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Soil Series and Corn Yield Potentials

Situation Statement
Soil surveys are often referenced by farmers and certified crop professionals for information on land capability or crop yield potential of various soil series. Crop yield levels are frequently used in writing comprehensive nutrient management plans where, for example, yield is a factor in determining how much manure phosphorus or sewage biosolids may be applied per acre. In New Jersey, most of the county soil surveys were published in the 1960s to 1970s and consequently the crop yield potentials are not current with more recent advances in agronomic technology and crop production levels.

Casual Agent or Factor
The yield potential of many crops and corn in particular, has increased markedly over the last few decades due to improvements from plant breeding, more intensive soil fertility management, and effective pest control. Thus, there is a need to revise yield estimates based on soil survey land capability classes for many crops, especially corn.

Importance and Impact
Although soil surveys provide values for crop yield potential and land capability class, the yield values are based on data that is several decades old. The mandate for comprehensive nutrient management plans in the mid-Atlantic region of the U.S. creates a need for realistic values for crop yield potential in relation to soil series. To be relevant, the crop yield estimates must be based on current cultural practices and production technology.

Recommendations
Soil surveys continue to provide a wealth of useful reference material regarding local soil conditions. The information on land capability or corn yield potential of various soil series is not, however, valid for today's crop production technology other than as a relative guide to compare different soil types. The land capability or yield levels, based on published soil surveys from the 1960's and 1970's range from 80 to 140 bu/acre and averaged 112 bu/acre on a group of 10 soil series. Experiments conducted on this same set of soils with non-irrigated corn yields obtained from 1990 to 2003 ranged from 115 to 238 bu/acre and averaged 176 bu/acre. Also, experiments with irrigated corn yields obtained from years 1997 to 2005 ranged from 225 to 282 bu/acre and averaged 244 bu/acre. These corn grain yield levels based on field trials conducted within the last 16 years demonstrate that the land capability of New Jersey soils has increased substantially over values given in the soil surveys. Nutrient management planners should not rely on soil surveys for yield potential of various soil series, but rather use current yield estimates based on recent measurements that are specific for the field. Fortunately, with the introduction of precision agriculture technology, nutrient management planners and farmers are increasingly gaining access to the necessary site and soil specific yield data.

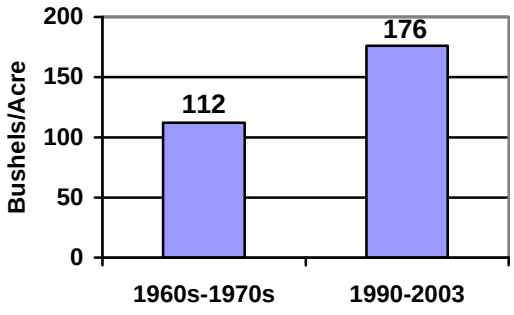

Figure 1. Soil survey land capability classes in New Jersey for non-irrigated corn based on grain yields observed in the 1960's to 1970's compared to yields observed 1990 to 2003.

Soil surveys are often referenced by farmers and certified crop professionals for information on land capability or crop yield potential of various soil series. Crop yield levels are frequently used in writing comprehensive nutrient management plans where, for example, yield is a factor in determining how much manure phosphorus or sewage biosolids may be applied per acre. In New Jersey, most of the county soil surveys were published in the 1960s to 1970s and consequently the crop yield potentials are not current with more recent advances in agronomic technology and crop production levels. The yield potential of many crops and corn in particular, has increased markedly over the last few decades due to improvements from plant breeding, more intensive soil fertility management, and effective pest control. Soil scientists working at the USDA-NRCS New Jersey are aware of the need to revise soil survey land capability classes for many crops, especially corn, and have requested that Rutgers Cooperative Extension prepare a summary of recent yield data associated with different soil series. The objective of this study was to report corn yield data obtained from field research projects since 1990 and associate them with different soil series in New Jersey.

