Indiana Climate and Corn Production: 1960-1969

Neil V. Weber
Department of Geography and Geology
Indiana State University, Terre Haute, Indiana 47809

Abstract

The relationship between two climatic variables and corn production within the Indiana Corn Belt during the past decade was tested quantitatively. Simple and multiple correlation coefficients computed for the study sample showed minimal linear relationship between the dependent variable (seasonal corn yield) and the independent variables (growing degree days and precipitation). The climate during the past decade apparently played a minor role in explaining the seasonal variation in corn yields in the Indiana Corn Belt. This phenomenon is believed to be attributed to two primary factors: 1) generally favorable weather combined with a lack of critical variation in the climate of the Indiana Corn Belt (particularly during the growing season of corn); and 2) the introduction of variables which aid in controlling yields from season to season (*i.e.* mechanization; fertilization; hybridization).

Introduction

With the advance of scientific farming and continued mechanization, many of the variables previously affecting corn yields can now be controlled from one season to the next. Problems concerning drainage, soil fertility and hybrid variety are no longer viewed as threats to production consistency.

One variable, however, which cannot be controlled is the microclimate for a given area. It fluctuates from season to season and from day to day. Although meteorological phenomena cannot be held constant, it is possible to statistically analyze potential trends in the weather and project (within certain error limits) future tendencies based on previous occurrences. This tells the farmer what climatic factors are crucial to high yields and if certain portions of the growing season are especially critical.

Regional research of this nature has been published for the Midwestern Corn Belt (3, 7, 8, 10, 11, 14). Somewhat larger-scaled analyses have been conducted in Illinois (9), Indiana (6, 13), Kansas (1, 5) and Nebraska (2). A minimal amount of current quantitative research, however, can be found concerning the Indiana Corn Belt.

My aim is to update the agricultural-climatological statistics for this portion of the Corn Belt. More specifically, this study is designed to test the relationship between two climatic parameters (growing degree days and precipitation) and corn production within Indiana during the past decade.

Growing degree days provide an updated method of computing thermal effectiveness for particular crop yields. This is a more reliable index than mean daily temperature readings because distinct echelon levels for individual crops are incorporated into the growing-degree-day statistic. Temperatures above 90°F and below 50°F are not conducive to effective corn growth. The statistic is therefore adjusted to reflect such conditions (1).

Delineation of Study Area

This study encompasses a relatively homogeneous area of approximately 28,500 square miles of Indiana—the northern two thirds of the state (Fig. 1). The 60 counties included in the study area lie within the Wisconsin glaciated portion of Indiana. The topography of the area is nearly flat to gently rolling.

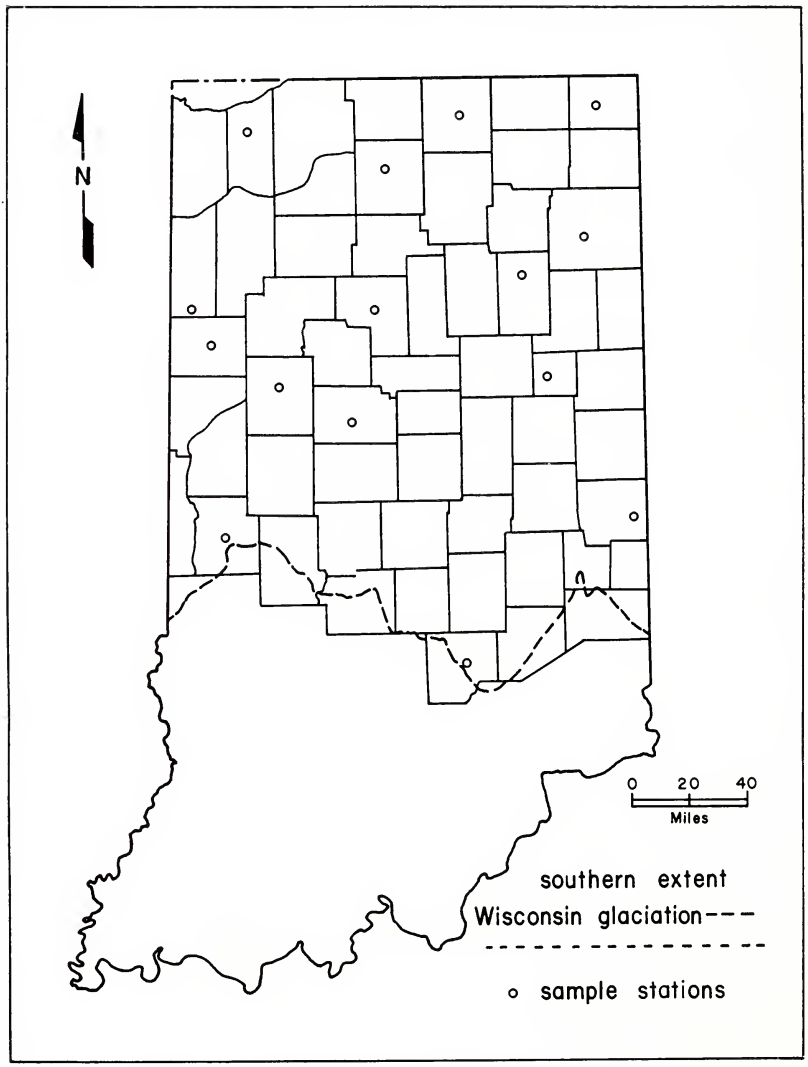

FIGURE 1. *Counties and sample stations included in study.*

The region of intense corn production for the state of Indiana, as delimited by Vinge and Vinge (2), coincides with the boundaries

