FANG CHEMICALS, INC.
Project on Phosphite form of P nutrition for Agricultural Crops

STUDIES ON THE DIFFERENTIAL BEHAVIOR OF AMMONIUM PHOSPHITE ON DIFFERENT CROPS – A REPORT

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INTRODUCTION

Phosphorus fertilization of plants is applied commonly in the form of salts of phosphoric acid as phosphate. Recent years, phosphorous acid is neutralized by potassium hydroxide or to add ammonia to form potassium phosphite or ammonium phosphite. It is commonly called as phosphite or phosphonates. Phosphite fertilizers are available commercially and are labeled as phosphorus supplements recommended for foliar or soil treatment to nursery, turf and agricultural crops. Among potassium phosphite and ammonium phosphite, potassium phosphite is very common in usage as P fertilizer as well fungicide for the control of oomycetous fungi, (Coffey and Ouimette, 1989). But there is very limited work on ammonium phosphite as soil P fertilizer. Though the phosphite is used as soil P fertilizer in some crops like cotton, tobacco, peanuts some plants like corn, beans are very sensitive and leaves shows chlorotic and found reduction in plant height. However the phosphite injury is recovered and obtained the similar yield of cotton and tobacco given with ammonium phosphite (11-35-0) and ammonium poly phosphate (10-34-0) as reported by Charles Mitchell and Jim Adams, 2004.

METHODS

The goal of present investigations on beans and corn is to study the effect of ammonium phosphite and find out its differential response on various crops. There are two observational trials are undertaken in Fang Chemicals, Inc. and its observations are compared with standing crop of corn, peanut, cotton and beans in southern regions of Georgia applied with 11-35-0 ammonium phosphite.

Experiment 1. Study of Ammonium phosphite on Beans – Observational trial (Dan's Place)

Treatments:

T1. Ammonium poly phosphate (10-34-0)
T2. Ammonium phosphite (11-35-0) 100 per cent
T3. Ammonium phosphite plus EDTA chelated micro-elements
T4. Ammonium phosphite (11-35-0) 30 per cent of the recommendation
T5. Untreated control (No Phosphorus)

Experiment 2. Study of Ammonium phosphite on Maize – Observational trial

Treatments:

T1. Ammonium poly phosphate (10-34-0)
T2. Ammonium phosphite (11-35-0) 100 per cent
T3. Ammonium phosphite (11-35-0) double the dose

T4. Ammonium phosphite (11-35-0) 30 per cent of the recommendation
T5. Untreated control (No Phosphorus)
T6. Farmer's practice (Check)

Experiment 3. Ammonium phosphite applied plots Corn, Cotton and Pea nuts– Farmer's fields of AGRI-AFC

Treatments:

12.0 Gallons of Ammonium phosphite per acre applied at the time of planting. Applied at 2" away from seed rows at 2" depth.

OBSERVATIONS

Observational Trial 1. (Start date of trial: 05-06-2004)

Crop stand at 18th days are showed as,

1. Good crop stand in ammonium poly phosphate applied plots.
2. Well establish root system observed in 30 per cent of ammonium phosphite applied plots.
3. Untreated control plots also showed good growth.
4. Ammonium phosphite applied plots shows slight reduction in plant height and few plants showed the yellowing of leaves.
5. Ammonium phosphite plus EDTA micro-elements applied plant rows showed more green color when compared to other treatments

Observational Trial 2. (Start date of trial: 12-06-2004)

Crop stand at 12th days after sowing is as,

1. Uniform germination observed in all the plant rows
2. More green color was observed in 10-34-0 ammonium poly phosphate applied plots and farmers practice of fertilizer mixture with 13 per cent nitrogen
3. Yellowing observed in untreated control plots
4. No much reduction in ammonium phosphite of 11-35-0 applied rows

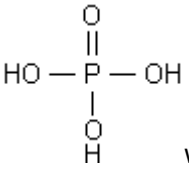
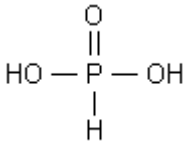
Field Observations in AGRI-AFC Customers:

