

WJEC (Eduqas) Biology GCSE

Topic 6.4 Some of the
biological challenges of
increasing food yields using
fewer resources

Questions by Topic

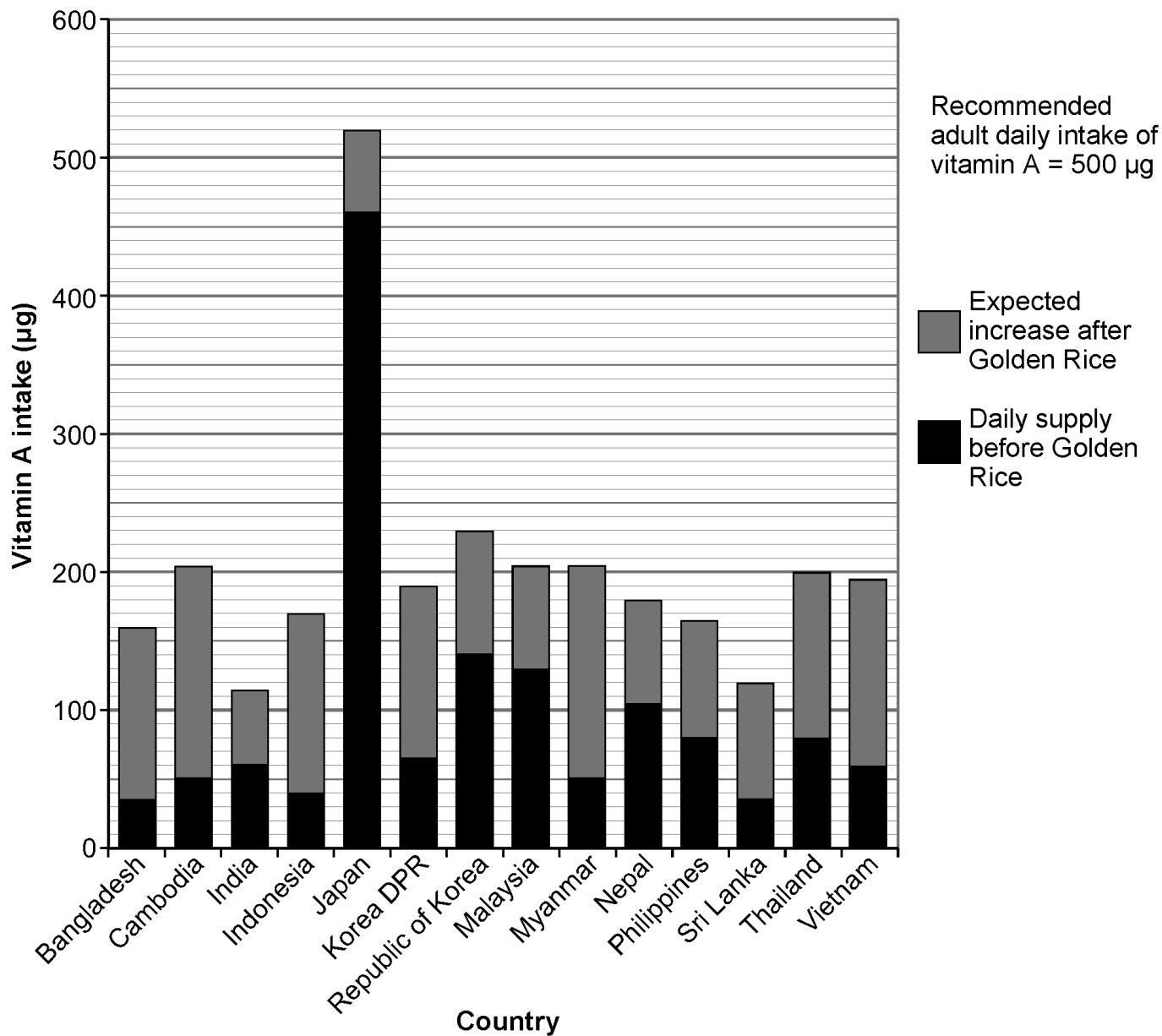
1.

