

AQA – The control of gene expression – A2 Biology P3

1. June/2021/Paper_3/No.6

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Plants transport sucrose from leaves to other tissues for growth and storage. SUT1 is a sucrose co-transporter protein.

Scientists investigated whether the cells of tobacco plant leaves used SUT1 to transport sucrose to other tissues.

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The scientists used a radioactively labelled DNA probe to show that the cells of tobacco plant leaves contained the *SUT1* gene.

Describe how they would do this.

Do not include PCR in your answer.

[4 marks]

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To study the role of SUT1 in tobacco plants, scientists reduced the expression of the *SUT1* gene.

When the *SUT1* gene is transcribed, the SUT1 mRNA produced is called 'sense' SUT1 mRNA. The scientists genetically modified plants by inserting an **extra** gene so that this **also** allowed the production of 'antisense' SUT1 mRNA.

The scientists had two types of tobacco plants:

- type **A** – plants that were genetically modified
- type **B** – plants that were **not** genetically modified.

Suggest how the production of 'antisense' SUT1 mRNA in type **A** plants would reduce the expression of the *SUT1* gene.

[4 marks]

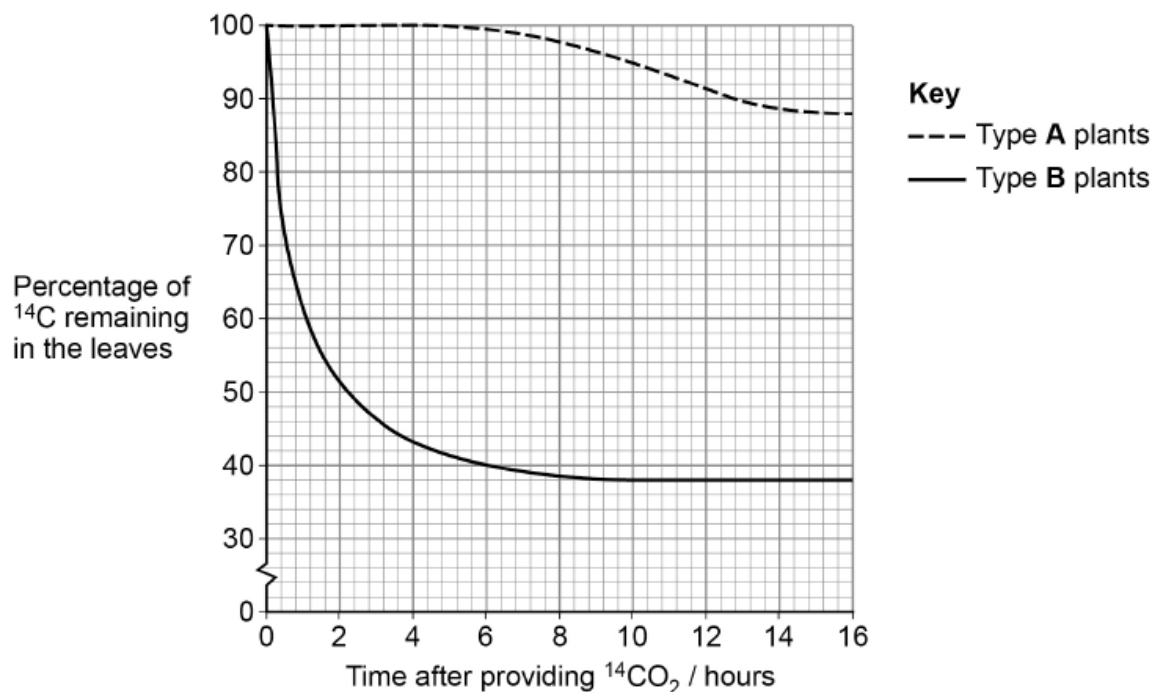
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The scientists hypothesised that lower rates of sucrose transport from leaves would cause reduced growth.

To test this hypothesis, the scientists provided leaves of type **A** and type **B** plants with labelled carbon dioxide ($^{14}\text{CO}_2$). To estimate sucrose transport out of leaves, they measured the percentage of ^{14}C remaining in the leaves for 16 hours.

Figure 5 shows their results.

Figure 5



Calculate the ratio of percentage of ^{14}C remaining in leaves of type **B** to type **A** plants 16 hours after providing $^{14}\text{CO}_2$

[1 mark]

Answer _____

0 6 . 4 In type **B** plants, the percentage of ^{14}C remaining in the leaves does not reach zero per cent, as shown in **Figure 5**.

Suggest **two** reasons why.

[2 marks]

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2

The scientists measured physiological differences between type **A** plants and type **B** plants.

Table 3 shows the scientists' results as they presented them.

Table 3

Physiological factor	Type of tobacco plant	
	Type A	Type B
Rate of sucrose transport from leaf cells / $\mu\text{mol m}^{-2} \text{s}^{-1}$	0.1	3.7
Leaf sucrose concentration / mmol m^{-2}	22	4
Ratio of shoot:root dry mass	6:1	2:1
Rate of photosynthesis / $\mu\text{mol glucose m}^{-2} \text{s}^{-1}$	4	14

Sucrose is able to inhibit the production and activity of rubisco in leaves of a plant. Type **A** plants have decreased dry mass compared with type **B** plants.

06.5

Use all the information to suggest **and** explain how the physiological factors in **Table 3** would contribute to the decreased dry mass observed in type **A** plants.

[4 marks]
