Fertilisers affect the way plants grow and the yield they produce

Background information

There are 2 types of fertilisers organic and inorganic, inorganic fertilisers can be used straight away. General inorganic fertilisers contain nitrogen, phosphorus and potassium (N, P and K). These are the three main elements which plants need from the soil in order to grow well. (Roberts, The living world 1991).

Phosphorus is essential for photosynthesis (the process by which plants trap the sun's energy and uses it to make food). It also plays a part in the healthy working of the plant cell nucleus and in control processes. It stimulates root development and is important in energy storage. Phosphorus occurs naturally. In soil it is mainly in mineral form, but it can also be found in organic matter.

Potassium maintains the salt balance in plant cells and is important for healthy metabolism. It's essential for the bacteria in legumes, which fix nitrogen from the air. Potassium is a common element, which is found as potassium chloride (often known as potash) derived from weathered rock. It can also be obtained from organic matter but only in small quantities.

Nitrogen is a major nutrient essential to life. It is vital for building DNA and proteins in plants. Air is 79% nitrogen. Nitrogen also occurs naturally in many compounds in soil and water. Like all matter, nitrogen can't be destroyed; it can only be changed into a different form. The movement between these forms is called the Nitrogen Cycle. Fertile soils hold vast reserves of organic nitrogen in decaying plant matter (humus) and in many soil organisms. To be usable by plants it has to be converted into the inorganic ammonium or nitrate ions which are released when bacteria and fungi breakdown organic matter. Plants and animals cannot make direct use of nitrogen from the air so the first step in the nitrogen cycle is to convert nitrogen in the air into ammonium ions. (This process is called fixation).

Biological aims

I am planning to see which of the three essential nutrients (N, P and K) is the most important and what effect they have on the plant individually and as a group.

Risk assessment

I will carry out normal laboratory safety procedures at all times.

Equipment

- 50 tomato plant seeds,
- 50 plant pots,
- compost,
- fertilisers: ammonium nitrate (NH NO), phosphorus pentoxide (P O and potassium oxide (K O),
- water,
- measuring cylinder,
- scales
- spray gun,
- Weigh boat.

Design of experiment

I will take 50 tomato plant seeds I will pot them in the same type of compost individually. With 10 of the plants I will use just water. With another 10 of the plants I will add ammonium nitrate and water in a solution (NH NO) : this will add nitrates to the soil. With another 10 I will add phosphorous pentoxide and water in a sol ution (P O): this will add phosphates to the soil. With another 10 I will add potassium oxide with water in a solution (K O): this will add potassium to the soil. With the final 10 plants I will add all three with water to form a solution. I will water the plants daily and use 10cm a day for the first week, 20cm for the second, 30cm for the third week increasing it by 10cm a week with a maximum of 150cm . This will allow a suitable amount of water for the plant as it grows. I intend to do a trial run before starting the actual investigation. This will ensure that the quantities I have chose are correct and that the experiment will work. I will wait for the plants to flower and then weigh the yield of each plant.

Changing the experimental variable

The only thing which is being changed is the fertiliser, which I have mentioned above. They will be added in equal amounts to the necessary plants. There is no need to repeat the experiment as I am using 10 plants for each part of the experiment, this will provide a wide spread of results and will enable me to plot an average which will be precise and reliable.

Maintaining other features constant

All other environmental features will be kept constant. All the plants will be kept in the same place so they get the same amount of light, the temperature will also be kept the same this way. The amount of water will be measured with a

measuring cylinder. The amount of fertiliser (which I am unsure of as I will need to find out what are the proposed measures are) will be measured on electric scales. The mixture will be applied using a spray. The seeds will be bought from the same place and same packet. The compost, which is going to be used, will also be from the place so it is continuos.

Control

The control will be the 10 plants, which are growing with out the fertilisers and only water.

Results

	Plants									
	1	2	3	4	5	6	7	8	9	10
Weight (g)										
Average (g)										

A table will be made for each part of the experiment.

Prediction

I think that the plants with the potassium will have a lot of fruit as potassium produces a high fruit yield. I think that the plants with the phosphates will also have a reasonably high yield. Although I think that the plants with the nitrates will have large leaves but not a high fruit yield. The plants with all of them should probably have the highest fruit yield and the plans with just water should have the lowest.

I believe this as the plants will take the nutrients which are already in the soil. But once they have used them all, they will get stunted growth and a low fruit yield etc. with the combination of all three of the nutrients the 10 plants which have this should produce the highest yield. As they will have a high disease resistance, strong stems, large green leaves etc (Dr. D. G. Hessayon).

Risk appraisal

All equipment was used safely. The experiment didn't involve acids but did involve powder form of some chemicals. I was careful to not spill this onto my skin and to make sure it went no where near my mouth.

Results

Seed	1	2	3	4	5	6	7	8	Average	Percentage

day									(cm)	increase (%)
7	N	0.2	0.4	0.5	N	0.2	N	0.3	0.32	941
21	2.8	3.5	3.1	4.0	2.9	3.5	3.1	3.7	3.33	

The seeds were kept in a control petri dish with all water.