1. There are about 5-6 different soil type ranging from sandy loam to clay loam
2. Crop stand in ammonium phosphite applied plots are showing the yellowing of leaves, slight reduction in plant height when compared to ammonium poly phosphate applied fields
3. Crop stand of pea nut and cotton is uniform in ammonium phosphite applied plots
4. As per the images taken by AGRI-AFC team at young stage (one month stage) is showed greater damage due to ammonium phosphite (11-35-0) applied @ of 12 gallons per acre.
5. About 80 acres are uprooted and replant with corn. Remaining fields about an area of 900 acres recovered and showed satisfactory crop stand. However, yellowing of leaves and uneven crop stand is also observed in ammonium phosphite applied plots.

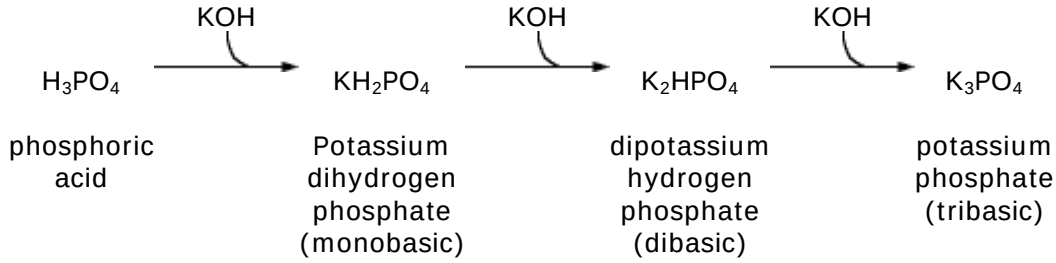
DISCUSSION

What is phosphite?

CHEMICAL DIFFERENCES OF PHOSPHORIC ACID (Phosphate), PHOSPHOROUS ACID (Phosphite) AND PHOSPHONIC ACID (Phosphonate)

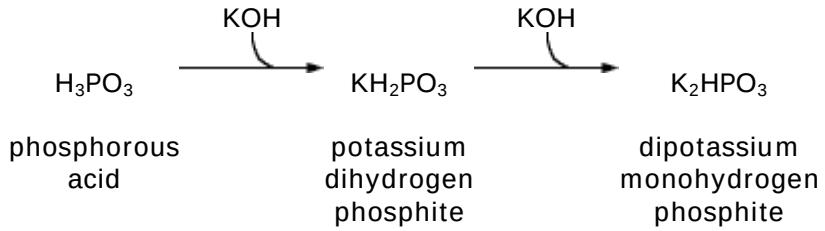
Contrast  which is phosphoric acid to  which is phosphorous acid.

When phosphoric acid (H_3PO_4) is neutralized with a base, such as potassium hydroxide (KOH) or ammonium hydroxide (NH_4OH), a salt results. The salt of phosphoric acid is a phosphate. For example:



(For convenience, all forms of the salt are routinely referred to as "potassium phosphate" with potassium dihydrogen phosphate and dipotassium hydrogen phosphate serving as phosphate fertilizers).

When phosphorous acid (H_3PO_3) is neutralized with a base, such as potassium hydroxide (KOH) or ammonium hydroxide (NH_4OH), a salt results. The salt of phosphorous acid is a phosphite. For example:



An organic derivative of phosphorous acid is a phosphonate. A break down product of a phosphonate is phosphonic acid.

Phosphite has one less oxygen molecule than phosphate, a higher degree of solubility and mobility, within the plant is achieved. This unique chararacteristic permits phosphites to be rapidly absorbed or taken up across the membranes of plant foliage and or roots, in both their nutritive and plant protective roles.

Once applied and rapidly absorbed, by the plant, Phosphites undergo an oxidation or conversion process resulting in the continual release of soluble phosphorus. This allows for the beneficially timed utilization of phosphorus, in preparation for critical times when demand by the plant may be especially high or uptake is otherwise impaired.

