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Shrimp-Processing Byproducts: a source of nitrogen, phosphorus and lime

Dan M. Sullivan, Extension Soil Scientist, Oregon State University, Corvallis
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Recent price increases for inorganic fertilizers have renewed interest in the use of nutrient-rich food processing by-products as nutrient sources. On the south Oregon coast, shrimp processing byproducts typically consist of the shrimp shells and heads of the Pacific pink shrimp that have undergone a cooking and peeling process. Shrimp processing byproducts are of particular value for crops requiring nitrogen (N) and phosphorus (P) fertilization. Shrimp byproducts also provide a liming benefit.

In 2007, Tracy Martz (program assistant, OSU Extension, Coos County) compared the nutrient concentrations present in a Coos County shrimp byproduct to values published earlier (Costa, 1977; Table 1). Although modern extraction methods for shrimp meat are more efficient, the nutrient analysis of the 2007 shrimp shells was remarkably consistent with analyses conducted 30 years before. Shrimp byproduct contained 24% solids (dry matter) and 76% moisture. Calcium carbonate equivalent of the fresh shrimp byproduct was 7% (1 ton of fresh shrimp byproduct = 140 lb lime). Organic matter was 10% of fresh shrimp byproduct (200 lb organic matter per fresh ton). Concentrations of sulfur, potassium, boron and sodium were insignificant.

Additional analyses conducted at OSU on shrimp byproduct in 2007 showed a pH of 9.2, electrical conductivity (EC; an indicator of soluble salts) of 8.6 and a carbon to nitrogen ratio less than 5. Because the shrimp byproduct organic matter is high in N (>5 % of dry matter) and its C/N ratio is low, rapid decomposition of the organic matter and rapid release of plant-available N is expected. The high pH of the shrimp byproduct indicates the presence of ammonia (NH_3). Ammonia loss to the atmosphere will reduce the value of shrimp byproduct as a N source. Ammonia loss can be reduced by incorporating shrimp byproduct into soil immediately after application. The high EC present in shrimp shell byproduct is another indicator of its putrescible nature (very rapid decomposition).

Students in a graduate nutrient management course at OSU also performed a soil incubation to measure N release for the 2007 shrimp byproduct. They found that about 30 % of the total N present in shrimp byproduct was converted to plant-available N (ammonium + nitrate-N) in 7 days at a temperature of 70 °F. The release rate of N from shrimp byproduct was similar to other high analysis organic fertilizers included in the same trial (fish meal and feather meal).

The typical first-growing season N release amount for shrimp byproduct is predicted to approximately 75% of its total N content, using the OSU Organic Fertilizer Calculator (Andrews and Foster, 2007). This estimate assumes that N is not lost as ammonia to the atmosphere.

A 5-ton per acre application of shrimp byproduct provides approximately 125 lb total N (approximately 100 lb plant-available N), 100+ lb phosphate (P2O5) and 0.35 ton lime. In order to get maximum value from this material, it needs to be applied early enough in the growing season so that the crop has opportunity for N uptake before fall rains leach N from the soil. Spring application for fertilizing a spring planted row crop would be one of the better opportunities to recover the applied N. Preplant application to a row crop will also allow lime and P fertilization of a deeper soil depth. Lime and P are relatively insoluble, so a surface application to a pasture will typically affect only the top 2 inches of soil. Because of the high P value of shrimp byproduct, targeting soils with low soil test P will make the most of its value. Repeated shrimp byproduct applications to the same field are not recommended because of the danger of building soil test P to very high levels that can result in loss of P via runoff to nearby surface waters. Phosphorus addition to surface water can trigger algal blooms and fish kills.

Table 1. Analysis of shrimp byproduct collected by Martz (2007) vs. published values from earlier OSU research (Costa, 1977). 2007 analyses performed by AgriCheck, Inc.; Umatilla, OR.

Nutrient	2007			1977
	% fresh weight	% dry weight	lb/ton fresh weight	lb/ton fresh weight
Total Nitrogen	1.3	5.4	26	26
Phosphate (P_2O_5)	1.8	7.3	35	20
Potash (K_2O)	0.1	0.2	1.1	1.1
Sulfur	0.1	0.2	1.2	1.2
Calcium	3.9	16.3	78	129
Magnesium	0.2	0.8	3.9	3.5
Sodium	0.07	0.29	1.4	
Boron	0.001	0.004	0.02	0.02
Solids (dry matter)	24	100	480	460
Moisture	76	0	1520	1540
Organic matter (loss-on-ignition)	10	42	201	
Lime (calcium carbonate equivalent)	7.2	29.8	143	

References

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