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Better Crops, Better Environment...through Science

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WHEN IS A BIOSOLID THE RIGHT SOURCE?

Assessing all available nutrient sources is a sound principle of nutrient stewardship. Avoiding the waste of whatever is available can save money through efficient recycling, and reduce impacts on the environment.

The U.S. Environmental Protection Agency (EPA) defines biosolids as "treated sewage sludge; nutrient-rich organic materials resulting from the treatment of domestic sewage." The biosolids produced annually in sewage treatment plants across North America contain substantial amounts of N and P; equivalent to about 3% and 8%, respectively, of total N and P removal by crops. Currently, just over half of the biosolids produced are applied to farmland. The area receiving these materials each year amounts to less than 1% of the total cropland.

When biosolids are applied to meet crop N needs, the P supplied usually exceeds the needs of the current crop by two or three times, but is available to succeeding crops. Thus most biosolids are applied only once in five or more years, rather than on an annual basis, and they are best suited to soils testing low in P; soils that benefit from the buildup of available P.

Across North America, the N contained in biosolids amounts to about one-fifth of the total N supply in the human diet, but the amount of P they contain is roughly the same as total dietary P supply. Thus one can conclude that the current methods of processing sewage recapture P efficiently, but lose a very considerable amount of N.

One difficulty with biosolids as a nutrient source is handling the volume, since it is a low-nutrient source. Some processes have succeeded in extracting the nutrients in more concentrated form. In particular, struvite extracted from sewage sludge is a much more easily managed slow-release form of P, suitable for band placement near seedlings. Research continues to seek lower cost extraction methods.

In biosolids, the proportion of N in the available form (mostly ammonium) varies. It can be as much as 35% in anaerobically fermented materials, but is typically 2% or less in aerobic or dewatered materials, particularly those stabilized with lime. The less-available organic form of N continues to mineralize slowly for years after application. For this reason, fall nitrate levels in soils that have received biosolids can be high, and can become a potential source of nitrate leaching. Cover crops can use this N.

The availability of biosolids P to plants will vary among materials, depending on the treatment process. If Fe, Al or Ca has been added, P availability can be lower.

Biosolids generally contain very little K. The K is usually discharged in the effluent from the sewage treatment plant. Biosolids can contain substantial amounts of secondary and micronutrients, particularly Zn. Research has shown higher concentrations of Zn in crop products harvested from biosolids-treated land. When biosolids have been stabilized with lime, the effects of application on soil pH need to be taken into account. As soil pH rises, deficiencies of some micronutrients, particularly manganese, can become more frequent.

Decades ago, there was much more concern with heavy metals in biosolids than there is today. The reason is that industrial discharges containing such materials have been diverted from sewage treatment systems. Biosolids materials in most areas are still regulated, requiring a certificate of approval. Responsible use requires attention to food safety risks including pathogens, pharmaceutical residues, endocrine disruptors, and heavy metals.

While biosolids supply only a small portion of the nutrients required by crops in North America, their utilization for crop nutrition in appropriate situations contributes to improvements in nutrient use efficiency.

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Abbreviations: N = nitrogen; P = phosphorus; K = potassium; Ca = calcium; Al = aluminum; Fe = iron; Zn = zinc.