Introduction

Both gardeners and homeowners alike have come in contact with plant food, or lawn fertilizer at some point. Fertilizer manufacturers label packages or bags of fertilizer with three numbers, representing the amount of nitrogen (N), phosphorus (P2O5), and potassium (K2O). While plants need nutrients of all kinds, it is especially important that they get nitrogen, phosphorus, and potassium for various reasons. Phosphorus is important to plants for capturing and collection sunlight during photosynthesis (which can be later used by the plant), acting as a catalyst in chemical reactions, and in plant structures. If a plant has too much phosphorus, roots and shoots can be destroyed. Too little phosphorus will discolor the plant and stunt its growth. The right amount of phosphorus can spell the difference between a healthy or sick plant.

This experiment looks at three different brands of plant food, and using techniques from earlier experiments, determine the amount of phosphorus in each brand. Once the experimental number is reached, it can then be compared against the manufacturer's given percent. Assuming care and that this experiment is accurate, the experimental percents obtained should be close to what the manufacturer states.

In order to determine the percent of phosphorus in each brand of plant food, each brand must be ionized, filtered, and a precipitate must form. The formed precipitate will then contain all the phosphorus filtered from the plant foods, and can be analyzed to determine just how much phosphorus is in each brand of plant food.

Procedure

A magnesium sulfate solution was prepared by dissolving 30 grams of Epsom salts into 300 mL deionized water. The amount of solution yielded was enough to perform ten testing trials. This experiment requires nine separate trials; therefore it is unnecessary to remake the magnesium sulfate solution before each trial. A small amount of plant food was placed into a mortar and pulverized into power. From this, two grams was separated, and dissolved into 30 mL of deionized water. A Buchner funnel apparatus was used to filter insoluble material, which was discarded. The remaining solution had 30 mL of the magnesium sulfate solution prepared earlier added to it, as well as 40 mL ammonia. The solution was then set aside for fifteen minutes, in order for the precipitate to gather at the bottom. During this time, a piece of 7cm filter paper was weighed. The precipitate was then collected onto the filter paper using a Buchner funnel apparatus. Any remaining precipitate was rinsed from the beaker using rubbing alcohol. The filter paper was placed into a Petri dish and allowed to dry completely for one day, and then weighed.

This procedure was repeated three times for each brand of plant food, resulting in nine total trials.

Results

Bloom Plus Raw Data Chart

	Trial One	Trial Two	Trial Three
Sample weight (g)	2.00	2.00	2.00
MgNH4PO4 and Filter Paper weight (g)	3.65	3.53	3.49
Filter paper weight (g)	.33	.34	.34
Grams MgNH4PO4 (g)	3.32	3.19	3.15

Ace Hardware Tomato and Vegetable Food

	Trial One	Trial Two	Trial Three
Sample Weight (g)	2.00	2.00	2.00
MgNH4PO4 and Filter Paper weight (g)	.91	.83	.88
Filter paper weight (g)	.33	.36	.34
Grams MgNH4PO4 (g)	.58	.47	.54

Miracle-Gro

	Trial One	Trial Two	Trial Three
Sample weight (g)	2.00	2.00	2.00
MgNH4PO4 and Filter paper weight (g)	2.63	2.55	2.58
Filter paper weight (g)	.36	.32	.35
Grams MgNH4PO4 (g)	2.27	2.23	2.23

The following calculations were done in order to determine the amount of P2O5 in each plant food brand, as well as percent of error.

Bloom Plus (60% P)
Grams P2O5

Trial One:

3.32g MgNH4PO4 (1 mol / 245.41g) (1 mol / 1 mol MgNH4PO4) (1 mol P2O5 / 2 mol P) (141.94g / 1 mol P2O5)

≈ .9601

Trial Two:

3.19g MgNH4PO4 (1 mol / 245.41g) (1 mol / 1 mol MgNH4PO4) (1 mol P2O5 / 2 mol P) (141.94g / 1 mol P2O5)

≈ .9225

Trial Three:

3.15g MgNH4PO4 (1 mol / 245.41g) (1 mol / 1 mol MgNH4PO4) (1 mol P2O5 / 2 mol P) (141.94g / 1 mol P2O5)

