As soon as the maize reached maturity, the ears were harvested from the experimental plots, weighed, and grain samples were taken to determine the moisture content. The yield data from the field experiments were analyzed, interpreted, and used to develop new recommendations on crop production practices.

The growth cycle was subdivided in this way because the magnitude of the effect of most factors on maize yields has been shown to depend on the stage of development of the plant at the time the damage occurs. The effect of drought, for example, is greatest when it occurs during the second or third parts of the growing period. (Throughout this chapter, data are presented for these four parts of the growth cycle in their successive order, from planting through physiological maturity.)

For the 23 experiments conducted in 1967, on the average there were 0, 7.3, 6.4, and 0.1 days with visible wilting during the first, second, third, and fourth parts of the growing period, respectively. The highest frequency of drought occurred precisely in the two periods when maize is most susceptible to damage. In general, there was little damage due to hail, high winds, and frost.

Maize yields were increased significantly by the application of nitrogen and phosphorus in 21 of the 23 experiments. Fertilizers did not increase yields in one experiment where the soil was naturally very fertile, nor at a second location where drought was severe and a poorly adapted variety was used.

Average treatment yields in each experiment were used to calculate a quadratic equation with maize yield expressed as a function of rates of nitrogen and phosphorus. These equations were used to estimate the optimal rates of fertilizer for each experiment. The partial derivatives of yield with respect to nitrogen and phosphorus were equated to the ratio of the cost of the corresponding fertilizer to the price of the maize. This resulted in two equations in two unknowns whose simultaneous solution gave the optimal rates of nitrogen and phosphorus for each experiment.

The estimated optimal rates of nitrogen in the 23 experiments varied from 0 to 221 kg/ha, with an average of 109 kg/ha. Optimal rates of phosphorus varied from 0 to 128 kg P_2O_5 /ha, with an average of 30 kg/ha. The maize yields were calculated for each experiment corresponding to the estimated optimal rates of nitrogen and phosphorus; these varied between 2,128 and 7,068 kg/ha grain, with an average of 4,137 kg/ha. The average yield without fertilizer in the 23 experiments was 1,326 kg/ha. Thus, the average increase in yield produced by the estimated optimal levels of fertilization was 2,811 kg/ha.

Results of the 1967 experiments were used to arrive at a second approximation to the recommended package of production practices for maize. Because a decision had been made to limit promotional activities in 1968 and 1969 to Zones I through IV, however, a second approximation was derived specifically for that portion of the Project area (see Figure 1.1). Fifteen of the experiments conducted in 1967 had been located in Zones I through IV. The optimal rates of nitrogen for these 15 experiments varied from 60 to 221 kg/ha, with an average of 128 kg/ha. The optimal rates of phosphorus for the same experiments varied from 0 to 128 kg/ha, P_2O_5, with an average of 37 kg/ha.

Two conditions suggested that the recommended levels of nitrogen and phosphorus should probably be slightly greater than the average optimal levels calculated from the 1967 results: (a) historical rainfall data and information from farmers indicated that drought during the flowering period of the maize crop (July and August) had been unusually severe in 1967 it was probable that, in most years, reductions in yield due to drought would be less than those observed in 1967; and (b) one of the varieties used in the experiments seemed poorly adapted in two locations—responses to fertilization at those sites would probably have been greater with a better-adapted variety.

It was decided, therefore, to recommend 130 kg/ha N plus 40 kg/ha P_2O_5 for maize plantings in Zones I through IV in 1968. One-tenth of the nitrogen and all the phosphorus were to be applied at planting time; the rest of the nitrogen was to be applied just before the second cultiva-