

Water Infiltration Rates On Varying Soil Types From Phytase

Applied Swine Effluent

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ABSTRACT. The infiltration and runoff of phosphorus (P) from agricultural land to ground and surface waters has contributed to an accelerated eutrophication of receiving waters. This nonpoint source of transported P is often the result of surface soils containing high P concentrations or direct consequence of land-applied animal manure. Application of the phytase enzyme to swine feed is considered a possible alternative to reduce the total P concentrations in the manure waste stream. Bench scale column studies were conducted at the TAMU-Kingsville Crops & Environmental Lab to monitor treated swine effluent infiltration rates through varying soil types. The objectives of these studies were to evaluate if particulate matter in swine waste would decrease water infiltration rate over time. Results have shown a decrease of P loading in soils where phytase was applied and swine effluent P levels were lower than effluent from swine not receiving phytase enhanced diets. The findings of this study may provide a reduction in the total amount of P applied to soils, which could benefit the overall water quality. However, particulate matter from swine waste irrigated soils may lead to increases soil pore clogging and exacerbate P surface run-off problems in the long run.

Keywords. Manure Application, Phosphorus, Phytase, Swine Waste.

INTRODUCTION

Phosphorus is an essential element for plant growth and is often applied to agricultural land to increase crop production. Animal waste generally has a high concentration of P. Livestock feedlots and cattle grazing on grassland can introduce substantial amounts of P-rich manure to the environment. A non-point source of P, such as runoff and subsurface leaching from agricultural land, are a major

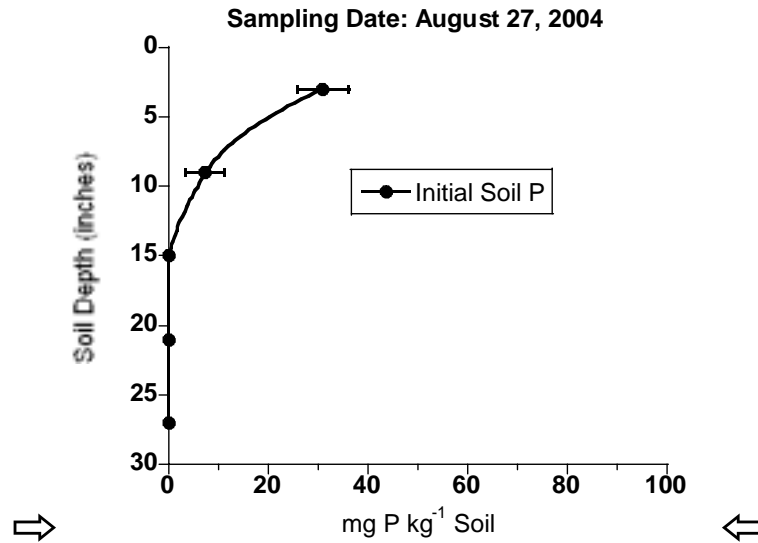
27 contributor to eutrophication in freshwater bodies (Sims, Baker,2003). Due to this environmental
28 concern a dietary supplement (Phytase) is now being introduced to livestock feedlots in hopes of
29 reducing phosphorus loading in the waste streams. Phytase is an enzyme that breaks down the
30 indigestible phytic acid (phytate) in grains and oil seeds and releases more digestible phosphorus that
31 pigs can use (McMullen, Hoyer 2001). By reducing the unused portion of phosphorus in feed, less
32 phosphorus is eliminated in manure, which is important for producers because of water quality
33 concerns due to phosphorus in manure moving off-site and into surface water. The objective of this
34 study was to determine the infiltration of P concentrations from cultivated soils in South Texas,
35 receiving surface applications of swine manure, as well as the effects of the phytase enzyme diets of
36 local swine breeds.

37 **MATERIALS AND METHODS**

38 A field study was conducted at the Texas A&M University-Kingsville Research Farm north of the
39 main campus. A 1.1 acre field site (200 ft x 240 ft) was prepared with 12 plots (20 ft x 240 ft each)
40 with a 1.5 ft tall border on each side of the plots to separate each other. Among the 12 plots, 3
41 treatments (WP=with phytase, NP=no phytase, and C=control) were randomized and grouped into 4
42 replications. Prior to manure applications three, soil samples were taken from each plot to a depth of 30
43 inches using a JMC environmental subsoil probe. Two months prior to manure application, phytase
44 was applied to corn feed at a rate of 50 g per ton of feed, and fed to swine continuously. A week after
45 sampling the soil, swine waste was then applied, to designated plots using a 2000/gal wagon pulled by
46 a tractor, after extracting the waste from two different swine barns (swine barn A-phytase and swine
47 barn B-no phytase). On the 11 October 2004 (58 days later) and a total of 4.2 in. of rain was collected
48 on the field site, a second set of soil sampled were collected and analyzed in the agronomy lab. The
49 Olsen, sodium bicarbonate P method was used to extract P from each sample. The % transmittance was
50 then read and recorded from a spectrophotometer.

