Candidate 1 evidence

The effect of fertilisers on growth of algae

Aim:

To compare the effect of a commercial fertiliser and worm tea on the growth of algae.

Underlying environmental science

Algae are sometimes classed as plants but are a separate class of organisms. Like plants, they photosynthesise, and require nutrients for growth. Essential plant nutrients include carbon, hydrogen, oxygen, nitrogen, phosphorus, sulfur, iron, and trace elements.[1]

Commercial fertilisers contain specific levels of nutrients essential for growth of plants, particularly nitrogen, phosphorus and potassium. Nitrogen boosts leafy growth, phosphorus helps formation of flowers and fruit, and potassium promotes root development. [2]

Use of a wormery to compost kitchen waste provides nutrient-rich compost and a liquid known as worm tea. The nutrient composition of the compost and worm tea depends on the types and volumes of waste added to the wormery but they are usually rich in nitrogen, phosphorus and potassium. The compost and worm tea from the wormery can be used in the garden as an alternative to commercial products.

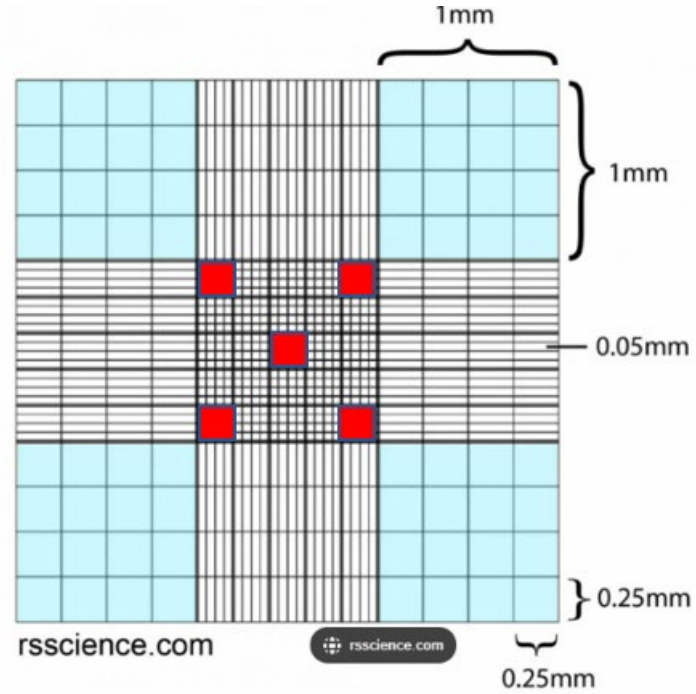
All fertilisers need to be applied carefully to make sure they don't enter waterways, where they can promote growth of aquatic plants and algae. Algae will increase rapidly and form an algal bloom across the surface of the water in a process known as eutrophication. As the bloom spreads across the surface of the water it blocks sunlight from reaching aquatic plants, causing them to die. The algae will also eventually die and will be decomposed by bacteria. As the bacteria decompose the plants and algae, the biological oxygen demand (BOD) of the bacteria increases and oxygen dissolved in the water is used up. This harms fish and other aquatic organisms that also depend on oxygen dissolved in the water.

Data collection and handling

Three cultures were made using *Chlorella vulgar*, a type of algae, before being left to grow in the lab for 3 weeks.

Culture 1: algae only, no fertiliser
Culture 2: algae + commercial plant feed (20 parts N : 20 parts P : 20 parts K)
Culture 3: algae + worm tea (NPK ratio unknown)

A microscope slide with a calibrated grid known as a haemocytometer was used for counting the number of algae cells present in a sample taken from each culture.