Materials and Methods

Between 1990 and 2005, many field experiments were conducted measuring corn grain agronomic/soil fertility research projects. The grain yields obtained in these experiments, and reported in this article, represent yield potentials using Rutgers Cooperative Extension crop production recommendations. Beyond this general statement concerning materials and methods, additional details are given in the original publications cited in this article. In each of the experiments where yield data was obtained, the yield level reported represents a corn grain yield obtained under best management practices available in terms of corn hybrid, soil fertility, and weed control. About one-third of the experiment sites were in farmer fields with the remainder conducted on New Jersey Agricultural Experiment Station land. In most experiments the corn was grown without irrigation. In all experiments the yield levels were measured from hand harvested plots with a minimum plot size of 50 ft of row length from corn grown in 30 inch rows. The data is tabulated separately for irrigated and non-irrigated corn. With the exception of one field experiment conducted on an eroded Quakertown soil in 1993 and abandoned due to drought and crop failure, all dry land field trials conducted by this author in New Jersey with corn are reported in Table 1. A few experiments conducted with corn were irrigated and are listed separately in Table 2.

Table 1. Non-irrigated land corn grain yields obtained on various soil series from agronomic studies conducted in New Jersey from 1990 through 1998, 2002, and 2003.

Soil Series	1990	1991	1992	1993	1994	1995	1996	1997	1998	2002	2003	Mean
	Bu/acre											
Califon				170								170
Chalfont		152	126									139
Freehold	198	115	226	180	214							188
			238	163	200							
				156								
Hazen		146										146
Holmdel						241						241
Penn	165				219							192
Quakertown		160	178	150	118	140	188	159	151	182	175	172
		181	219		200	163	197	154	151			
			222									
Sassafras		201										187
		172										
Washington	210		162									165
			122									

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, 1996).

From 1990 through 1994, experiments were conducted at one field site on the Rutgers University Snyder Research and Extension farm to evaluate land application of leaf mulch (Heckman and Kluchinski, 2000) (only the yields from the unamended plots are reported here) and from 1995 through 1998 at another field site on the same farm to evaluate manure treatments and corn hybrids (Singer et al., 2000). From 1997 through 1999, experiments were conducted with corn at 64 field sites across the Northeast USA to calibrate soil tests for predicting corn need for phosphorus fertilizer (Heckman et al., 2006). In this large multi-state research project, 5 of the field sites were in New Jersey. The sites outside of New Jersey may be of interest to other Northeast states.

Additional field experiments conducted in 2002, 2003, and 2005 that have not been published yet are also included in Tables 1 and 2.

Table 2. Irrigated corn grain yields obtained on various soil series from agronomic studies conducted in New Jersey from 1997 through 1999 and 2005.

Soil Series	1997	1998	1999	2005
	----------Bu/acre----------			
Aura			234	
Freehold	225	242		251
Quakertown		231	282	

Table 3. Non-irrigated land capability and corn grain yields based on New Jersey county soil surveys published in the 1960s and 1970s.

Soil Series	Bu/acre
Aura	80 – 100
Califon	110 – 120
Chalfont	90 – 120
Freehold	110 – 130
Hazen	90 – 120
Holmdel	110 – 120
Penn	100 – 110
Quakertown	110 – 140
Sassafras	100 – 130
Washington	120 – 140

Results and Discussion

The Soil Survey land capability or yield levels, based on published soil surveys, range from 80 to 140 bu/acre on the soils where these experiments were conducted. On average, this group of 10 soil series would have a land capability of producing 112 bu/acre of corn grain according to the published soil surveys for New Jersey counties Burlington, Cumberland, Hunterdon, Middlesex, Monmouth, Somerset, and Warren.

The non-irrigated corn yields obtained from 1990 to 1998 ranged from 115 to 241 bu/acre and averaged 176 bu/acre. The irrigated corn yields obtained from years 1997 to 1999 ranged from 225 to 282 bu/acre and average d 244 bu/acre. The grain yield levels summarized here, based on corn experiments conducted in past decade and a half, suggest that the land capability of New Jersey soils are more than 50% higher than values originally given in the soil surveys.

Conclusions

Assuming that soil properties of the various soils have not changed significantly since the land capability yield levels were originally published, the increases in grain yield are primarily a reflection of improvements in corn production technology. Nutrient management planners should not rely on soil surveys for yield potential of various soils, but rather use current yield estimates based on recent measurements that are specific for the soil in question. Fortunately, with the introduction of precision agriculture technology, nutrient management planners and farmers are increasingly gaining access to site and soil specific yield data.

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