N= didn't germinate

The measurements were added up then divided by the number of plants, which grew

i.e.: 5

Seed day	1	2	3	4	5	6	7	8	Average (cm)	Percentage increase (%)
7	0.4	0.3	0.6	0.8	N	N	0.5	0.4	0.50	658
21	3.7	3.6	4.0	4.3	3.2	N	3.9	3.8	3.79	

The seeds were kept in a petri dish in a 0.1 molar solution. I used 0.045g of fertiliser.

The fertiliser I used was ammonium nitrate.

N = didn't germinate

The measurements were added up then divided by the number of plants, which grew

i.e.: 2

Seed day	1	2	3	4	5	6	7	8	Average (cm)	Percentage increase (%)
7	0.6	0.9	0.7	0.4	0.5	0.8	0.6	N	0.64	558
21	4.1	4.8	4.3	3.8	4.2	4.6	4.3	3.6	4.21	

The seeds were kept in a petri dish in a 0.2 molar solution. I used 0.045g of fertiliser.

The fertiliser I used was ammonium nitrate.

N= didn't germinate

The measurements were added up then divided by the number of plants, which grew

i.e.: 1

Seed day	1	2	3	4	5	6	7	8	Average (cm)	Percentage increase (%)
7	0.8	0.9	1.1	0.7	0.6	0.8	1.0	1.2	0.89	465
21	4.9	5.0	5.2	4.8	4.5	5.1	5.3	5.4	5.03	

The seeds were kept in a petri dish in a 0.3 molar solution. I used 0.14g of fertiliser. The fertiliser I used was ammonium nitrate.

Seed day	1	2	3	4	5	6	7	8	Average (cm)	Percentage increase (%)
7	1.3	1.5	1.2	0.9	1.0	1.1	1.6	1.9	1.31	397
21	6.4	6.6	6.3	6.1	6.3	6.4	6.8	7.2	6.51	

The seeds were kept in a petri dish in a 0.4 molar solution. I used 0.18g of fertiliser. The fertiliser I used was ammonium nitrate.

Seed day	1	2	3	4	5	6	7	8	Average (cm)	Percentage increase (%)
7	2.2	1.9	2.1	2.0	1.8	2.3	2.0	1.6	1.99	246
21	7.1	6.8	6.8	6.9	6.6	7.4	7.0	6.5	6.89	

The seeds were kept in a petri dish in a 0.5 molar solution. I used 0.23g of fertiliser. The fertiliser I used was ammonium nitrate.

Analysing evidence and drawing conclusions

My percentage increase graph was plotted from day 7, which is when the main growth will have taken place. So from day 7 to 21 the percentage decreases with the

stronger solution because the plant doesn't rely upon the nutrients as much. A plants growth takes place in the first 7 days by the 21st day it starts to develop into a plant. It grows leaves and can photosynthesise. So it no longer needs to rely upon the nitrates as much.

Nitrogen is essential to growth it increases the building of DNA and proteins, these are used to grow quicker. Therefore the seeds with the higher concentration would grow faster due to the building of DNA and proteins at a faster rate. This explains the results from my second graph.

My other graph shows that as the concentration is higher the rate at which the plants grow is faster. This is the same for both day 7 and day 21. Some variables could not be kept exact constantly such as the amount of sunlight in the room or the heat of the room.

I had one anomalous result in my average growth of day 21. This was 0.4 molar. And another one in my percentage increase graph at 0.5 molar, but I will talk about this more in my evaluation.

Conclusions

The results supported my prediction, which was the ***higher the concentration the faster the plants will grow.*** This is because there was more nitrogen in the higher concentrations which will allow proteins and DNA to build up faster. Because they built up faster it meant that the plant was able to grow quicker and mature faster. It then grew its leaves quicker, which would allow it to photosynthesises and produce its own energy without having to rely on the nitrates.

The graphs shows these results and the scientific reasoning behind it also backs my results up. The few anomalous results that I got could be put down to human error. As it has nothing to do with the scientific side of it. as it was only a couple of readings were out.

Evaluation

The experiment had a few flaws, which could have been changed if they had been noticed at the start of the experiment. This is why I had a couple of anomalous results one at 0.4 molar and the other at 0.5 molar (percentage increase) in the rest of my evaluation a will explain why they are there.

The seeds were placed in a room where the temperature and amount of sunlight could not be recorded. As the seeds were in slightly different parts of the room it meant that one set of seeds might have got more sunlight where the other could have been in the shade. The temperature wouldn't have been constant all the

time as at night the temperature in the room would have dropped a couple of degrees. Which meant that that variable would be changed.

The concentrations could have been measured better as the fertiliser was measured using a digital balance to two decimal places. And the water was measured in a syringe. It could have been measured more precisely in a burette. This may be the reason a couple of my results weren't accurate enough. The mixture of fertiliser and water may not have been mixed completely so parts of the fertiliser could have been left in the syringe so it wouldn't be the right concentration.

I did eight seeds for each concentration as this would give a sufficient set of readings to make sure that they would be accurate enough. This would allow for room for error incase one of the seeds was dead. If I repeated the experiment again I would probably use 10 seeds as it would make my results even more accurate.

I think the results I collected provide enough sufficient evidence to support a firm conclusion, which supports my hypothesise. I think this as the results I collected all show the same trends and there is only a couple anomalous results, which have been identified and explained earlier on in my evaluation.

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