IOWA STATE UNIVERSITY
Extension and Outreach

A Comparison of Iowa's Original Corn Suitability Rating Index to the new Corn Suitability Rating 2 Index

Aaron M. Sassman*, C. Lee Burras, and Gerald A. Miller
Department of Agronomy, Iowa State University

Concepts to rate Iowa's soils for crop production were first developed in the 1940s; however, wasn't until 1971 when Dr. Thomas Fenton and several colleagues made a major advancement by establishing the Corn Suitability Rating (CSR) with their publication of *Productivity Levels of Some Iowa Soils - Special Report No. 66* (Fenton et al., 1971). The CSR provided county assessors an unbiased means to assess farmland. In 1977 legislation was passed that more clearly guided county assessors on how best to use CSR by clarifying the role of productivity indices and net earning capacity. This put even greater importance on the need for the CSR. About the same time, Dr. Gerald Miller organized ISPAID, which made CSR and other soils interpretations widely accessible to many users.

The CSR established an index rating soil map units (SMU) on their potential crop productivity. A CSR rating is based on the inherent properties of each SMU, average weather, and the frequency of use of the soil for row-crop production (Equation 1). The rating also assumes a SMU is adequately managed, artificially drained where required, SMUs located on lower landscapes are not frequently flooded, and there is no land leveling or terracing. Corn suitability ratings can range from 100 for SMUs that have no physical limitations for continuous row cropping to as low as 5 for SMUs with severe limitations for row cropping.

Equation 1

CSR = S - E - B ± W - C - D - SG - P - DSM - PM - MP (modified from Fenton et al., 1971)

S = slope
E = erosion
B = biosequence
W = wetness
C = calcareous soils
D = depth phase
SG = sandy or gravelly soils
P = precipitation factors
DSM = deposition and special soil modifiers
PM = parent material
MP = muck and peaty soils

Since the establishment of the CSR in 1971, the science for calculating CSR for a SMU became more robust as the knowledge base of soil properties was significantly enhanced and expanded. Another change since the establishment of the CSR in 1971 was the soil classification system in use at that time has since been replaced with the current classification system. With the change in soil classification systems, there are currently 500 soil series recognized in Iowa. That is 150 additional soils recognized than when the CSR was first established in 1971.

As the knowledge of soil's increased and more SMUs were recognized, the CSR calculation became more expert driven. In 2013, ISU introduced a new method for calculating CSR values called the Corn Suitability Rating 2 (CSR2) (Equation 2). The CSR2 method provided an index with ratings comparable to CSR, but was more consistent and transparent. This provided interested individuals the ability to calculate a CSR2 value from parameters that can be clearly understood and used.

Equation 2

CSR2 = S - M - W - F - D ± EJ (Burras et al., 2015)

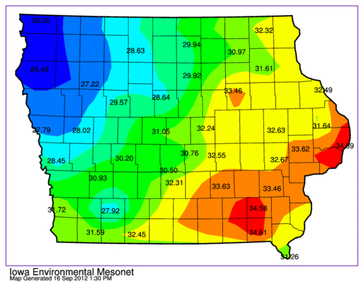
S = taxonomic subgroup class of the series of the soil map unit (MU)
M = family particle size class
W = available water holding capacity (AWC) of the series
F = field condition of a particular MU
- Slope
- Flooding
- Ponding
- Erosion class
- Topsoil thickness

D = soil depth and tolerable rate of soil erosion
EJ = expert judgement correction factor
- Normally used with parent materials with very high bulk density and/or are usually clayey or sandy

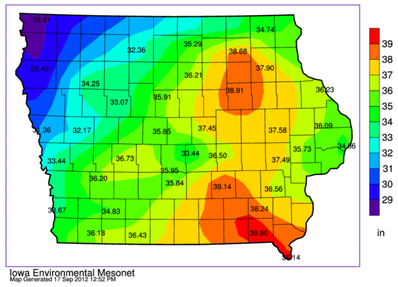
Similar to the original CSR, the CSR2 assumes a SMU is adequately managed, artificially drained where required, and there is no land leveling or terracing. A major difference between the CSR and the CSR2 is the CSR included a rainfall correction factor where the CSR2 does not.

When the original CSR was created it was based on normal rainfall for the 30-year period of 1931-1960. During this period rainfall was significantly lower in west, southwest, and northwest of central Iowa compared to the remaining areas of the state (Figure 1). This is why a weather factor was included with the original CSR calculation. In comparison, more recent normal rainfall data for the 30-year period of 1981-2010 documented an increase in rainfall by approximately 5 to 7 inches in north central, northwest, and western Iowa (Figure 2). The increase in normal rainfall for the period of 1981-2010 compared to the 1931-1960 period was enough that weather was no longer considered a limiting factor within any region of Iowa, and was thus why the weather correction factor was removed from the CSR2 calculation.