Wayne (3) proposed for Wisconsin glaciation in Indiana. This study is restricted, therefore, to the glaciated northern ⅔ of the state.

Procedure

A random sample of 15 stations was selected for the correlation analysis (Fig. 1). Correlation coefficients were calculated between the dependent variable (seasonal corn yield in bu/acre) and two independent variables (monthly growing degree days and monthly precipitation). Simple correlations and multiple correlations were computed for each month of the growing season (April-August) and for cumulative figures of each complete growing season.

Data Sources

The statistics used in this study were generated from county data for the 15 sample locations. The following three factors were analyzed: diurnal range in temperature (used in the computation of monthly growing degree days), total monthly precipitation and annual corn yields.

The climatological data were taken from *Climatological Data for Indiana: 1960-1969*, published by the U. S. Dep. Comm. Corn yield values are from the U. S. Dep. Agr. publication *Indiana Crops and Livestock-Annual Crop Summary: 1960-1969*.

Results

Results from the study showed annual yields averaging 83.99 bu/acre. Yields ranged from a minimum of 48.1 bu/acre in Blackford County in 1964 to over 110.00 bu/acre in Benton County in 1969. April had a mean of 73.51 growing degree days, May averaged 224.84, June averaged 531.48, July had 673.20 and August averaged 602.51. Total rainfall throughout the growing season (April-August) averaged 18.48 inches. Mean rainfall for April was 3.73 inches, May averaged 3.76 inches, June averaged 3.45 inches, July's mean was 3.90 inches and August averaged 3.65 inches.

Simple correlation coefficients calculated between monthly precipitation and seasonal yield ranged from −0.27 in June to +0.42 in April (Table 1). A simple correlation of +0.20 was computed between cumulative seasonal precipitation and seasonal yield. Simple correlation coefficients between monthly growing degree days and seasonal yield ranged from −0.30 in April to a +0.36 in May. The simple correlation coefficient between cumulative seasonal growing degree days and seasonal yield was computed to be +0.20.

Multiple correlation coefficients computed between monthly precipitation—monthly growing degree days and seasonal yield ranged from 0.32 in August to 0.45 in April (April = 0.45; May = 0.36; June = 0.44; July = 0.35; August = 0.32; Total = 0.26). The multiple correlation coefficient between cumulative seasonal precipitation—cumulative seasonal growing degree days and seasonal yield was calculated to be 0.26.

TABLE 1. *Matrix of simple correlation coefficients.*

	YELD	GDAP	GDMA	GDJN	GDJL	GDAU	RNAP	RNMA	RNJN	RNJL	RNAU	TGDD	TRN
YELD	1.00	−0.30	0.36	0.35	0.14	−0.25	0.42	−0.08	−0.27	0.31	0.19	0.20	0.20
GDAP		1.00	0.00	−0.10	−0.01	0.52	−0.36	−0.02	0.36	0.07	−0.17	0.41	0.02
GDMA			1.00	0.01	−0.28	−0.01	0.37	−0.18	0.01	−0.22	0.29	0.51	0.03
GDJN				1.00	0.75	0.25	0.17	0.30	0.02	0.01	−0.01	0.63	0.24
GDJL					1.00	0.30	0.16	0.18	−0.02	−0.06	−0.16	0.48	0.05
GDAU						1.00	−0.33	0.44	0.60	−0.21	0.07	0.67	0.35
RNAP							1.00	−0.27	−0.33	−0.11	0.18	0.11	0.04
RNMA								1.00	0.25	0.08	0.12	0.21	0.69
RNJN									1.00	−0.20	0.00	0.32	0.43
RNJL										1.00	−0.17	0.21	0.38
RNAU											1.00	0.11	0.44
TGDD												1.00	0.25
TRN													1.00

YELD = Yield per Acre; GDAP, GDMA, GDJN, GDJL, GDAU = Growing degree days for April, May, June, July, August, respectively; RNAP, RNMA, RNJN, RNJL, RNAU = Precipitation for April, May, June, July, August, respectively; TGDD = Total seasonal growing degree days; TRN = Total seasonal precipitation.

Conclusions

Correlation coefficients of the magnitude of those found in the study make accurate prediction highly improbable. Only a minimal portion of the variance of the dependent variable is accounted for by the independent variable(s). Furthermore, no specific control month was found to have a positive association with the seasonal variation in corn yield.

Acknowledgments

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