2024 Bi H2 Q10

Section: Sustainability and Interdependence

Topic: Crop Protection

Question Summary

The question examines the effects of weeds on crop productivity, the selectivity of herbicides, and how resistance develops in weed populations. It also links increasing global population with the rise in herbicide-resistant species and the resulting impact on food security.

Worked Solution

- (a)(i) Weeds compete with wheat for light, water, space, and mineral nutrients. This reduces the resources available for wheat, lowering its growth rate and yield.
- (a)(ii) Selective herbicides are designed to target metabolic pathways that occur mainly in certain types of plants. For example, they often affect broad-leaved plants (dicots) more than narrow-leaved crops such as wheat (a monocot). The wheat plants can tolerate or metabolise the herbicide more effectively, so are less affected.

- (b)(i) The number of herbicide-resistant species increased from 8 in 1980 to 480 in 2020. 480 ÷ 8 = 60. The number of resistant species was 60 times greater in 2020 than in 1980.
- (b)(ii) As resistant weed species increase, crop yield and food

production decline despite higher global population. This reduces the availability of food per person, leading to a decrease in global food security.

- (c) Within any weed population, random mutations may occur that confer resistance to a herbicide. When the herbicide is applied, most susceptible individuals die, while resistant individuals survive and reproduce. Their resistant alleles are passed on to offspring, and over successive generations, the frequency of resistance increases. This is an example of evolution by natural selection.

Final Answer

-> (a)(i) Weeds reduce crop productivity by competing for light, water, and nutrients.
-> (a)(ii) Selective herbicides target broad-leaved weeds; wheat (a monocot) is less affected.
-> (b)(i) 480 ÷ 8 = 60 times greater in 2020.
-> (b)(ii) More resistant weeds -> lower yields -> reduced food security.
-> (c) Resistant individuals survive and reproduce -> resistance frequency increases (natural selection).

Revision Tips

- Selective herbicides work because metabolic differences exist between dicots and monocots.
- Repeated use of the same herbicide selects for resistant weed populations.

- Natural selection acts on existing variation, increasing the frequency of advantageous alleles.
- Crop yield depends on reducing competition and maintaining biodiversity for long-term food security.