CHQPITER2/ WEEDS

How do weeds affect plant production?كيف تؤثر الأعشاب الضارة على إنتاجية النباتات؟

Weeds negatively impact plant production through several mechanisms:

1. **Competition for Resources**:
    - Weeds compete with crops for essential resources like water, nutrients (e.g., nitrogen, phosphorus), sunlight, and space.
    - Their fast growth and aggressive root systems often outcompete cultivated plants

Competition for Resources

Weeds compete with cultivated plants for essential resources necessary for growth and survival, significantly reducing crop productivity. The main resources contested include:

1-Water:

Weeds have extensive root systems that absorb water faster than crops, especially in dry conditions.

- Example: In arid regions, weeds like *Cynodon dactylon* (Bermuda grass) can deplete soil moisture, leaving crops dehydrated.

2-Nutrients:

Weeds consume nitrogen (N), phosphorus (P), potassium (K), and other minerals, depriving crops of these vital elements.

- Example: *Chenopodium album* (lamb's quarters) is a nutrient-hungry weed that outcompetes wheat for soil fertility.
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- **3-Sunlight**:

Tall or dense weeds shade crops, reducing photosynthesis and stunting growth.

- Example: *Amaranthus retroflexus* (redroot pigweed) grows rapidly, blocking sunlight from reaching corn or soybeans.

4-Space:

Weeds occupy physical space, limiting root expansion and above-ground growth of crops.

- Example: In vineyards, *Convolvulus arvensis* (field bindweed) can choke grapevines by wrapping around stems.

5-Impact on Crop Yield:

Prolonged competition leads to weaker plants, smaller fruits, and lower harvests.

- In severe cases, crops may fail if weeds dominate the field.

2-Allelopathy (Chemical Interference):

- Some weeds release toxic chemicals (allelochemicals) into the soil that inhibit the growth of nearby crops.
- Example: *Sonchus oleraceus* (sowthistle) produces substances that suppress
- seed germination in other plants.

Allelopathy is a biological phenomenon where certain plants release biochemical substances (allelochemicals) into the environment that inhibit the growth, germination, or survival of neighboring plants. These chemicals can be exuded from roots, leaves, or decaying plant material, affecting both crops and weeds.

Mechanisms of Allelopathy:

1. **Root Exudation:**
   - Some plants release allelochemicals through their roots into the soil, suppressing nearby plants.
   - Example: *Rye* (*Secale cereale*) secretes compounds that inhibit weed seed germination.
2. **Leaching from Leaves:**
   - Rainwater can wash allelochemicals from leaves into the soil, affecting plants below.
   - Example: *Eucalyptus* trees release volatile oils that inhibit understory plant growth.
3. **Decomposition of Plant Residues:**
   - When allelopathic plants decompose, they release toxic substances into the soil.
   - Example: *Black walnut* (*Juglans nigra*) produces juglone, which stunts tomato and potato growth.

Effects on Crop Production:

- Reduced Germination: Allelochemicals can prevent crop seeds from sprouting.

- Stunted Growth: Affected plants may exhibit yellowing, wilting, or reduced biomass.
- Lower Yield: Allelopathic interference can lead to poor fruit development or crop failure.

Examples of Allelopathic Weeds:

- Sunflower (*Helianthus annuus*): Releases chemicals that inhibit grass growth.
- Sowthistle (*Sonchus oleraceus*): Produces substances that suppress lettuce and spinach seedlings.
- Quackgrass (*Elymus repens*): Exudes allelochemicals that harm legumes like beans and peas.

Management Strategies:

- Crop Rotation: Avoid planting susceptible crops after allelopathic weeds.
- Cover Crops: Use non-allelopathic cover crops to suppress weed growth.
- Soil Amendments: Add activated carbon or compost to neutralize allelochemicals.

3-Harboring Pests and Diseases:

- Weeds serve as alternate hosts for insects, fungi, and viruses that attack crops.
- Example: *Amaranthus* species (pigweed) can host root-knot nematodes, which damage crop roots.

Weeds can act as reservoirs or "harbors" for pests and diseases, creating a continuous threat to nearby crops. By providing shelter, food, or breeding grounds, they help pests and pathogens survive, multiply, and spread to cultivated plants, leading to reduced yields and poor crop quality**.**

How Weeds Harbor Pests and Diseases:

1. **Alternative Hosts for Pests:**
   - Many insects and mites feed on both weeds and crops, using weeds as a secondary food source when crops are unavailable.
   - Example: *Amaranth* species harbor *Spodoptera litura* (tobacco cutworm), which later attacks cotton and soybeans.
2. **Breeding Grounds for Pathogens:**
   - Weeds can host viruses, fungi, or bacteria that infect crops, serving as a bridge for disease transmission.

- Example: *Nightshade* (*Solanum nigrum*) carries the *Tomato yellow leaf curl virus* (TYLCV), which spreads to tomatoes via whiteflies.