Phosphites in the form of potassium were found useful for soil application. There were plenty of products labeled as soil nutrients addressing for P nutrition for turf, fruit crops and vegetables. Combination of phosphites of ammonium and potassium were also available in the existing market used as soil P fertilizer. This was evident to see the label " http://www.clearychemical.com/Nutri-Grow%20Mag%20SL-Oklahoma.pdf "

As reported by Mitchell and Adams (2004) and presented in the Agronomy series extension bulletin, (http://www.aces.edu/timelyinfo/Ag%20Soil/May2004/s-04-04-phosphite.pdf) on the usage of ammonium phosphite (11-35-0) in comparison with ammonium poly phosphate (10-34-0) were applied to cotton at 12 gallons per acre in a 2X2 band at planting and applied on the surface. The ammonium phosphite resulted in shorter plants at the fourth true leaf stage but no differences in P concentration in yield at harvest were observed. Field observations recorded on peanut and cotton crops applied with ammonium phosphite (11-35-0) were exhibited the similar trends in establishments of cotton and peanut

Phosphorus Uptake

Phosphorus has long been one of the most difficult nutrients to supply to plants. Even though soil may have either naturally available and/or added phosphorus, adequate reservoirs may not be readily available for optimum plant functions. Therefore, natural phosphorus levels are generally not sufficient to support the needs of plants without supplemental fertilization.

Phosphorous acid is readily taken up by the plant and is xylem- and phloem-mobile (Ouimette and Coffey 1989). The limited amount of available phosphorus due to the fixation in the soil media and the less efficient uptake of some foliar applied phosphorus materials, which undergo a degree of conversion in plants or soils to available phosphoric acid (P_2O_5). PO3 was found to be not stable in soil and pH dependant. The factors like P fixation, soil reaction, temperatures, pH, moisture levels, oxygen supply and chemical reactions with other minerals were limiting the P availability in the soil.

Large quantities of phosphates, both soil and foliar applied, have been utilized to correct phosphorus deficiencies and provide sufficient levels. This practice has contributed to increased cultural costs and environmental contamination among other problems associated with excessive phosphate use.

Based on the observations made on corn, peanut and cotton fields applied with ammonium phosphite needs further investigation to find out the efficient way to utilize ammonium phosphite as P fertilizer.

By making use the existing literatures, observations and crop stand in ammonium phosphite applied plots following were the suggestions for increasing the efficiency of ammonium phosphite,

1. P is in excess from ammonium phosphite applied plots at 12 gallons per acre caused the crop damage in early stage of corn crop.
2. Beans are comparatively shorter duration crop needs more of phosphate form of P for quick establishment of root system.
3. Excess P from PO3 form was found toxic on corn and beans when it is applied at 100 per cent level. Hence the split application of ammonium phosphite may be recommended for increasing the P use efficiency of the crop.
4. P from ammonium phosphite applied to peanut and cotton was found effective and crop stand was uniform. There was no reduction in plant height.
5. PO3 seems to be unstable in soil and pH dependant. Hence the soil pH of 6.5 to 7.2 with good aeration was found effective to respond for P without any toxicity. Hence the soil reclaim either with lime or sulfur to regulate the pH for the better uptake of P from the soil.

Besides fertilizer value of phosphonates, phosphorous acid is also used as fungicides inhibiting fungus growth, and also by changing the nature of the fungal cell walls by activating the plants own immune defense response through rapid cytological action, and triggering other cellular phytoalexin accumulations and metabolic changes and other resistance inducers. (Smille, R., B.R.Grant and D.Guest. (1989) Phosphonates are highly selective, non-toxic fungicides against numerous fungal pathogens, and provide both protective and curative responses against such plant disease isolates of Phytophthora, Rhizoctenia, Pythium, Fusarium and others plant diseases.

SUMMARY

There are about dozens of phosphonate products are labeled as fertilizers and few products are labeled as fungicides. With reference to the literatures and detailed research investigations are not yet studied in detail in any of the research organizations. Moreover the analytical procedures are also not yet designed to measure P out of phosphite. Additional research is needed on application methods, timing of application and find out the differential behavior of various crops respond to phosphite based P fertilization.

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