Improving Fertilizer Phosphorus Use Efficiency with Fertilizer Applied Resins (Polymers) for Brazil and Idaho Soils

Terry A. Tindall, Ph.D., Director of Agronomy, Ganga Hettiarachchi, Ph.D., Assistant Professor, Kansas State University, Galen Mooso, Ph.D., Agronomy Manager, and Larry Murphy, Ph.D., Consultant with Specialty Fertilizer Products.

Introduction:

Previous agricultural research performed over many years has found that the contribution of fertilizer to yield is between 50% and 60%. This knowledge has led to a substantial increase in fertilizer use during the past 50 years, primarily in developing regions of the world, including East Asia, South Asia, Southern Africa, and Latin America. Today's fertilizer use is approximately six times higher than the global fertilizer consumption in 1960. Phosphorus (P) is one of the three primary components of effective fertilizer campaigns.

Challenge:

Successful growers must create field management practices that improve nutrient uptake in order to improve crop quality efficiently. Past studies have developed guidelines for nutrient placement, timing, rates of application, and forms of P fertilizer, but the differences in outcome between liquid and dry P in different soil types had not been fully addressed.

AVAIL® is a commercially available fertilizer additive that is designed to enhance P uptake. Use of this or similar additives may improve efficiency of nutrient applications, allowing growers to apply lower doses of nutrients without lowering yield or plant quality.

Research:

Agronomy researchers Terry A. Tindall, Ganga Hettiarachchi, Galen Mooso, and Larry Murphy performed laboratory analyses of the effects of monoammonium phosphate (MAP), diammonium phosphate (DAP), and ammonium polyphosphate (APP) fertilizers alone and with AVAIL. These P sources were tested on several different soil types to determine the mobility and availability of P from different sources, along with any beneficial effects on yield.

Methodology:

The team placed samples of calcareous soil from Idaho, U.S., and acidic soil from the Cerrado region of Brazil in petri dishes. Treatments included a control, MAP, MAP+AVAIL, DAP, DAP+AVAIL, APP, and APP+AVAIL.

Samples were incubated for five weeks at 25° C, and then material in each dish was divided into four concentric sections and analyzed for pH, total P, and resin-extractable P. Analysis was performed with a scanning electron microscope using x-ray absorption near-edge structure spectroscopy.

Results:

The availability of P from all three sources increased when combined with AVAIL.

Practical Applications:

Growers seeking to reduce the impact of fertilizer products on local watersheds and environmental quality can improve nutrient-use efficiency by using AVAIL to reduce the amount of P necessary to achieve goals for yield and plant health.

Sample	pH	Ca ppm	CEC meq /100g	OM %	Fe ppm	Mn ppm	Al ppm	N ppm	P ppm
Calcareous ID	8.0	3376	19.6	0.6	2.4	3.6	ND	403	468
Oxisol BZ	4.3	49	12.4	3.7	52.9	2.2	79.5	1243	237

Table 1. Soil Characteristics of two soils evaluated with x-ray absorption near edge structure spectroscopy (XANES) analysis.

Treatment	Apatite	Hydroxy Apatite	Aluminum Phosphate	Ferrihydrite Adsorbed P	Vivianite	Red. Chi Square
Control	20.4	48.2	-	31.4	-	0.06
MAP	59.2	-	-	31.0	9.8	0.02
DAP	64.1	-	-	35.9	-	0.04
APP	27.8	-	-	48.2	24.0	0.04
MAP + AVAIL	37.7	5.5	-	36.6	20.2	0.06
DAP + AVAIL	57.1	-	-	42.9	-	0.06
APP + AVAIL	32.0	-	7.1	61.0	-	0.16

Table 2. Effect of three phosphorus sources without and with AVAIL copolymer on XANES analysis results (inner-most section, 0-7.5 mm radius from the point of application) on a calcareous soil (Idaho).

Treatment	Aluminum Phosphate	Alumina Adsorbed P	Ferrihydrite Adsorbed P	Strengite	Vivianite	Red. Chi Square
Control	13.9	-	64.1	-	21.9	0.27
MAP	-	-	72.1	-	27.9	0.32
DAP	-	47.3	-	-	52.7	0.04
APP	-	43.6	-	-	56.4	0.02
MAP + AVAIL	-	-	24.1	-	75.9	0.02
DAP + AVAIL	-	33.7	-	-	66.3	0.01
APP + AVAIL	-	21.4	-	78.6	-	0.00

Table 3. Effect of three phosphorus sources without and with AVAIL copolymer on XANES analysis results (inner-most section, 0-7.5 mm radius from the point of application) on an Oxisol soil (Brazil).