Vitamin A deficiency occurs when humans do not obtain enough of this vitamin from their food. It is very common in developing countries. It can result in blindness and between 250 000 and 500 000 children in these countries go blind each year from vitamin A deficiency. Approximately half of these children die within one year of becoming blind.

Golden Rice is a genetically modified (GM) crop plant which contains high levels of vitamin A. It was developed to help prevent vitamin A deficiency and has been grown in field trials in the Philippines, Taiwan and other countries.



(b) The graph below shows the mass of additional vitamin A which could be obtained each day if the countries indicated were to replace the rice varieties they grow with Golden Rice.



(i) In which of the countries in the graph would the people have sufficient vitamin A each day if they grew Golden Rice? [1]

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(ii) In how many of the countries shown could the people increase the intake of vitamin A per day by 50% or more, if they grew Golden Rice? [1]

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- (iii) Since the data for the graph were obtained, a new variety of golden rice, Golden Rice 2, has been developed. The table below shows the potential benefits of Golden Rice 2 in Bangladesh.

	Adults	Children under 7 years of age
Recommended daily intake of vitamin A (μg)	500	450
Vitamin A provided by Golden Rice 2 (μg)	775	338
Vitamin A provided by other food eaten (μg)	245	112

Explain the effect of a diet containing Golden Rice 2 on the number of cases of blindness caused by vitamin A deficiency in Bangladesh. [2]

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- (c) In August 2013 a crop of Golden Rice that was being grown in a field trial was destroyed by protesters in the Philippines. The protesters said they had many concerns about the growth of GM crops.

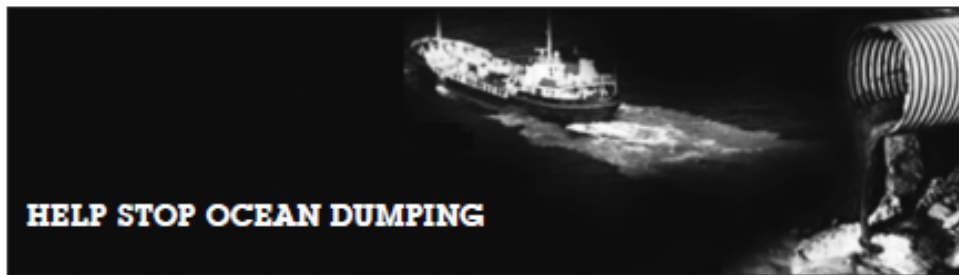
Suggest what **two** of these concerns might have been. [2]

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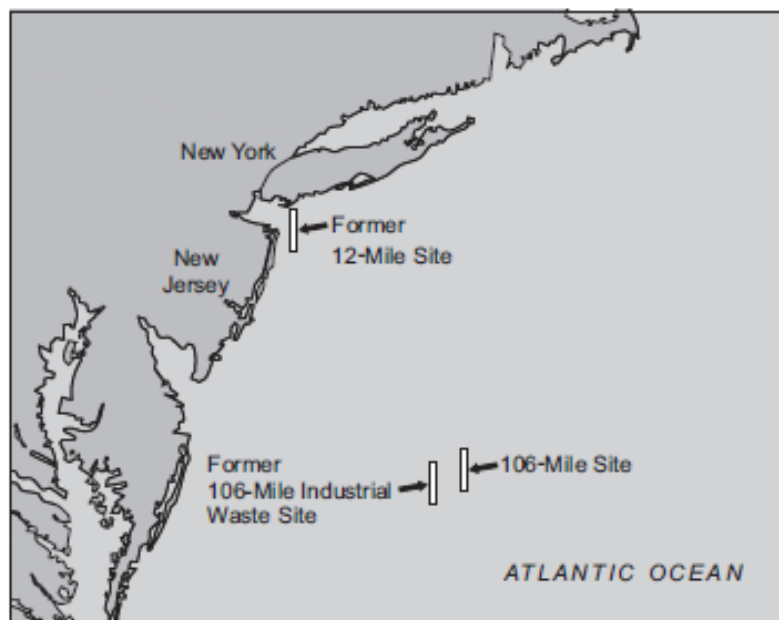
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2. In the past, many countries, including the UK, have disposed of sewage sludge in the open ocean. A famous example of this practice is the '106 mile' dump site in the North West Atlantic. This site, 106 miles off the east coast of the USA, served the populations of New York and New Jersey. Prior to the use of the '106 mile' dump site sewage sludge was disposed of at the '12 mile' dump site.

