

Biology Coursework by Duncan Garnett

Experiment 1 – Comparing the growth of pea plants grown in the light and in the dark

Aim: To compare the vertical growth and weight gain of pea plants grown in the light and in the dark.

Background Knowledge: Photosynthesis forms the basis for this experiment. This is the process by which a plant makes food for itself from the raw materials around it. The energy needed for photosynthesis comes from sunlight, which is the variable for this experiment. The substance that absorbs sunlight is chlorophyll, which is mainly contained in chloroplasts. This energy is used to convert carbon dioxide (CO₂) and water into sugars. This conversion creates the waste product oxygen, which is used by humans for breathing. Without being able to photosynthesise plants will stop growing and die. In a plant growing in the dark the chlorophyll will slowly be destroyed causing them to use their food reserves. Once the reserves have been used the plant will die. This is what happens in plants that are not grown in sunlight. Etiolation is a phenomenon that occurs in plants not being grown in sunlight, whereby the stem of the plant rapidly elongates to increase the probability of the plant finding light. In order to carry out this etiolation the plant must use its food reserves, so if the plant does not find light having used these reserves, it will die.

Planning: I am planning to do an experiment over 3 weeks to find out the effect light has on the growth of pea plants. It will take place in an environment with controlled light, with equal amounts of plants being grown in the light and in the dark. All elements of the experiment other than light will be kept the same, such as amount of seeds in each pot, amount of soil in each pot and amount of water given to each plant each day. This will ensure a fair experiment.

Prediction: I predict that in general, the plants grown in the light will grow better than those grown in the dark. To begin with the plants grown in the dark will be taller than their counterparts in the light due to etiolation, but once these plants have used up their food reserves they will stop growing and some will most likely die. The plants grown in the light will grow more steadily and continuously so that at the end of the experiment they will be taller and heavier than the plants grown in the dark. They will be heavier because when the plants in the dark are

growing fast to reach the light they are not growing outwards and are not growing large roots. Also, the plants grown in the light will have a greener pigment than those grown in the dark although this is not something being measured in this experiment.

Apparatus: 24 Pea seeds (2 per pot)

12 Pots

12 Labels

12 Equal amounts of soil

12 Equal amounts of water each day

Rulers

Envelopes

Scales

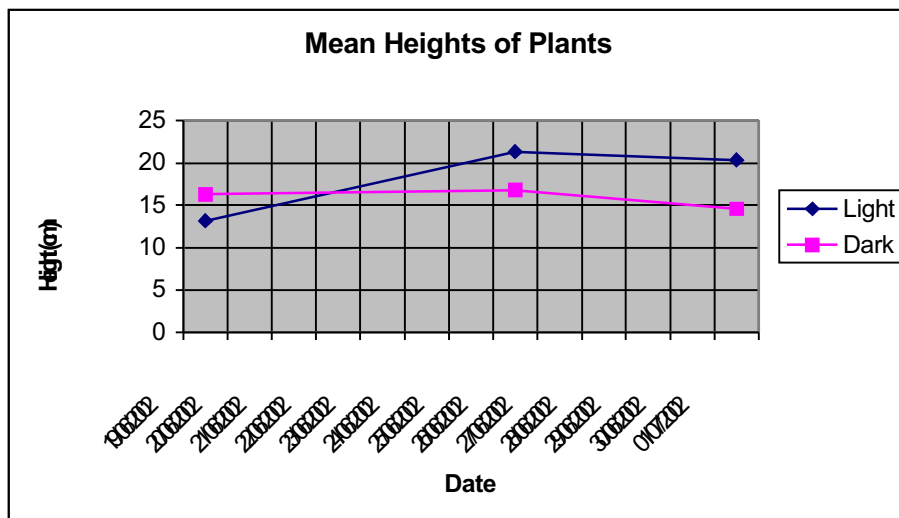
Method:

- Each person filled 1 black pot with soil up to the rim, and pushed 2 pea seeds to 1cm below the surface of the soil.
- All the pots were then left in sunlight for a week to germinate to approximately the same height.
- The smaller of the two seedlings was then removed from each pot and they were separated into two groups of six plants, one group was put next to a window with plenty of sunlight and the other was put inside a cupboard with no light.
- Every day all of the plants were equally watered and returned to their positions in the light and in the dark.
- Each week the plants were measured from the surface of the soil to the tip of the plant and returned to their respective positions.
- After 3 weeks of growing each plant was removed from the pot and the soil was cleared from the roots. The roots were then washed and the plants were put into envelopes for a week to dry.
- Once completely dried the plants were removed from their envelopes and weighed, with their weights being recorded in a table.

