The Pesticide Problem

Contents: A decision-making and data-analysis exercise concerning the testing and use of pesticides.

Time: 2 periods.

Intended use: GCSE Chemistry, Biology and Integrated Science. Links with work on the use of chemicals as pesticides, and the ecology of pest control.

Aims:

- To complement work on pesticides and pest control
- To show some of the benefits and disadvantages of the use of pesticides
- To develop awareness of some of the methods used in commercial decision-making
- To provide opportunities to practise skills in the evaluation of evidence and the use of information and data in making decisions.

Requirements: Students' worksheets No. 210. It would be useful to have samples of pest-damaged plants and examples of commercial pesticides available for showing the class.

Suggested use of the unit

In school trials it was found valuable to precede the use of the unit with some discussion of pesticides and their advantages and disadvantages, rather than going into the unit 'cold'. For example, students could be asked to write a quick list of the properties needed in a good pesticide. After a brief discussion they could then tackle the unit.

The idea of Official Registration may prove difficult, and may need some explanation.

The exercise is best conducted in small groups of four or five, with an appointed or elected group recorder. At the end of the exercise a plenary session could be held to compare results. Alternatively, groups could be asked to design posters advertising one of the pesticides, incorporating information from the unit.

Notes on some of the questions

Q.8 The difference between rows is only 2 plants in about 50, and therefore not significant.

Q.10 The trial plots should be more widely spaced, with 'guard rows' in between to avoid the pesticide on one plot affecting the results on a neighbouring plot.

Q.11 Further trials would be necessary to verify results, thus increasing validity.

Q.12 Trials should be carried out on other crops that are prone to slug damage, for example, potatoes, strawberries, celery, carrots.

Acknowledgements Figures 1 and 3 are Shell photographs

THE PESTICIDE PROBLEM

Pests and pesticides

Pests are animals which steal or damage the food grown by humans.

The most common pests are insects. But mammals such as rats and mice, and molluscs such as slugs and snails can also be pests.

Pesticides are chemicals which kill or control pests. You are using a pesticide every time you use a fly-spray. Gardeners often use pesticides, and farmers spray them on their crops.

Figure 1 Crop spraying

Pesticides have to be very carefully designed. They must kill the pest, but not damage the food crop. They must not be harmful to the humans who will eat the food. They should not harm animals other than pests.

The chemical companies which manufacture pesticides have a tricky problem getting this balance right. Sometimes it is not possible. For example, DDT is a very effective insecticide which has been used to help control diseases, such as malaria, as well as protecting crops. But many countries, including Britain, have now banned the use of DDT. This is because it is suspected of killing birds, fish and harmless insects as well as pests.

There are strict Government regulations about testing pesticides for safety. Chemical companies spend millions of pounds on testing. Even so, many people say that pesticides are still unsafe, and that we use them too much. Others say that without pesticides we could never grow enough food to feed the world's huge, and growing population.

In this unit you will be looking at the testing of pesticides. You will be trying to make the kind of decisions a Government department or a pesticide manufacturer might have to make.

The unit is in two parts: Part 1, Which registration?; Part 2, Trials on pesticides.

Part 1 Which registration?

Before pesticides can be sold in Britain they have to go through tests for safety and efficiency. Manufacturers test their products to check they meet five conditions:

1 The pesticide is safe for people to use and does not harm them

2 Treated crops are safe to eat

3 Wildlife and the environment are not harmed

4 Treated crops are not damaged by the pesticide

5 The pesticide works in the way it is supposed to.

Once the test results have been collected, the company applies to the Ministry of Agriculture, Fisheries and Food for Official Registration. The Ministry has to decide whether the pesticide can be sold for use. There are three different types of registration that can be given. Without one of the different types of registration, the pesticide must not be used at all.

- *Trials Registration* This is granted if conditions 1, 2 and 3 only are met. The pesticide can then be used for 'field trials' by farmers. If these trials are successful it may be considered for Full Registration.
- *Provisional Registration* All five conditions have to be met. The pesticide can be sold, but there might be limits on:
  (a) the area it is used on
  (b) the time it is available for sale
  (c) the quantity that can be sold.
- *Full Registration* Again, all five conditions have to be met, but now the pesticide can be sold, provided it is properly labelled.

Three pesticides for controlling slugs

Slugs are a common garden pest (Figure 2). Slugs cause damage to food crops, including potatoes, celery, lettuce, carrots and strawberries. They can attack wheat grains in the soil, and young wheat plants. There are many species of slugs but only some of them are pests.

You work in the Official Registration Department at the Ministry of Agriculture. You have been asked by the Ministry to decide which type of registration (if any) to give to each of three pesticides which kill slugs. The pesticides are called **Slugger**, **Slugoff** and **GoSlug**. All three are made in pellet form.

