Lab Report Template: Genetics Lab

TS Biology | Winter 2022

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Introduction:

By observing the phenotypes of height and stem color of the generations of the plant, *Brassica rapa*, conclusions can be drawn about the patterns of genetics of the *Brassica rapa* plant and its dominant and recessive traits. Mendelian patterns of inheritance define dominant and recessive alleles for each gene of an organism, which determine the phenotype. When one allele is dominant, and one is recessive, dominant traits are present in the phenotype while recessive traits are not. When both alleles are dominant, the dominant trait appears in the phenotype. When both alleles are recessive, the recessive trait appears in the phenotype. When two plants are crossed, the offspring can have different possible genotypes. The existence of Mendelian inheritance patterns for *Brassica rapa* is important because it shows the genetics of the plant and how traits are passed down in it. This information can be used in examining other traits exhibited by *Brassica rapa* as well. This experiment was conducted to find out whether the *Brassica rapa* plant follows Mendelian inheritance patterns.

Materials & Methods:

Materials:

- *Brassica rapa* P1 seeds
- *Brassica rapa* F1 seeds
- *Brassica rapa* F2 seeds
- Petri dishes
- Paper towel or similar absorbent paper
- Pipette
- Fluorescent lamp and bulb
- Dechlorinated Tap Water

Procedure:

1. Preparing seeds for germination
    a. Label the edge of the bottom side of the petri dishes: “P1”, “F1” and “F2”.
    b. Place the paper towel in the lid of the petri dish and add water until it is completely soaked. Pour off any excess water not absorbed by the filter paper.
    c. Place seeds on the paper, taking care of spreading them evenly.
    d. Place the bottom of the petri dish and label—make sure to match seeds and labels.
    e. Place the petri dish in a germination cup and add water until the water level reaches the edge of the paper towel (approx 1 cm) (Figure 1).

f. Place the cup approximately 7 inches below the lamp and place a “DO NOT TURN OFF LIGHT” sign.
g. Keep the cup at room temperature (22°C)

Figure 1. Petri dishes are placed in the cup with water.

2. Germinating seed and Data collection
    a. Maintain the dishes under constant light and temperature (optional: monitor temperature in the room).
    b. Every 12 hours inspect the water level in the cup and check the filter paper for moisture—add water to the cup as needed. Do not let the paper dry out.
    c. Every 12 hours inspect the seedlings and record observations in the Data Collection Sheet. Take a picture of each dish.
3. Clean up
    a. Discard paper and seedlings as compostable.
    b. Discard dishes and cup as Recyclable waste.
    c. Lamp and bulb should be returned to the instructor.

Results:

In the P1 generation, all observed plants were non-purple and standard height. They had green stems and were roughly all the same height **(see Figure 2)**. In the F1 generation, 8 out of 10 of the observed plants were Rosette Dwarfs with purple stems, 1 was a Rosette-Dwarf with a non-purple stem, and 1 was a standard height with purple stem **(see Figure 3)**.

In the F2 generation, 5 plants were purple, 4 plants were green, 5 plants were Rosette-Dwarf, and 4 plants were of standard height **(see Figure 4)**.

In the class data, all observed plants in the parent generation were green. Of those, 17 were Rosette-Dwarfs and 153 were standard height. In the F1 generation, 33 plants were purple Rosette-Dwarfs, 4 were non-purple Rosette-Dwarfs, 123 purple standard height, and 11 non-purple standard height. In the F2 generation, there were 57 purple Rosette-Dwarfs, 16 non-purple Rosette-Dwarfs, 98 purple standard height, and 31 non-purple standard height **(see Table 1 and Figure 5)**.

Figure 2: The P1 Generation After 96 Hours

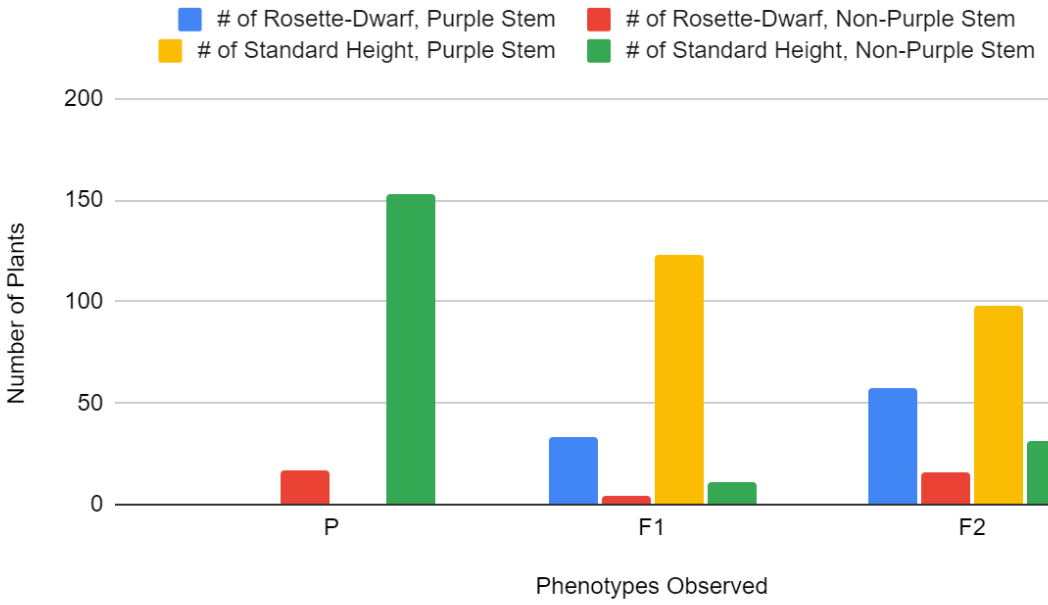
Figure 3: The F1 Generation After 96 Hours

