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Michigan State University Agricultural Experiment Station and Cooperative Extension Service
Research Report
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Issued August 1978
4 pages

AUGUST 1978

32.8

RESEARCH REPORT 363

FROM THE MICHIGAN STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION EAST LANSING

FARM SCIENCE

Test Levels in Profiles of Two Soils Producing World-Record Corn Yields

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INTRODUCTION

Two Michigan farmers, Orville Montri and Roy Lynn, Jr., produced world record-breaking corn yields of 306.6 and 352.6 bu/acre in 1973 and 1977, respectively (1, 4). This paper reports field soil characteristics evaluated after these yields were "in the record books."

The soil on the Montri farm in Monroe County was identified as a Pewamo clay loam one year after the record yield was produced. Soil profile samples were taken at this time.

Pewamo clay loam is a member of the 1.5c soil management group (SMG). The dominant profile texture is clay loam formed under naturally poor drainage conditions (2). Therefore, it is relatively high in organic matter and needs drainage to produce high crop yields.

The soil on the Lynn farm in St. Joseph County was identified soon after the record yield was announced. Although the 160-acre field contained five different soil series, the record yield was produced "within a 10 acre map unit of Brady sandy loam" (7).

This soil is a member of the 4b SMG. The dominant profile texture is a loamy sand formed under a somewhat poorly-drained condition (2). Therefore, other conditions being equal, this soil naturally contains less organic matter than that formed under poor drainage conditions such as on the Montri farm. This soil type normally does not require artificial drainage to produce high crop yields.

SAMPLING AND TESTING PROCEDURES

Soil profile samples were collected with a bucket auger from the Ap (plow layer), Bt (subsoil) and C (parent material) horizons in each record field. Samples of the same horizons were also taken from a nearby field which was of the same soil type but farmed by another person.

In the laboratory the samples were air dried and ground to pass a 10-mesh sieve. The samples were then tested by standard procedures currently used in the Michigan State University soil testing laboratory (3).

The soil test results on the record-breaking fields are compared with those from a nearby field and with average levels of the SMG to which each soil series belongs (5, 6).

RESULTS AND DISCUSSION

Soil test results are reported in Table 1 for each of the record fields, a nearby field of the same soil type and as an average of several tests from fields representing the same SMG, but not necessarily the same soil type.

The pH levels of the plow layer in both record fields were relatively high, above the neutral point of 7.0. Levels in the Pewamo series represent a natural condition, while the high pH in the Brady reflects the marl that was used two years before the record yield was produced (4).

The acid condition of the Bt and C horizons of the Brady is somewhat different than that found in a nearby field, and is distinctly different than that reported for similar groups in the 4b SMG. In fact, the pH of 5.2 is outside of the range previously observed for the Bt horizon of the 4b group.

The exceptionally high phosphorus (P) tests from the Ap horizon of the Pewamo soil are the highest ever made by the laboratory for this soil type. The tests undoubtedly reflect in part the very high rates of fertilizer used on both tomatoes and sugarbeets in previous years. The neighboring field had been treated differently as reflected by the unexpectedly low P levels.

Test levels for P in the surface of the Brady soil were considerably lower than levels observed in the Pewamo, but would be classed as "medium high." Field research in Michigan suggests that a test of 72 lbs is high enough to produce 100 bu/acre of shelled corn without any added fertilizer P (8).

The exchangeable potassium (K) levels in the surface of the Pewamo soil were also exceptionally high, among the highest ever tested for soils in the 1.5c SMG. Again, this reflects the high rates of fertilizer used in the past. Research in Michigan shows that an average of 8 lb of fertilizer P_2O_5 and 4 lb of K_2O will increase soil test levels about 1 lb per acre (9). The neighbor's field tested less than half that of the record field and less than the mean levels for the SMG. Levels in the Bt horizon were similar, but levels in the parent material varied greatly.

In contrast, K levels in the Brady soil were relatively low and did not change greatly with depth. Amounts in the surface soil were lower than average for the SMG. Exchangeable K was much higher in the C horizon of the nearby field.