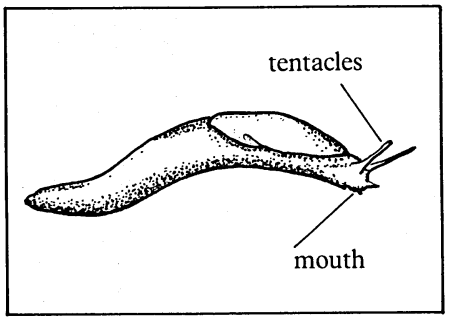

Figure 2 The garden slug — a common pest. It eats plants using a hard file-like tongue which tears at plant tissue.

Outline information about the three pesticides

Slugger (Chemical formula: $Cu(O_2C\ CH_3)_2AsO_3$)
The pesticide contains arsenic and is poisonous to humans and animals. A small amount of it is taken up by plants. It is very efficient, killing 90 per cent of slugs in the area where it is used.

Slugoff (Chemical formula: $C_{11}H_{15}O_2NS$)
This chemical is not poisonous to humans. The recommended time between using the product on a crop and harvesting the crop is 7 days. About 5 per cent of the earthworms in the treated area may be killed by it. Birds do not eat the blue pellets or the dead slugs. Plants are unaffected, and it kills 95 per cent of slugs in the treated area.

GoSlug (Chemical formula: $C_8H_{16}O_4$)
The chemical is harmful to animals. The product does not affect the crop or nearby plants. 50 per cent of slugs may recover in damp weather, because the pesticide works by drying out the slug.

Which registration will you give each pesticide? It is best to work in groups for this activity.

Draw up a table like Table 1. Then answer questions 1 to 7.

Table 1

	Refuse a Registration	*Trials Registration*	*Provisional Registration*	*Full Registration*
Slugger				
Slugoff				
GoSlug				

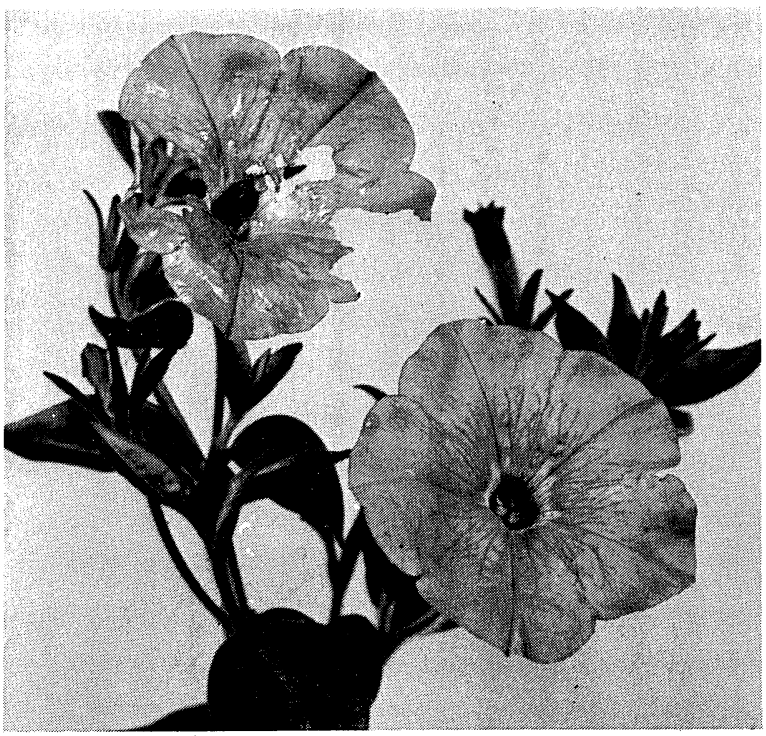

Figure 3 Slugs eat flowers as well as leaves. This petunia flower shows slug damage

Questions

1 *What registration will you give each product? Enter your decisions in Table 1. In each case give a brief reason.*

2 *For the product or products (if any) that you have given Trials Registration, what sort of evidence will you be looking for in the trials?*

3 *For the product or products (if any) that you have given Provisional Registration, what extra information would you need before granting Full Registration? In the meantime, what limits would you put on the use of the pesticide?*

4 *For the product or products (if any) that you have given Full Registration, what sort of information should be put on the label?*

5 *For the product or products (if any) that you have rejected, what will you tell the manufacturer?*

6 *The decision about registration is based on the five conditions given earlier. Do you think any other conditions should be added? If so which?*

Part 2 Trials on pesticides

Table 2 gives information about 'field trials' that were carried out by farmers. The idea of these trials was to test the effectiveness of Slugoff and GoSlug. Figure 4 shows how the trials were carried out.