Figure 4: The F2 Generation After 96 Hours

Table 1: Class Data of Phenotypes Observed

	P1	**F1**	**F2**
# of Rosette-Dwarf, Purple Stem	0	33	57
# of Rosette-Dwarf, Non-Purple Stem	17	4	16
# of Standard Height, Purple Stem	0	123	98
# of Standard Height, Non-Purple Stem	153	11	31
Total	170	171	202

Figure 5 (Graph): Graph of Class Data of Phenotypes Observed



<u>Discussion & Conclusion:</u>

The purpose of the experiment was to investigate the genetic patterns of the *Brassica rapa* plant for the relevant traits, which can be used to study other traits of the plant.

The mode of inheritance observed is complete dominance. Because all *Brassica rapa* plants are either green or purple, incomplete dominance can be ruled out since the plants would need to be a mixture

of green and purple in order for this to be the case, and codominance can be ruled out because both green and purple are not present in the phenotype at the same time.

The phenotype ratios in F1 and F2 suggest that one parent's genotype is ppHH (green, standard height) and the other's is PPhh (purple, Rosette-Dwarf). Because F2 has all possible phenotypes, the F1 individuals must be heterozygous for both stem height and color. The ratio predicted by a Punnett square with two heterozygous individuals **(see Figure 7)** aligns with the class data **(see Table 1)**. The ratio also shows that purple and standard height stems are dominant due to their greater prevalence. The same pattern of dominance is seen in both F1 and F2. One of the parents is green and F1 is all purple, so purple stems are dominant. Rosette-Dwarf individuals appear in F2 and F1 is all of standard height, meaning the trait for stems of standard height is dominant, since the F1 plants are heterozygous.

Punnett Squares:

P: purple
p: green

H: standard height
h: Rosette-Dwarf

P genotype: ppHH
Genotype of other parent: PPhh

Figure 6: F1 Punnett Square:

	pH
Ph	PpHh

Figure 7: F2 Punnett Square:

	PH	Ph	pH	ph
PH	PPHH	PPHh	PpHH	PpHh
Ph	PPHh	PPhh	PpHh	Pphh
pH	PpHH	PpHh	ppHH	ppHh
ph	PpHh	Pphh	ppHh	pphh

Purple standard height = 9/16
Purple Rosette-Dwarf = 3/16
Non-purple standard height = 3/16
Non-purple Rosette-Dwarf = 1/16

The probabilities calculated by these Punnett squares line up closely with the data from the class after human error is taken into account. This shows that the stem color and stem height of *Brassica rapa* sprouts show a Mendelian inheritance pattern.

The results do provide conclusive evidence to determine that the mode of inheritance is complete dominance. Through qualitative observations, it can be seen that the *Brassica rapa* plants are either green or purple completely, which suggests complete dominance.

Through prior knowledge it is known that the ratio of the dominant phenotype to the ratio of the recessive phenotype is 9:3:3:1. The Punnett square shows that a dihybrid cross is taking place because one parent is Ph and the other is pH. When those are mated, the possible phenotypes are 9/16 purple standard height, 3/16 purple Rosette-Dwarf, 3/16 non purple standard height, 1/16 non-purple Rosette-Dwarfs. Looking at the data collected in **Table 1,** the ratio of the purple standard height to the purple Rosette-Dwarf to the non-purple standard height to the non purple Rosette-Dwarfs was 98:31:57:16. This ratio does not exactly match up with the 9:3:3:1 ratio, and this can be explained because nature is not exact and the ratios are only rough estimates. Human error also played a role due to different perceptions of which plants might be of standard height or Rosette-Dwarf. So looking at it through that lens shows that these ratios do indeed give a good estimate even though they are not exact answers.

A possible follow-up experiment that one could conduct to confirm these conclusions would involve running the experiment at a larger scale and in a more controlled environment. The experiment being conducted at a larger scale implies that more seeds from the P1, F1, and F2 *Brassica rapa* would be grown at the same time. The experiment being conducted in a more controlled environment implies that all the seeds will be grown at once in a temperature-controlled room that is set to 22°C with appropriate lighting that is uniform throughout all of the plants, rather than the experiment being conducted in each student's own house, which prevents the experiment from being fully controlled and allows for a larger margin of human error. In some plants from the F2 generation, a variation in phenotypes was observed, in that the leaves of some plants looked like they expressed both the green and purple phenotype. The proposed experiment would allow one to study these patterns further. Additionally, conducting the experiment multiple times, with the environment being different each time the environments of the plants would assist someone in explaining these variations in phenotypes. Another possible experiment that would confirm these conclusions involves investigating different genes of *Brassica rapa* in the same format as either the experiment conducted or the larger scale experiment proposed.

This experiment tells us that the plant *Brassica rapa* follows the Mendelian inheritance patterns that were inquired about, which was found by analyzing two genes of the plant. This information could allow us to predict patterns of inheritance for other genes on the plant and those of similar plants. An interesting observation that can be made from the F2 generation of the plant is that the leaves of some of the plants appear to show both the green and purple phenotype, which may lead one to think that some sort of codominance was occurring. This may be a result of environmental pressures, which if explored further using the proposed follow up experiment could prove insightful on the characteristics of the plants grown, and may add to the field of biology.