Squares counted on the haemocytometer, shown in red [3]

Raw data:

Sample	Number of algae cells counted					
	Square 1	Square 2	Square 3	Square 4	Square 5	Total
Algae only	17	11	20	12	15	75
Algae + commercial	63	57	85	73	63	341
Algae + worm tea	78	93	83	101	69	424

Five squares representing 0.02 mm^3 were counted for each culture, but algae counts are expressed as the number of cells in 1 cm^3

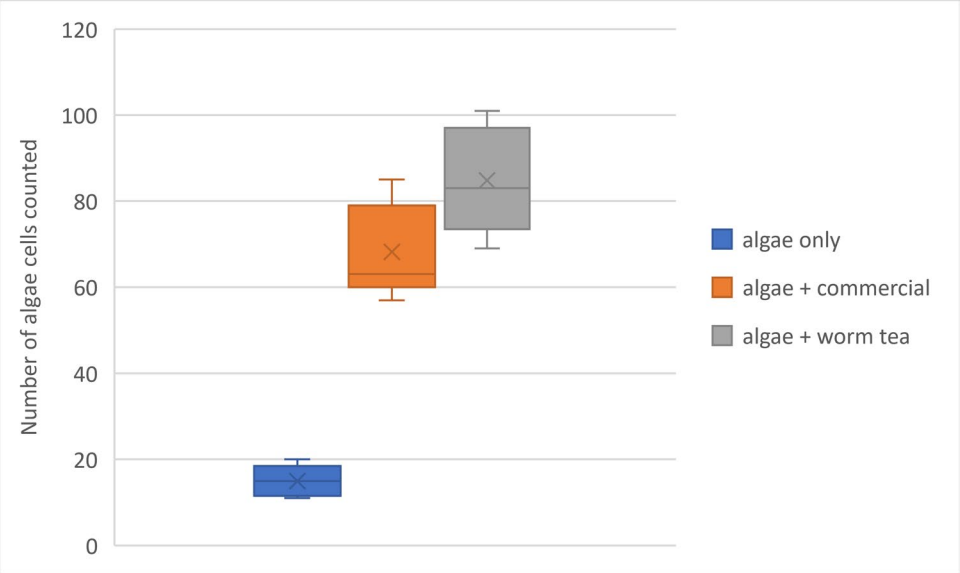
Sample	Total number of algae cells in 0.02 mm^3	Total number of algae cells in 1 mm^3	Total number of algae cells in 1 cm^3
Algae only	75	3750	3,750,000
Algae + commercial	341	17,050	17,050,000
Algae + worm tea	424	21,200	21,200,000

I then calculated the interquartile range to determine the spread of the data for each sample. The IQR shows variability in the middle 50% of the data. Larger IQR values show the values have a greater spread than smaller values.

Sample	Q1	Median	Q3	IQR
Algae only	11.5	15	18.5	7
Algae + commercial	60	63	79	19
Algae + worm tea	73.5	83	97	23.5

Graphical presentation

The interquartile values were used to produce a boxplot.



Analysis

The investigation shows that more algae cells were present in cultures containing fertiliser, and that the sample with worm tea added has the highest number of algae cells present.

The IQR results and boxplot show that there was greater variation in the number of algae cell counts for the sample with worm tea than in the other samples.

Conclusion

The aim of the investigation was to compare the effect of a commercial fertiliser and worm tea on the growth of algae. The data show that addition of fertiliser to the culture increases the growth of algae, and that worm tea promotes algae growth even more than commercial plant feed.

Evaluation

The algae culture bottle was mixed well before using a pipette to remove a sample from each bottle for count the cells. Five counts from each sample should have provided a representative sample, but

reliability of results would have been improved by sampling each culture more than once and carrying out more counts.

The same algae cell counting procedure was used for all three samples, using the same squares on the grid and the same rules for when a cell was touching the outer border. Cells touching the top or right hand line of the square were counted, but cells touching the bottom or left hand side of the square were ignored. This improved the accuracy of the count.

The NPK content of the worm tea was unknown but could have been checked using dip sticks. This would have shown if more of one nutrient was present than the others and could have been the reason for the worm tea culture having the highest algae cell count.

Sources

1 Penn State 10.3 Algae Growth and Reaction Conditions | EGEE 439: Alternative Fuels from Biomass Sources (psu.edu) [accessed July 2019]

2 Gardeners World Understanding and Using NPK Fertilizer. | BBC Gardeners World Magazine [accessed July 2019]

3 RS Science RS How to Use a Hemocytometer to Count Cells - Rs' Science (rsscience.com) [Accessed July 2019]