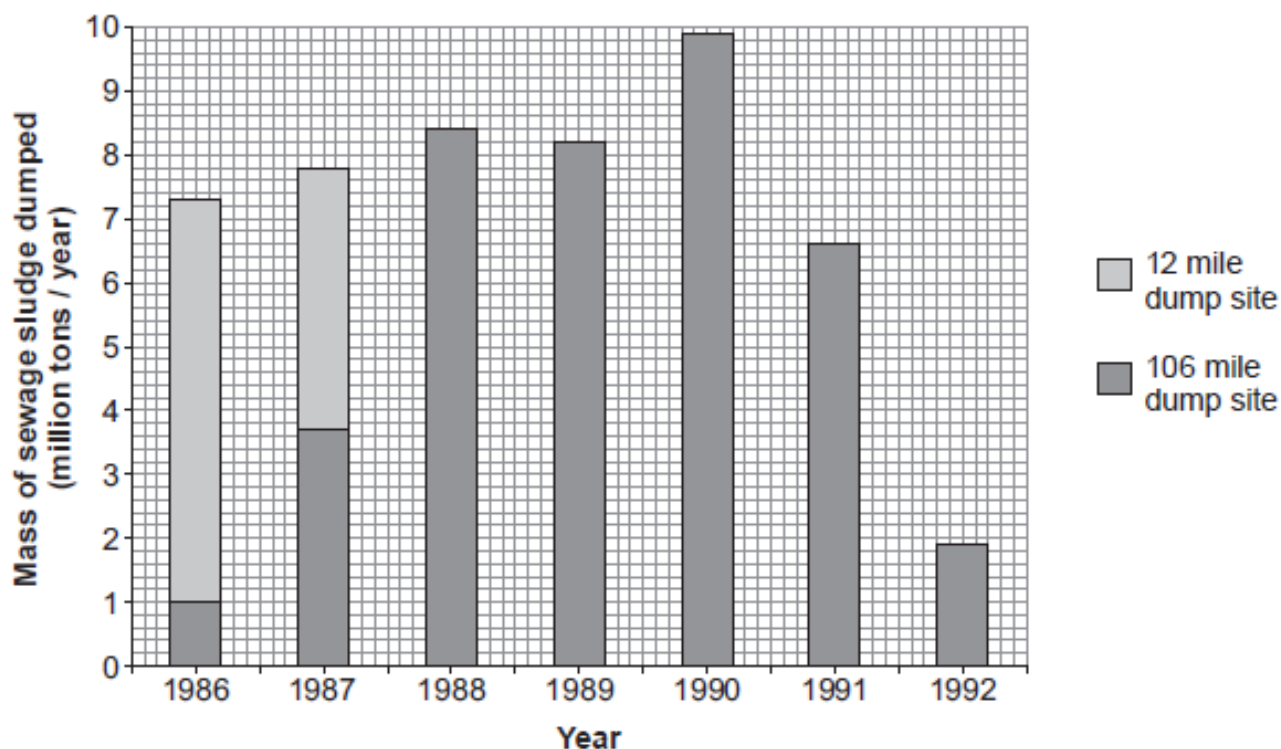


(All data from the US Environmental Protection Agency Report to Congress Sept 1995)

Map 1 showing the east coast of the USA together with disposal sites



Graph showing the annual disposal of sewage sludge at the '12 mile' and '106 mile' dump sites from 1986 to 1992.