≈ .9109

Average Grams:

.9601 + .9225 + .9109 / 3

≈ .9311

Percent P_2O_5:

(.9311 P_2O_5 / 2.00 g Sample) x 100%
≈ 46.555%

Percent Error:

[|60.00% - 46.555%| / (60.00%)] x 100
≈ 22.4083%

Ace Hardware Tomato and Vegetable Food (10% P)
Grams P_2O_5

Trial One:

.58g $MgNH_4PO_4$ (1 mol / 245.41g) (1 mol / 1 mol $MgNH_4PO_4$) (1 mol P_2O_5 / 2 mol P) (141.94g / 1 mol P_2O_5)
≈ .1677

Trial Two:

.47g $MgNH_4PO_4$ (1 mol / 245.41g) (1 mol / 1 mol $MgNH_4PO_4$) (1 mol P_2O_5 / 2 mol P) (141.94g / 1 mol P_2O_5)
≈ .1359

Trial Three:

.54g $MgNH_4PO_4$ (1 mol / 245.41g) (1 mol / 1 mol $MgNH_4PO_4$) (1 mol P_2O_5 / 2 mol P) (141.94g / 1 mol P_2O_5)
≈ .1561

Average Grams:

.1677 + .1359 + .1561 / 3
≈ .1532

Percent P_2O_5:

(.1532 P_2O_5 / 2.00 g Sample) x 100%
≈ 7.66%

Percent Error:

[|10.00% - 7.66%| / (10.00%)] x 100
≈ 23.4%

Miracle-Gro
Grams P_2O_5

Trial One:

2.27g $MgNH_4PO_4$ (1 mol / 245.41g) (1 mol / 1 mol $MgNH_4PO_4$) (1 mol P_2O_5 / 2 mol P) (141.94g / 1 mol P_2O_5)
≈ .6564

Trial Two:

2.23g $MgNH_4PO_4$ (1 mol / 245.41g) (1 mol / 1 mol $MgNH_4PO_4$) (1 mol P_2O_5 / 2 mol P) (141.94g / 1 mol P_2O_5)
≈ .6448

Trial Three:

2.23g $MgNH_4PO_4$ (1 mol / 245.41g) (1 mol / 1 mol $MgNH_4PO_4$) (1 mol P_2O_5 / 2 mol P) (141.94g / 1 mol P_2O_5)
≈ .6448

Average Grams:

$$.6564 + .6448 + .6448 / 3$$
$$\approx .6486$$

Percent P_2O_5:

$$(.6486\ P_2O_5 / 2.00\ g\ Sample) \times 100\%$$
$$\approx 32.3\%$$

Percent Error:

$$[|30.00\% - 32.3\%| / (30.00\%)] \times 100$$
$$\approx 7.66\%$$

Discussion

The results of this experiment show a large scope of numbers compared to the plant food brands, and compared to the percent given by the manufacturers. Both Bloom Plus and Ace Hardware Tomato and Vegetable Food showed a considerable difference in the experimental value and the accepted value. Additionally, both brands have a high percent of error of 22% and 23%, respective. However, Miracle-Gro was found to have *more* then what the manufacturer had stated by nearly 2.5 percent. Miracle-Gro also had the lowest percent of error of the three brands at 7.66%. Sources of errors for this experiment include human error, contamination of instruments used, poor batch of plant food, improper pulverization of the plant food, poor scale measurements, poor magnesium sulfate solution, improper calculations, or too much or too little solutions being mixed.

Conclusion

This experiment yielded ambiguous results in the sense that it is unclear who is at fault by having skewed results: the experimenters or the

manufacturers. It is of note that two of the three brands tested had a large difference in the amount of phosphorus found in comparison with the stated value. If all three brands were off, it could be questioned that the experimenters were not conscientious or careful in experimentation. Since Miracle-Gro, however, yielded a result considerably close to the stated value, it is difficult to determine why the first two were skewed greatly while Miracle-Gro was slightly skewed.

The only way to tell if the experimental results are true or false is to do thorough testing of each brand extensively. Using the results of this experiment, it can be said that the experiment is inadequate for determining the amount of phosphorus in plant foods due to the ambiguity of the results.