A-2	N-2	(4190)	2664	6599	6557	20,010
	N-3	3861	7041	5195	5905	22,002
	N-4	4675	5642	(6022)	6076	22,415
	Total	22,365	24,393	29,066	26,784	102,608
	N-0	2326	4158	5049	(4639)	16,172
	N-1	2187	4288	5804	3608	15,887
A-3	N-2	(3507)	2664	2960	7722	16,853
	N-3	2024	7041	4125	(4788)	17,978
	N-4	2913	5642	5519	6375	20,449
		12,957	23,793	23,457	27,132	87,339

Nitrogen Level in Kg/ha.

Water	0	100	200	300	400	Total	$\bar{x}$
A-1	19,911	21,971	22,396	20,480	20,104	104,862	5,243
A-2	18,416	19,765	20,010	22,002	22,415	102,608	5,130
A-3	16,172	15,887	16,853	17,978	20,449	87,339	4,367
Total	54,499	57,623	59,259	60,460	62,968	294,809	
$\bar{x}$..	4,542	4,802	4,938	5,038	5,247		

Table 7b. Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-value	5 % Level	1% Level
Repetitions	3	10,781	3.594	1.136	4.76	9.78
Irrigation	2	9,088	4.544	1.436	5.14	10.92
Error (a)	6	18,986	3.164			
Plots	11	38,855				
Nitrogen (N)	4	3,341	0.835	0.502	2.63	3.89
Irrig. x N	8	4,133	0.517	0.311	2.21	3.04
Error (b)	36	59,840	1.662			
Total	59	106.169				