- (a) (i) Calculate the total mass of sewage sludge disposed of at the '12 mile' dump site in 1986 and 1987. [2]

total mass of sewage sludge = million tons

- (ii) What was the final year in which sewage sludge was disposed of at the '12 mile' dump site? [1]

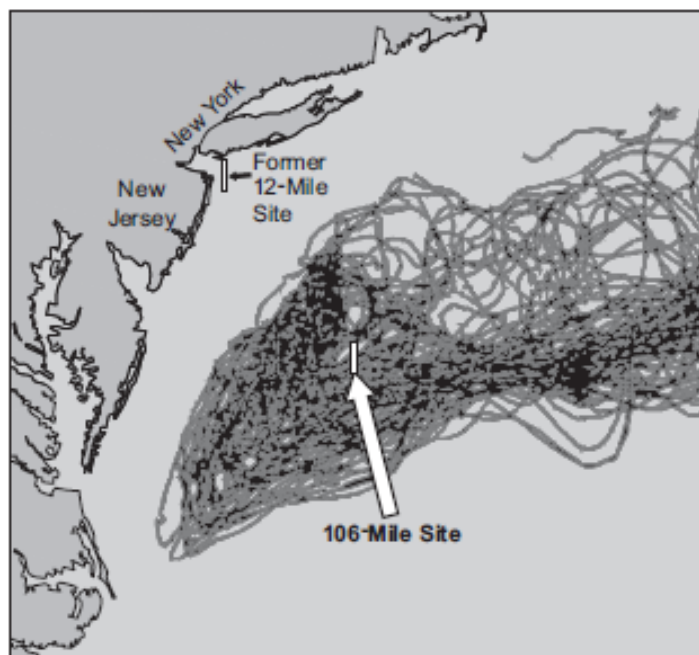
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- (iii) The US Environmental Protection Agency released buoys into the ocean at the 106 mile dump site. They used satellites to track the movement of the buoys between 1989 and 1992.

drifting buoy tracked
by satellite



Map 2 showing the movement of buoys



Use the information in map 2 to suggest why it was decided to select a sewage dump site 106 miles off the east coast of the USA and to close the '12 mile' dump site. [2]

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3. The following article appeared on the BBC news website on the 13th of April 2010.

A “perfect storm” of nutrients from sewage effluent and unusual weather conditions has been blamed for a 2009 outbreak of toxic algae in a lake.

1 Llyn Padarn at Llanberis was closed to leisure users for much of last summer.

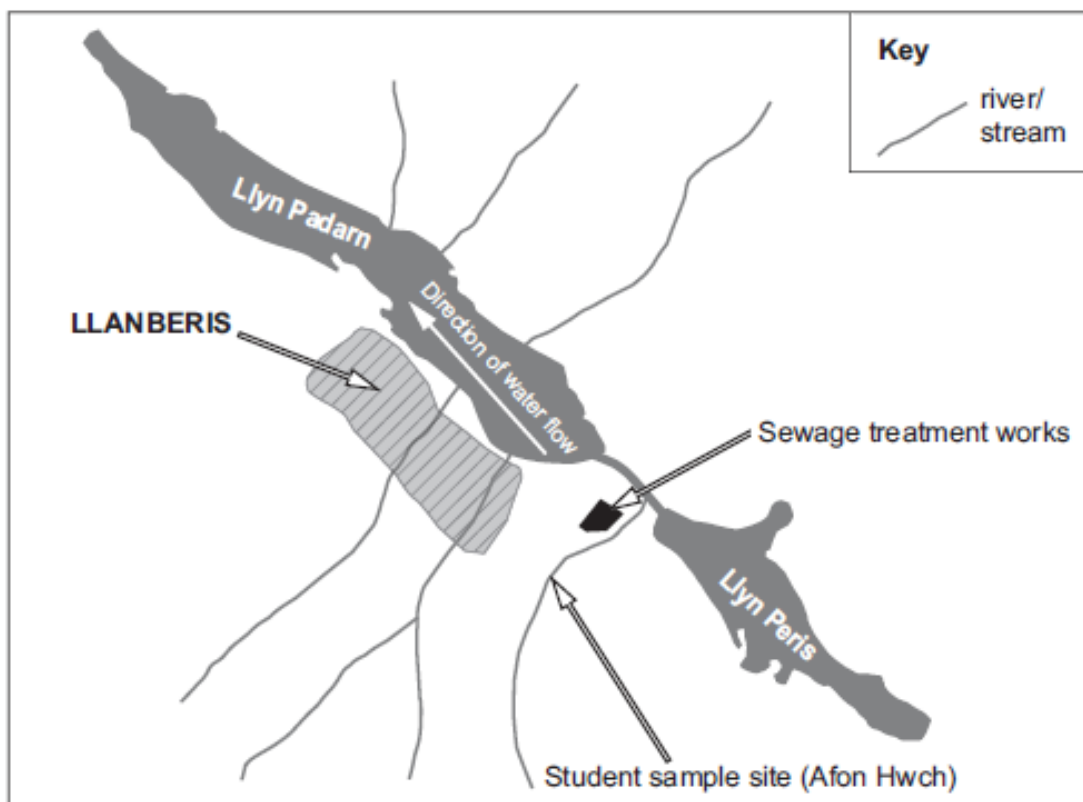
A report commissioned by Environment Agency Wales calls for stricter limits on effluent discharged from the local sewage treatment works.