51 **RESULTS AND DISCUSSION**

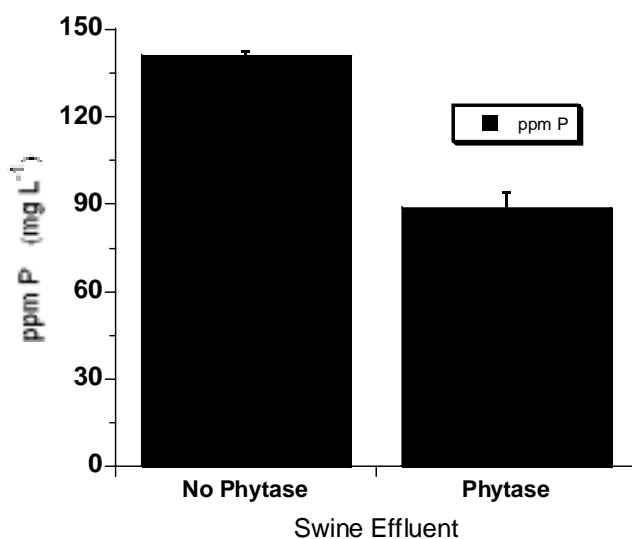
52 Typically, when feeding phytase in swine diets, the percentage of reduction of the inorganic
53 phosphorus will be the amount of phosphorus reduced in the swine manure.



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55 **Figure 1. Initial soil samples were taken prior to manure application on 27 August 2004 to a 30 inch depth. P**
56 **levels decreased with increasing soil depth, with an average of 30.9 mg P kg⁻¹ soil within the upper 6 inches of soil and**
57 **decreased to minimal P levels below 15 inches.**

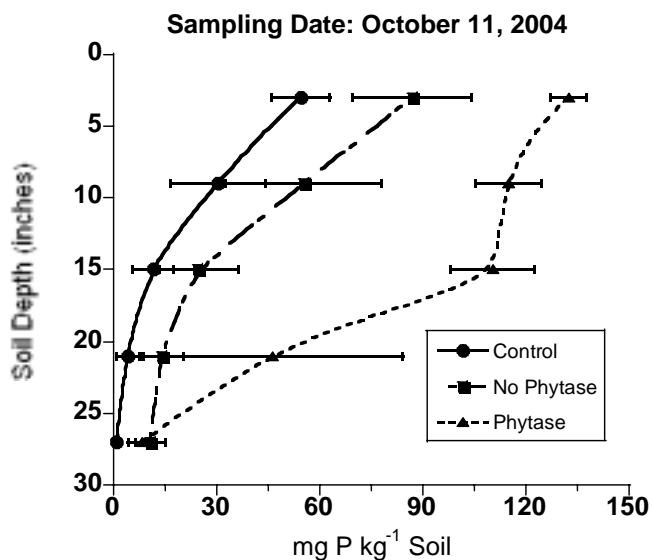
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60 **Figure 2.** Swine were fed diets with and without phytase application to corn diets starting 2 months prior to
 61 swine waste application to soil. A total of three representative samples were taken from each of the phytase and no
 62 phytase treated wine waste lagoons. The amount of P within the swine waste from the no phytase treated diets had
 63 statistically greater levels of P than compared to the phytase treated diets. Confirming that P was more bio-available
 64 to swine in phytase treated feed supplements than in diets without phytase.

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68 **Figure 3. Following a single application event of swine manure effluent on 25 September 2004, the swine waste**
69 **was allowed to infiltrate through the soil over a 3 weeks time period as a total of 4.2 inches of rain fell after**
70 **application. A second soil sampling event was performed on the 11 October 2004 from all three treatments. As**
71 **expected, in plots not receiving manure application (Control) the level of P within the soil remained about the same**
72 **amount within the soil. Surprisingly, however, P levels within the soil from phytase treatment swine waste plots had**
73 **statistically greater P concentrations than in non-phytase treated plots. The highest P concentration from phytase**
74 **treated soils was 132.5 mg P kg⁻¹ soil, but 87.0 mg P kg⁻¹ in the non-phytase treated soils.**

75 **CONCLUSION**

76 The significance of the reduction of phosphorus in the phytase fed swine lagoons proved to be
77 significantly important to the overall quality of swine waste. Although there was a negative effect with
78 the overall application (swine waste WP) to the experimental plots, it provided significantly important
79 data to future analysis. These negative results may be due to the continuous amount of rain, weed
80 growth and clayish soils preventing phosphorus from moving through the soil adequately. In addition
81 the overall transfer of swine waste from the lagoons needs further evaluation. Further field trials will
82 determine the actual fate of phosphorus leaching from the phytase enzyme..

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