3. **Shelter for Pests During Off-Seasons:**
   - Some pests overwinter in weeds, emerging in spring to infest newly planted crops.
   - Example: *Corn earworm* (*Helicoverpa zea*) larvae survive in weeds like *pigweed* (*Amaranthus*) before attacking corn.
4. **Attracting Pest Predators (Indirect Effect):**
   - While some weeds attract beneficial insects (e.g., ladybugs that eat aphids), many primarily draw pests that damage crops.
   - Example: *Mustard weeds* (*Brassica spp.*) attract *diamondback moths*, which devastate cabbage and broccoli.

5-Impact on Crop Production:

- Increased Pest Pressure: Weeds sustain pest populations, making chemical or biological control more difficult.
- Disease Epidemics: Weeds facilitate the rapid spread of pathogens, leading to widespread crop losses.
- Higher Production Costs: Farmers spend more on pesticides and labor to manage pests and diseases fueled by weeds.

Examples of Weed-Pest/Disease Associations:

- Bindweed (*Convolvulus arvensis*): Hosts *root-knot nematodes* that damage tomatoes and carrots.
- Johnson grass (*Sorghum halepense*): Carries *maize chlorotic mottle virus* (MCMV), causing severe yield losses in corn.
- Ragweed (*Ambrosia artemisiifolia*): Attracts *tarnished plant bugs*, which feed on cotton and fruit crops.

6-Management Strategies:

1. Weed Control: Regular removal of weeds reduces pest and disease reservoirs.
2. Crop Rotation: Avoid planting susceptible crops after weed-infested fields.
3. Sanitation: Remove crop residues and weeds to disrupt pest life cycles.
4. Biological Control: Use natural predators (e.g., parasitoid wasps) to target pests in weeds.

4-Physical Interference:

- Dense weed growth can shade crops, reducing photosynthesis.
- Weeds may also interfere with irrigation systems or mechanical harvesting.

Physical interference refers to any form of direct, tangible obstruction or disruption that prevents the normal functioning, movement, or interaction of objects, systems, or organisms. It occurs when physical forces, structures, or barriers interfere with the intended operation or behavior of something else.

5-Soil Degradation:

- Some weeds (e.g., *Cynodon dactylon*—Bermuda grass) have deep root systems that deplete soil moisture and nutrients, making the land less fertile for crops.

Soil degradation refers to the decline in soil quality and productivity due to natural or human-induced factors, reducing the soil's ability to support plant growth, biodiversity, and ecosystem functions. It is a critical environmental issue that threatens food security, water availability, and climate stability.

Types of Soil Degradation:

1. **Erosion**:
   - The removal of topsoil by wind, water, or human activities (e.g., deforestation, overgrazing).
   - Example: Heavy rainfall washing away fertile soil from hillsides.
2. **Chemical Degradation**:
   - Loss of soil fertility due to nutrient depletion, acidification, salinization, or contamination by pollutants (e.g., pesticides, heavy metals).
   - Example: Excessive use of chemical fertilizers leading to soil acidification.
3. **Physical Degradation**:
   - Structural breakdown of soil due to compaction, crusting, or loss of organic matter, reducing water infiltration and root growth.
   - Example: Heavy machinery compacting soil, making it hard for plants to grow.
4. **Biological Degradation**:
   - Decline in soil biodiversity (e.g., microorganisms, earthworms) due to pollution, deforestation, or unsustainable farming practices.

- Example: Overuse of pesticides kills beneficial soil organisms.

Causes of Soil Degradation:

- **Deforestation & Land Conversion**: Clearing forests for agriculture or urbanization exposes soil to erosion.
- **Overgrazing**: Excessive livestock grazing removes vegetation, leaving soil vulnerable to wind and water erosion.
- **Poor Agricultural Practices**: Monoculture, excessive tillage, and improper irrigation deplete nutrients and degrade soil structure.
- **Climate Change**: Increased droughts, floods, and extreme weather accelerate erosion and nutrient loss.
- **Pollution**: Industrial waste, plastic, and chemical runoff contaminate soil, harming its health.

Effects of Soil Degradation:

- **Reduced Crop Yield**: Poor soil fertility leads to lower agricultural productivity and food shortages.
- **Desertification**: Severe degradation turns fertile land into desert, displacing communities.
- **Water Pollution**: Eroded soil carries pesticides and fertilizers into water bodies, harming aquatic life.
- **Loss of Biodiversity**: Degraded soil supports fewer plants and animals, disrupting ecosystems.
- **Climate Change**: Healthy soil stores carbon; degraded soil releases CO_2, worsening global warming.

Examples in Different Regions:

1. **Sub-Saharan Africa**:
    - Overgrazing and deforestation have led to widespread soil erosion, reducing crop yields.
2. **India**:
    - Excessive use of chemical fertilizers and monoculture farming has caused soil acidification and nutrient depletion.
3. **China's Loess Plateau**:
    - Historically severe erosion due to deforestation and farming on steep slopes; now restored through reforestation and terracing.