5 The report by Professor Glen George described the warm spring, followed by a still June and a wet July and August as “the perfect storm”.

He said the weather conditions, combined with nutrients in the lake, not only created the right conditions for the algal bloom to form but also meant it continued through the summer.

10 His report makes a number of recommendations for further scientific studies of the lake and more work to find out how the management of the sewage treatment works in Llanberis is affected by heavy rain.

The map below shows Llyn Padarn and the surrounding area.



Llyn Padarn is also home to a rare breed of fish called the Arctic char fish (*Salvelinus alpinus*). The char feeds on insects found on the water's surface, fish eggs and snails found on the lake bottom.

- (b) Explain why the local fishermen thought that the algal blooms could lead to a decrease in the population of the arctic char. [3]

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4. The photograph below shows crops being sprayed with herbicides.



- (a) Explain how herbicides increase crop yield. [2]

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- (b) Plants can be genetically modified (GM) to make them resistant to herbicides.

The table below gives some arguments for and against growing GM plants which are resistant to herbicide.

- (ii) Place a tick (✓) next to each argument for **or** a cross (✗) next to each argument against growing GM crop plants. Two have been done for you. [1]

argument	✓ or ✗
increased crop yield	✓
less herbicide used	✓
reduced biodiversity	
cheaper food	
long term effects unknown	



Soya bean plant

- (iii) GM herbicide resistant soya has been grown in Argentina for many years. Seeds from the GM soya have spread widely and the plant is now a serious pest growing in fields of crops such as maize. Farmers now have to use increased concentrations of herbicide to try to kill the pest soya.

From the information above, suggest reasons why the price of maize has risen.

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5.

Scientists investigated how crop yields (mass of crops produced per m^2) vary when plants are grown at different densities in a field. The results are shown in the table below.

Density (number of plants per m^2)	Crop yield (kg per m^2)
1	20
5	85
10	92
15	90
20	90
25	80

(a) Which density gives the greatest crop yield? plants per m^2 [1]

(b) Complete the table below by calculating the yield per plant. The first four have been done for you. [2]