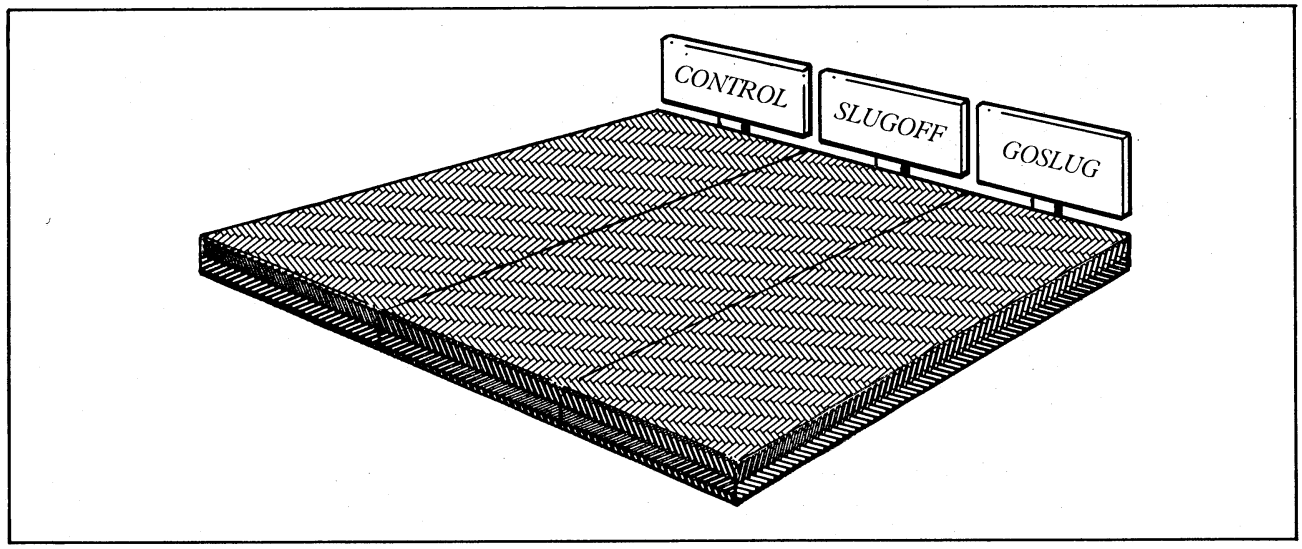

Figure 4 Field trials of pesticides.
Crop: winter wheat

Table 2 Results of trials

	Control	*GoSlug*	*Slugoff*
Amount applied/kg per hectare	Untreated	31	6
Dead slugs per square metre	0.0	6.5	10.3
Wheat plants per metre of row	52.1	54.2	54.9
Slug damaged wheat plants per metre of row	21.0	9.3	4.1
% damaged wheat plants	40.3	17.2	7.4

Questions

7 *Why was there a 0.0 count of dead slugs in the control area?*

8 *The number of plants per metre of row is not exactly the same in each case. Do you think this is an important factor in the trial? Give a reason for your answer.*

9 *Assuming Slugoff and GoSlug cost the same per kg, which product would seem better in terms of value for money?*

10 *Look again at Figure 4. What improvements could you make to the way the trial plots are arranged?*

11 *This trial was not the only one carried out. Explain why further trials would be necessary.*

12 *On what other crops, apart from wheat, would you recommend trials to be carried out?*

SATIS 2
List of units in this book

201 ENERGY FROM BIOMASS
Reading and problem-solving exercises, including optional practical work, on the production of biomass energy.

202 ELECTRIC VEHICLES
Reading and questions concerning the advantages and limitations of electric vehicles.

203 DRINKING ALCOHOL
Practical work, reading and questions on alcohol and its effects on the body.

204 USING RADIOACTIVITY
Reading and problems concerning the medical and industrial applications of radioisotopes.

205 LOOKING AT MOTOR OIL
Information and questions on the function of motor oil in an engine, and the problems involved in formulating an efficient oil. Optional practical work investigating the change of oil viscosity with temperature.

206 TEST-TUBE BABIES
Information and discussion questions on the problem of infertility and the technique of *in vitro* fertilization.

207 THE STORY OF FRITZ HABER
Reading and discussion questions relating to the life and work of the inventor of the Haber Process.

208 THE PRICE OF FOOD
Survey, analysis and discussion concerning the factors affecting the price of food items.

209 SPECTACLES AND CONTACT LENSES
Reading, questions, practical work and a survey concerning spectacles and contact lenses.

210 THE PESTICIDE PROBLEM
A decision-making and data-analysis exercise concerning the testing and use of pesticides.

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