Results:

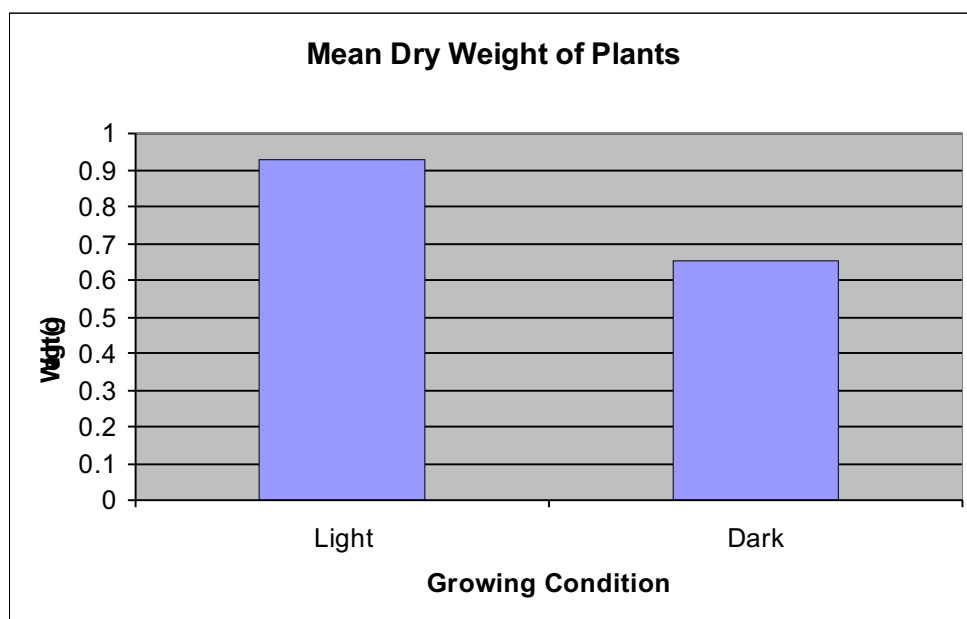
Plant Heights in Centimetres (cm)

	19 / 6 / 02	26 / 6 / 02	3 / 7 / 02	Increase from 19 / 6 / 02
Light - Pot 1	18.0	24.5	25.2	7.2
Pot 2	16.0	25.9	26.5	10.5
Pot 3	12.0	32.4	25.4	13.4
Pot 4	12.1	16.0	16.7	4.6
Pot 5	13.1	20.1	18.2	5.1
Pot 6	8.0	9.0	9.5	1.5
Total	79.2	127.9	121.5	42.3
Mean	13.2	21.3	20.3	7.1
Dark - Pot 7	18.0	18.2	16.5	-1.5
Pot 8	17.8	19.0	13.5	-4.3
Pot 9	-	-	-	-
Pot 10	17.0	17.0	17.4	0.4
Pot 11	12.3	13.0	11.1	-1.2
Pot 12	-	-	-	-
Total	65.1	67.2	58.5	-6.6
Mean	16.3	16.8	14.6	-1.7



Dry Weight of Plants in grams (g)

Light	Dry Weight (g)	Dark	Dry Weight (g)
Pot 1	1.39	Pot 7	0.66
Pot 2	1.20	Pot 8	0.63
Pot 3	0.84	Pot 9	-
Pot 4	0.88	Pot 10	0.69
Pot 5	0.66	Pot 11	0.72
Pot 6	0.62	Pot 12	-
Total	5.59	Total	3.25
Mean	0.93	Mean	0.65



Analysis: The main differences between plants grown in the light and the dark is that those grown in the light eventually grow taller and heavier than those grown in the dark. Also plants grown in the light are more likely not to die than those grown in the dark. In the first week of the experiment the plants in the dark grew more than those in the light as they were growing to try and find the light they need for photosynthesis. After this they had become weak without light so stopped growing and 2 of them died. By the 2nd week of the experiment 4 of the plants grown with light were over 20cm tall, a height which none of the plants grown in the dark ever achieved.

In the main, my prediction for what would happen in the experiment was correct. Over the 3 weeks the plants grown in the light

will grow taller and weight more than those grown in the dark. Although some of the plants grown in the dark were taller and weighed more than some grown in the light, on average the plants grown with ample sunlight grew better.

Evaluation: I think that the experiment did fulfil the aim in comparing the growth of pea plants in the light and the dark. The experiment proved correct the prediction that plants would grow better in the light than in the dark. This is shown by 3 statistics; Plants in the light grew an average of 5.7cm taller than those grown in the dark, only two thirds of the plants grown in the dark stayed alive for the whole experiment whereas all of the plants grown in the light stayed alive, and the dry weight of the plants grown in the light was an average of 0.28 grams heavier than those grown in the dark.

There were anomalous results in both the height and weight parts of this experiment. It could be expected that plants kept in the dark would shrink after some time as they would become increasingly weak and begin to die, but for some of the plants grown in the light to shrink, and by large amounts, is unexpected. One specific case is that Pot 3 appeared to shrink by 7cm between the 26th June and 3rd July. But it is more likely that the incorrect result is the one recorded on the 26th June as this suggests that it grew over 20cm in 1 week and went from being shorter than plant 4 to being over twice as high as it. Pot 5 also showed a slight decrease in height over the 3rd week of the experiment but this is more likely caused by leaf drop-off or growth beneath the surface of the soil rather than above. In terms of weight, pot 11, which was the shortest of the surviving plants in the dark was the heaviest of those grown in the dark, but this may well be due to extensive root growth rather than growth of stems and leaves.

The main improvement I would make to this experiment would be to increase the amount of results obtained in the experiment, in order to draw more accurate averages and more concrete conclusions. This would include using more plants in both the light and the dark, recording growth everyday to compare the point at which plants in the light grow faster and also I would lengthen the experiment to compare the flowering and pea production of plants under different light conditions. Another improvement would be to compare growth under different light intensities, in order to determine the ideal intensity of light in which to grow plants. However this would require further equipment and more controlled environments to implement and is not possible on the available scale.