Sample Lab Report

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September 9, 1996

Effect of the Hormone Gibberellic Acid on the Growth of Dwarf Peas

Objective
In this experiment students will grow genetically dwarf and tall peas with and without gibberellic acid to measure the effect of this hormone on growth.

Problem
How does the plant hormone gibberellic acid affect the growth rate and dwarf character of peas?

Hypothesis
Gibberellic acid will increase the growth rate of genetically dwarf peas.

Background Information
The pattern and rate of plant growth are controlled by a group of chemicals known as *hormones*. One hormone, gibberellin, stimulates cell division and enlargement in normal peas. However, dwarf peas have a mutation in a gene that controls either the content of or response to gibberellin (A.W. Galston, Aug. 13, 1996, personal communication).

Materials
2 gallons potting medium
3 flats with segmented inserts
Package tall pea seeds
Package dwarf pea seeds
Vial gibberellic acid paste (500 ppm)
Toothpicks
Centimeter ruler
3 clear plastic lids or cellophane

Procedure
1. Prepare soil by mixing 2 gallons of soil with 8 cups of distilled water and let the mixture sit overnight.
2. Place the tall and dwarf seeds in 2 labeled containers of distilled water, and let the seeds imbibe overnight.
3. Label the first flat “control dwarf peas,” the second flat “gibberellic dwarf peas” and the third “control tall peas.”
4. Fill each segment with soil, and place 2 seeds at least 2 cm apart and 5 mm deep in each segment.
5. Cover the flats with clear lids or cellophane.

6. After the seeds germinate, remove covers from flats.
7. Select 1 seed from each segment - ones that appear healthy and most similar in height to the others in the flats. Discard the other seedlings.
8. Measure each seedling, and record its height to nearest 0.5 cm.
9. Using a toothpick, smear gibberellic acid on the dwarf seedlings 2 mm thick from the soil to the tip of the plant.
10. Spray with distilled water until soil is moist throughout each flat.
11. Place flats under fluorescent or gro-lights.
12. Every second or third day, measure the plants and record the date and height of each plant. Note any changes in appearance of the plants (color, branching, etc.). Water the plants before replacing under the lights.

Results

1. Table

See the attached data table.

2. Graph

See the attached graph.

3. Summary Statement

According to our results, at 20 days after germination, the control dwarf peas only showed an average height of 15.8 cm, while the gibberellic acid-treated group of dwarf peas had an average height of 35.2 cm. The control tall peas had an average height of 32.4 cm. Performing a t-test on these values showed significant differences between the control dwarf and the gibberellic acid-treated dwarf peas ($t=0.022$) and between the control dwarf and the control tall peas ($t=0.048$). The t-test between the control tall and the gibberellic acid-treated dwarf peas ($t=0.296$) showed there is not a significant difference between these two groups. See the attached data table and graph.

Discussion of Results

1. Significance of Results

Since the gibberellic acid-treated peas grew to a height similar to that of the tall peas, and significantly more than the dwarf peas, the results suggest that gibberellic acid may replace the substance genetically missing from the dwarf peas, or may otherwise enhance the growth of these peas.

Variations in the amount of gibberellic acid applied to the seedlings may account for variations in the heights of the treated dwarf peas. Errors of 0.5 to 3 cm may also occur in the measuring, especially when the peas start to grow tall and twist. Temperature and light intensity under the fluorescent lights was not measured. It is possible that changes in light intensity from one plant position to the next might influence growth rates.

2. Applications to Advanced Life-Support Research

It would be interesting to determine if hormonal treatment could increase the food production in potential CELSS crops. It would also be interesting to measure the growing time and food production of other dwarf species, to determine if it might be more efficient to have dwarf species in an enclosed environment rather than their normal taller counterparts.

3. Suggestions for Future Experiments

Additional investigations on the effects of gibberellic acid may be done such as measuring the effects of gibberellic acid on the plant weight and leaf size, comparing the number of pea pods produced by dwarf, tall, and gibberellic acid-treated peas, or studying the effects of gibberellic acid on other species of plants. Another investigation could involve treating a set of tall pea plants with gibberellic acid to see if the growth rates of the treated group increases beyond that of a control tall group.

Conclusion

The data support the conclusion that gibberellic acid increases the growth rate of genetically dwarf peas.

References

Carolina Biological Supply Company. (1993). *Plant growth regulators kit 20-6050.* Burlington, NC: Author, 1-6.

Kaufman, P.B. (1989). *Plants: Their biology and importance.* New York: Harper & Row, 715.

Data Table

Effects of Gibberellic Acid on the Growth of Peas							
Plant common name:	Dwarf Pea and Alaska (Tall) Pea				Date planted:		6/13/96
Scientific name:	Pisum sativum				Date germinated:		6/15/96
	Control Dwarf Pea Heights (cm)						
Days after germination	2	4	6	9	11	18	20
Plant 1a	1.2	3.1	4.4	6.1	8.3	12.3	16.1
Plant 1b	1.8	3.6	5.1	7.1	8.8	15.9	19.0
Plant 1c	1.3	3.3	4.6	6.4	8.9	15.4	18.1
Plant 1d	0.4	2.9	4.2	6.3	9.5	12.0	13.4
Plant 1e	1.2	3.7	5.1	6.9	7.2	10.8	12.3
Mean Height of Control Dwarf	1.2	3.3	4.7	6.6	8.5	13.3	15.8
	Gibberellic Acid-Treated Dwarf Pea Heights (cm)						
Days after germination	2	4	6	9	11	18	20
Plant 2a	1.1	5.5	12.1	22.4	25.9	37.5	38.5
Plant 2b	0.6	5.4	14.6	24.7	28.1	35.8	30.1
Plant 2c	1.1	6.6	15.0	24.5	26.8	34.8	30.0
Plant 2d	0.9	6.7	14.2	21.7	26.5	30.2	38.2
Plant 2e	0.4	4.8	14.1	23.6	25.9	29.0	39.2
Mean Height of Gibberellic Dwarf	0.8	5.8	14.0	23.4	26.6	33.5	35.2
	Control Tall Pea Heights (cm)						
Days after germination	2	4	6	9	11	18	20
Plant 3a	1.7	5.8	12.1	20.0	23.4	42.2	50.1
Plant 3b	2.6	6.9	11.1	17.5	19.4	26.0	23.8
Plant 3c	1.8	3.2	6.7	15.5	18.4	24.3	25.4
Plant 3d	1.6	5.6	10.0	15.0	21.0	29.0	33.7
Plant 3e	2.1	6.5	9.5	12.5	11.1	23.5	29.0
Mean Height of Control Tall	2.0	5.6	9.9	16.1	18.7	29.0	32.4
Groups Compared	t-test Value			Significant (Yes or No)			
Gibberellic Acid-Treated Dwarf vs. Control Dwarf Peas	0.022			Yes			
Control Dwarf vs. Control Tall Peas	0.048			Yes			
Gibberellic Acid-Treated Dwarf vs. Control Tall Peas	0.296			No			

"Pasted Special" data columns for creating the chart used in this report:							
	Pea Heights (cm)						
Days after germination	2	4	6	9	11	18	20
Mean Ht. of Control Dwarf Peas	1.2	3.3	4.7	6.6	8.5	13.3	15.8
Mean Ht. of Gibberellic-Treated Dwarf Peas	0.8	5.8	14.0	23.4	26.6	33.5	35.2
Mean Ht. of Control Tall Peas	2.0	5.6	9.9	16.1	18.7	29.0	32.4

Graph of Results