Exchangeable calcium (Ca) levels in the profiles

Table 1. Test levels in profiles of soil producing world-record corn yields

County Soil Series SMG[1]	Monroe Pewamo 1.5c			St. Joseph Brady 4b		
	Record Field	Nearby Field	SMG[1] Average	Record Field	Nearby Field	SMG[1] Average
Horizon	Soil Reaction (pH)					
Ap	7.5	8.1	7.5	7.2	7.1	7.4
Bt	7.6	7.7	7.6	5.2	6.4	7.5
C	8.1	7.4	8.0	5.6	5.7	8.4
	Available Phosphorus (#/A)					
Ap	172	3	43	72	82	45
Bt	5	4	6	15	61	46
C	4	4	18	128	34	15
	Exchangeable Potassium (#/A)					
Ap	549	200	284	99	113	164
Bt	240	253	206	71	99	53
C	180	491	259	71	184	39
	Exchangeable Calcium (#/A)					
Ap	6348	8206	6400	960	1200	3900
Bt	4955	5265	4700	960	1440	1800
C	7277	5729	6800	720	2640	3300
	Exchangeable Magnesium (#/A)					
Ap	1080	545	800	167	209	400
Bt	644	687	900	125	288	200
C	513	1040	1000	240	288	100

[1] SMG — Soil Management Group

of the Pewamo soil were similar to the SMG average but were lower than levels in the nearby field. This situation probably reflects the production of exceptionally high yields in the past and the removal of significant levels of Ca in the harvest procedure.

In 1970, the Montri farm produced a measured 198.7 bu/acre of corn, which enabled Montri to be district corn champion. Soybeans, a crop with a relatively high Ca requirement, were grown there in 1971. The 1972 wheat crop is reported to have yielded in excess of 100 bushels per acre (1).

The land on which the recent record was produced has been owned by Lynn for only 3 years but, with irrigation, has produced some high yields. In 1975, his best yield was measured at 141 bu/acre. In 1976, he produced 238 bu/acre of corn (4). Significant quantities of nutrients were removed from the soil when the previous crops were harvested.

Exchangeable magnesium (Mg) levels in the Pewamo surface soil were slightly higher than the average of the SMG and almost 100% higher than levels in a neighboring field. They were more than six times higher than levels in the surface horizon of the Brady, which tested lower than in the neighboring field which was lower than the average of the SMG.

CONCLUSIONS

These observations suggested that record corn yields can be produced over an exceptionally wide range in soil P, K, Ca and Mg test levels. This challenges the idea that high soil test levels are needed to produce high corn yields. Test levels from the Lynn field strongly suggest that with good management, world record-breaking corn yields can be produced on soils testing below average or well below the "desirable level."