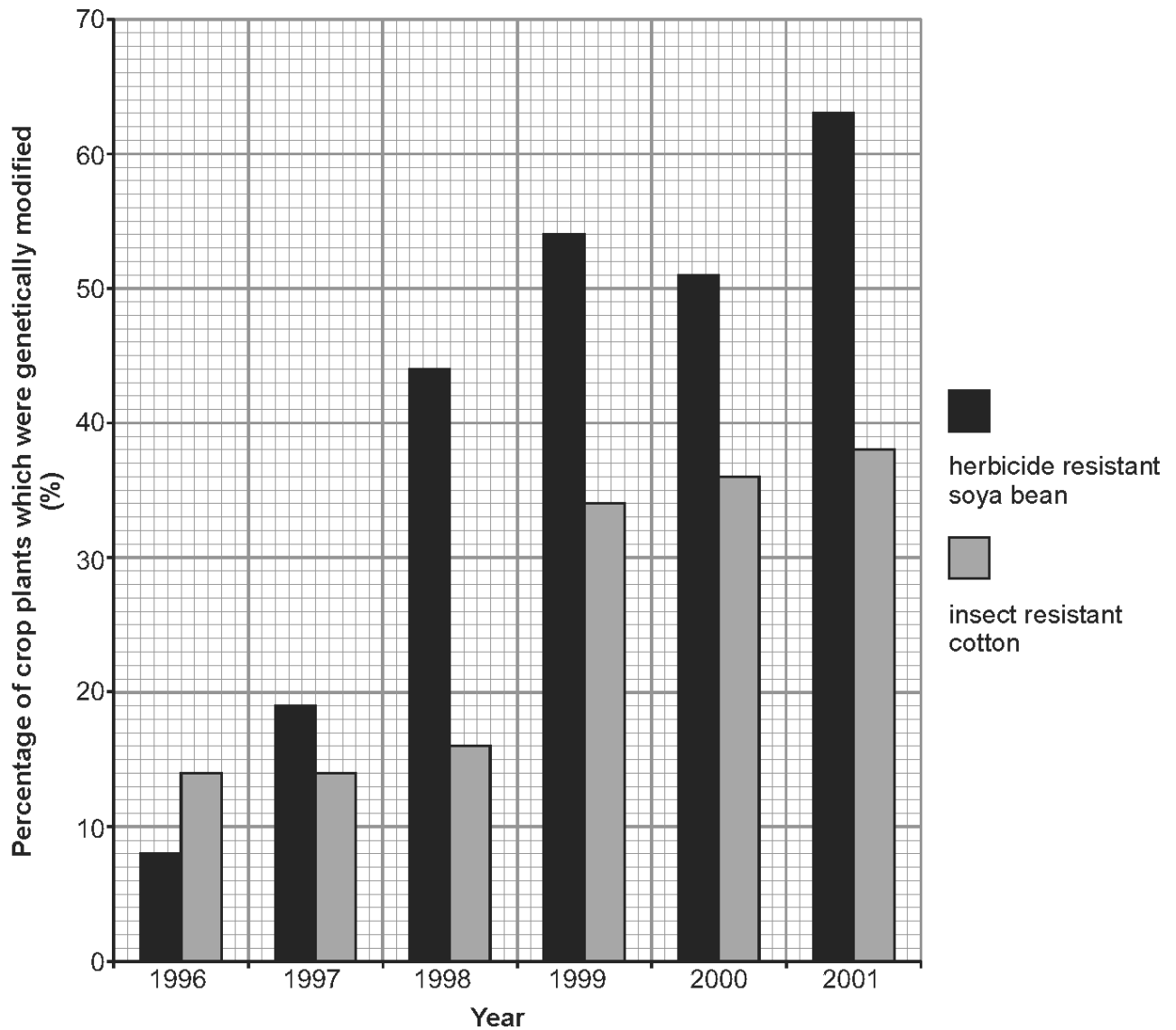
Density (number of plants per m^2)	Crop yield (kg per m^2)	Yield per plant (kg)
1	20	20.0
5	85	17.0
10	92	9.2
15	90	6.0
20	90	
25	80	

(c) Suggest two reasons why the yield per plant decreases as the number of plants increases.

1.

2.

7. Soya bean and cotton are crop plants grown in the USA. The bar chart shows the percentage of these crops grown between 1996 and 2001 which were genetically modified (GM).



- (a) What does the general trend shown in the bar chart suggest about the attitude towards planting GM crops between 1996 and 2001 in the United States? [1]
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(b) Describe how soya bean plants could be made resistant to herbicide using GM crop technology. [2]

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(c) The effect of insects on the yield of cotton has been investigated for GM insect resistant cotton plants and for non-GM cotton plants. The results are shown in the table:

	GM insect resistant cotton plants	non-GM cotton plants
mean number of insecticide sprays per month needed to control leaf eating insects	0.6	3.7
mean number of insecticide sprays per month needed to control sap sucking insects	3.6	3.5
yield (kg per hectare)	1500.0	800.0

State three conclusions that can be drawn from the data in the table. [3]

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II.

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III.

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