tion. A population density of 50,000 plants/ha was to be used, and the plantings were to be kept free of weeds during the 60 days following emergence.

It was estimated that this revised recommendation would produce an average increase in yield of 3,066 kg/ha. Estimated costs of this package of practices, mainly fertilizer costs, were equivalent in value to 1,795 kg/ha maize. The expected average net increase in grain production was 1,271 kg/ha. Two additional sources of income would be associated with the use of the recommendation: (a) yields of stover would be increased proportionately to that of grain and could be sold or used on the farm; and (b) the higher labor requirements for applying fertilizers, harvesting, and shelling the maize would increase family employment and family income.

The soil samples collected at the 23 experimental sites were analyzed for nitrifiable nitrogen and available phosphorus. The experiments were divided into four groups, depending on whether the levels of nitrifiable nitrogen and available phosphorus were less than, or greater than, 10 parts per million parts of soil (ppm). The value of 10 ppm was selected arbitrarily, to permit a comparison of soil test levels and average optimal rates of nitrogen and phosphorus. The average optimal levels of nitrogen and phosphorus for the experiments in each group are shown in Table 3.1.

TABLE 3.1. The average optimal fertilizer rates for soils containing different amounts of nitrifiable nitrogen and available phosphorus.

		Available phosphorus (ppm) (Bray P_1 Method)		Weighted average N rate
		<10	>10	
Nitrifiable nitrogen (ppm)	<10	141-49(10)*	130-9 (5)	137
	>10	90-37(2)	44-12(6)	55
Weighted average P_2O_5 rate		47	10	

* The first number is the average optimal rate of nitrogen, the second is the average optimal rate of P_2O_5, and the third, in parenthesis, is the number of experiments corresponding to the group.

The average optimal rates of nitrogen were 137 kg/ha for soils containing less than 10 ppm of nitrifiable nitrogen and 55 kg/ha for soils containing more than 10 ppm. The average optimal rates of P_2O_5 were: 47 kg/ha for soils containing less than 10 ppm of available phosphorus; and 10 kg/ha for soils containing more than 10 ppm. This promising relationship between optimal rates of fertilization and levels of available soil nutrients prompted the staff and consultants of the Puebla Project to explore the possibility of using soil analyses as an aid in determining fertilizer recommendations for Puebla farmers. Unfortunately, it was not possible to provide an efficient soil testing service for the farmers, and the Puebla Project was not able to make use of this resource.

FIELD RESEARCH IN 1968 AND 1969

The experiments in 1967 suggested that under unfavorable conditions (severe drought, shallow soils), the population density of 50,000 plants per hectare was probably too high. For certain favorable production conditions (little or no drought, deep soils) the same plant density appeared to be too low. Thus, it was decided to study levels of plant density along with levels of nitrogen and phosphorus.

It was also decided that experimental verification was needed for the hypothesis that significant amounts of moisture were conserved by fall plowing.

Observations of the traditional land preparation practices of the farmers during the winter of 1967-1968 led the research staff to question the effectiveness of these practices for several reasons: (a) there is little weed growth during the winter, thus little moisture should be lost, even without plowing; (b) February and March are windy months, and leaving the surface bare might foster wind erosion; and (c) the organic matter contents of the soils are very low, and plowing the soil would tend to accelerate the mineralization of the organic matter.

Another question arose in 1967 about the way farmers made their last cultivation. Most farmers cultivated very deeply with a double moldboard plow and pruned many of the lateral maize roots. This also seemed to be a factor for local study.

Experiments on farmers' fields were used to obtain information on rates of fertilization, time on applying nitrogen and phosphorus, dates of planting, methods of land preparation, residual effects of fertilizers and manures, and other production practices.