SOIL RESOURCES: WHAT IS NEEDED AND HOW DO WE MAINTAIN THESE RESOURCES

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Abstract

The soil as a resource in potato production must be maintained if potato production is to be sustained into the 21st century. Increased pest resistance, resource scarcity, and increased input costs will all be important in determining the availability of technology in the future. As demands to maintain and improve environmental quality increase, our ability to overcome poor soil management by increased inputs may be restricted.

To sustain soil as a resource more attention must be given to soil organic matter, structure, and water holding capacity. Cropping systems that increase crop residue returned to the soil and reduce tillage can increase soil organic matter levels and improve soil physical properties. Green-manure crops may also help reduce pathogen populations.

Soil compaction, soil erosion, and salinization represent the most significant threats to maintaining the soil resource. Compaction can significantly limit the soil's ability to supply water and nutrients to the plant by limiting water holding capacity and root growth. Limiting rooting depth increases the potential for nitrates to be leached below the rooting zone. Erosion, through the removal of the most productive topsoil, has the potential to destroy soil productivity. The actual impact of erosion over time is very difficult to measure and has been compensated for by increased inputs. Salinization throughout history has decreased productivity of irrigated soils.

The sustainability of the soil resource depends upon the development and use of Best Management Practices that maintain or improve soil physical properties, while minimizing soil compaction and erosion. These practices will have to be developed within the parameters established by changing human needs and expectations.

Introduction

As agriculture moves through the 90's and into the 21st century the concept of "sustainable agriculture" has taken central focus both within and outside agricultural circles. Although this term has been defined in many different ways, it is clear that the management of our soil resource is a key
issue. Soils must be managed in such a way as to preserve them as a productive resource, while maintaining or enhancing environmental quality. Moore, as cited by Lal and Pierce (19), suggests that "sustainable agriculture should involve the successful management of resources to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources." Potato production practices will have to develop means of maintaining those soil resources critical for the production of high-quality tubers, under the constraints imposed by society, as well as increased pest resistance, resource scarcity, and increased costs. The productivity of the system will be determined by the management of all available resource inputs, including soil, water, energy, climate, fertilizers, pesticides, labor, machinery, available information and new technology. Pierce (26) concludes that "as managed inputs increase or agriculture becomes more technically advanced, the relative contribution of the soil to crop yield diminishes." In order to assure the sustainability of agriculture, the soil's inherent productive capacity must be maintained to enable farming if external inputs are curtailed.

Soil resources, here defined as "beneficial" assets or properties, will vary depending upon the soil and the use for which the soil is intended. For the purpose of this paper, the end use of the soil will be to produce a sustained high yield of high-quality potatoes within an economically sound cropping system that provides protection for the environment. It is important to remember that soils differ widely in their physical and chemical properties. Soil, as defined by Hausenbuilller (15) is "the unconsolidated mineral matter on the surface of the earth that has been subjected to and influenced by genetic and environmental factors of parent material, climate (including moisture and temperature), macro- and microorganisms, and topography, all acting over a period of time and producing a product-soil that differs from the material from which it is derived in many physical, chemical, biological, and morphological properties," and is ever-changing. The management practices that are used in potato rotations bring about changes in soils. These changes may have either negative or positive influences on the soil properties important to potato production.

Potatoes are adapted to a wide range of soil conditions (32). However, not all soil conditions and climates are conducive to producing economic returns of high-quality tubers. The role of the soil in potato production must be considered if management practices are to be evaluated. The soil not only provides an anchor for the plant but also serves as the major water and nutrient pool for plant uptake. Therefore, the value of a particular soil for potato production is determined by its ability to provide a physical, chemical, and biological environment conducive to root growth, water and nutrient uptake and tuber formation. This paper will focus on the physical properties of the soil that serve as a resource for potato production. Issues of soil chemistry and nutrient availability are covered by Westermann (34).