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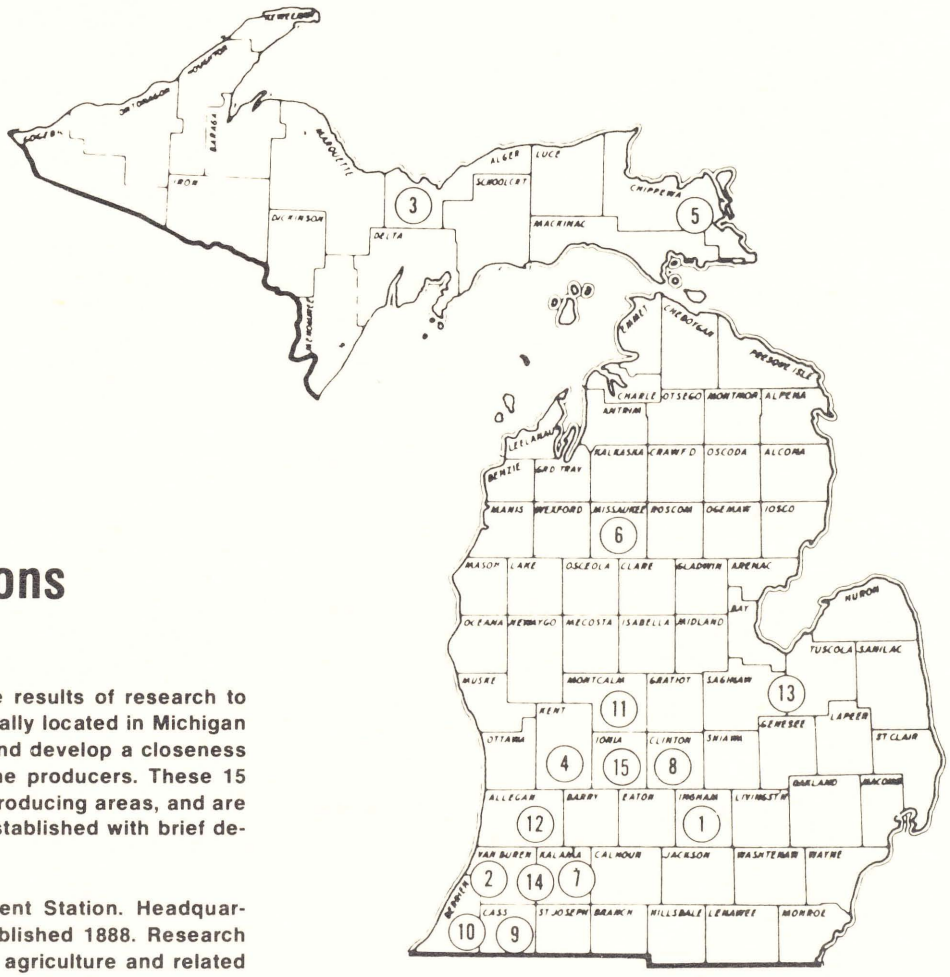

Outlying Field Research Stations

These research units bring the results of research to the users. They are geographically located in Michigan to help solve local problems, and develop a closeness of science and education to the producers. These 15 units are located in important producing areas, and are listed in the order they were established with brief descriptions of their roles.

(1) Michigan Agricultural Experiment Station. Headquarters, 101 Agriculture Hall. Established 1888. Research work in all phases of Michigan agriculture and related fields.

(2) South Haven Experiment Station, South Haven. Established 1890. Breeding peaches, blueberries, strawberries, cherries. Small fruit management.

(3) Upper Peninsula Experiment Station, Chatham. Established 1899. Beef, dairy, soils and crops. In addition to the station proper, there is the Jim Wells Forest.

(4) Graham Horticultural Experiment Station, Grand Rapids. Plots established 1919. Varieties, orchard soil management, spray methods, orchard physiology.

(5) Dunbar Forest Experiment Station, Sault Ste. Marie. Established 1925. Forest management.

(6) Lake City Experiment Station, Lake City. Established 1928. Breeding, feeding and management of beef cattle and aquatic studies.

(7) W. K. Kellogg Biological Station Complex, Hickory Corners. Established 1928. Natural and managed systems: agricultural production, forestry and wildlife resources. Research, academic and public service programs.

(8) Muck Experimental Farm, Laingsburg. Plots established 1941. Crop production practices on organic soils.

(9) Fred Russ Forest, Cassopolis. Established 1942. Hardwood forest management and forest genetics.

(10) Sodus Horticultural Experiment Station, Sodus. Established 1954. Production of small fruit and vegetable crops. (land leased)

(11) Montcalm Experimental Farm, Entrican. Established 1966. Research on crops for processing, with special emphasis on potatoes. (land leased)

(12) Trevor Nichols Experimental Farm, Fennville. Established 1967. Studies related to fruit crop production with emphasis on pesticides research.

(13) Saginaw Valley Beet and Bean Research Farm, Saginaw. Established 1971, the farm is owned by the beet and bean industries and leased to MSU. Studies related to production of sugar beets and dry edible beans in rotation programs.

(14) Kalamazoo Orchard, Kalamazoo. Established 1974. Research on integrated control of grape, cherry and apple pests.

(15) Clarksville Horticultural Experiment Station, Clarksville. Purchased 1974. Plots established 1978. Research on all types of tree fruits, small fruits, vegetable crops and ornamental plants.

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