1931-1960 Yearly Average Precipitation



1981-2010 Yearly Average Precipitation



Generally, CSR2 ratings are proportional to the original CSR. An exception to this is in north central and western Iowa where CSR2 values are generally higher (Figure 3 and Table 1) than the original CSR values (Figure 4 and Table 1). This increase is because CSR2 no longer considers weather as a limiting factor within the state. Whereas CSR considered weather as a limiting factor in certain regions of the state, and deducted points, primarily in north central and western Iowa, to address the impact this may have on row-crop production. In regions of the state where weather was not previously limiting, there is little difference between CSR and CSR2 values (Table 1).

Figure 3 - Iowa CSR2 Weighted Means by County

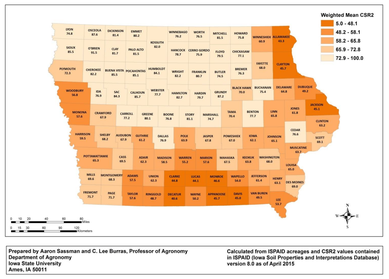


Figure 4 - Iowa CSR Weighted Means by County

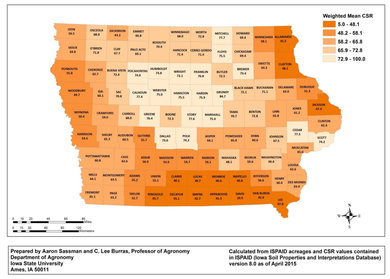


Table 1 - Comparison between the CSR and CSR2 of various soils across Iowa.†

			Suitability Rating		Projected Corn Yield	
Soil Series	Map Unit	County	CSR	CSR2	CSR	CSR2
					bu/ac	
Galva	310B	O'Brien	70	95	192	232
Ida	1E3	Harrison	30	11	128	98
Monona	10D2	Crawford	53	61	165	178
Marshall	9D2	Audubon	58	61	173	178
Sharpsburg	370B	Adair	87	91	219	226
Shelby	24D2	Taylor	48	55	157	168
Clarion	138B	Kossuth	77	91	203	226
Nicollet	55	Story	94	96	230	234
Webster	107	Franklin	84	90	214	224
Tama	120B	Marshall	95	95	232	232
Downs	162D2	Jasper	61	53	178	165
Kenyon	83B	Chickasaw	84	91	214	226
Clyde	84	Bremer	76	90	202	224
Fayette	163D2	Dubuque	58	53	173	165
Otley	281B	Keokuk	90	91	224	226

† Data from Iowa Soil Properties and Interpretations Database (ISPAID) version 8.0

Similar to values between the CSR and CSR2, projected corn yields in north central and western Iowa increased under the CSR2 (Table 1 and Figure 5) compared to the original CSR (Table 1 and Figures 6), and were calculated using equation 3.

Equation 3

Projected Yield = (1.6 * CSR2) + 80
1.6 = slope of regression
CSR2 = calculated CSR2 value for SMU
80 = constant

The equation is based on a soil map unit with a CSR2 value of 100 having a projected yield of 240 bushels per acre (bu/ac). As with the CSR, projected corn yields for the CSR2 are assumed to have a high level of management, and are normalized for a 5 year yield mean. It needs to be noted that these are projected, not expected yields. Corn yields can be greatly influenced by weather, advancements in technology, and changes in disease, pest, and weed control. Adjustments to how corn yields are projected in the future are necessary as new technologies and information become available.

Figure 5 - Projected Iowa CSR2 Corn Yield Weighted Means by County

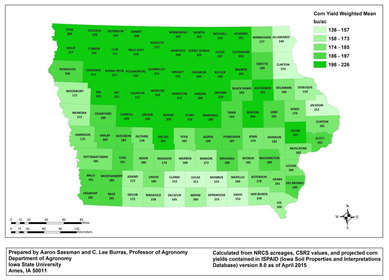
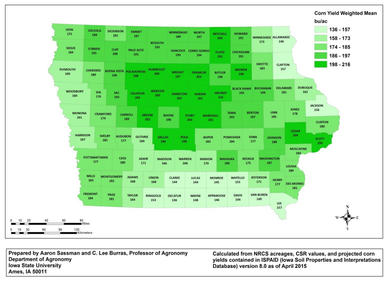


Figure 6 - Projected Iowa CSR Corn Yield Weighted Means by County



Over time human influence on land use will greatly impact soil properties, which in turn affects soil productivity for row-crops. The need for an index to rate soil productivity is more important now than it ever has been. Continuation of soil based research will provide data that shows how humans have influence soil properties. In turn, this data can be used to update crop productivity indexes to help determine areas that need increased conservation practices or need to be removed from production all together. Productivity indexes can not only tell us how productive a soil is, it can help us sustain what soil we have for future generations.

References

Burras, C.L., G.A. Miller, T.E. Fenton, and A.M. Sassman. 2015. Corn Suitability Rating 2 (CSR2) equation and components values. Available at http://www.extension.iastate.edu/soils/suitabilities-interpretations Iowa State Univ., Ames, IA.

Fenton, T.E., E.R. Duncan, W.D. Shrader, and L.C. Dumenil. 1971. Productivity levels of some Iowa soils. Iowa State Univ. Ext. Special Report No. 66. Iowa State Univ., Ames, IA.