4. **United States Midwest**:
    - Intensive farming practices have led to soil compaction and loss of organic matter, reducing fertility.

Solutions to Combat Soil Degradation:

1. **Sustainable Agriculture**:
    - Crop rotation, cover cropping, and reduced tillage to maintain soil health.
    - Organic farming to avoid chemical contamination.
2. **Afforestation & Reforestation**:
    - Planting trees to prevent erosion and improve soil structure.
3. **Terracing & Contour Farming**:
    - Building terraces on slopes to slow water runoff and reduce erosion.
4. **Soil Conservation Techniques**:
    - Using mulch, windbreaks, and erosion control blankets to protect soil.
5. **Policy & Education**:
    - Governments promoting sustainable land use and educating farmers on best practices.

https://youtu.be/Va3zEVIttWk VIDEOS WEEDS

https://youtu.be/6PyGFdHjSiY VIDEOS WEEDS

Figure 2. Trying to establish an "economic threshold" based on weed counts is not practical. For instance, how many common purslane plants (a) would have the same impact as one common cocklebur (b)? Would this purple nutsedge clump (c) count as one, two, or twenty? Figure credit: Mark Schonbeck, Virginia Association for Biological Farming. https://eorganic.org/node/2731

Figure 4. The weeds growing with this young sweet corn are just beginning to compete with the crop. Prompt action can prevent significant yield loss; however, it may be very difficult to control these weeds by mechanized cultivation without damaging the crop. On a small scale, this situation means a few extra hours of manual labor. At a multi-acre scale, it could necessitate tilling up the entire field and replanting. Scouting this field just a week earlier could have led to timely cultivation while weeds were still small and easier to manage. Figure credit: Mark Schonbeck, Virginia Association for Biological Farming. **https://eorganic.org/node/2731**

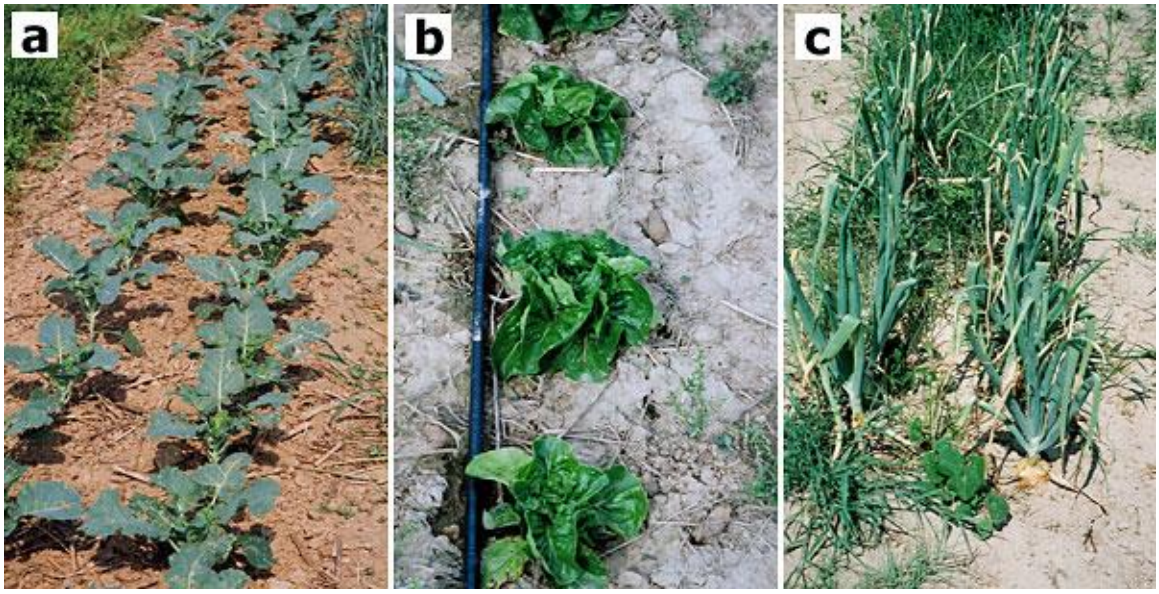

Figure 5. These crops are old enough not to need as much effort to keep them weed-free. The broccoli (a) is far enough ahead of the tiny weeds just emerging in the bed. Larger weeds and cover crop regrowth in alleys can be controlled by mowing. The lettuce (b) is about two weeks from maturity. Prompt tillage after harvest will be sufficient to control the weeds present. Weeds were allowed to grow during the last few weeks of the growth of this onion crop (c). These weeds came in late enough not to hurt onion yield significantly, and were tilled in promptly after onion harvest. Figure credit: Mark Schonbeck, Virginia Association for Biological Farming. **https://eorganic.org/node/2731**


Figure 6. The young johnsongrass (left), Bermuda grass (center), and yellow nutsedge (right) in this photo have already begun to form new underground rhizomes that can propagate and spread the weeds. Figure credit: Mark Schonbeck, Virginia Association for Biological Farming. **https://eorganic.org/node/2731**

Figure 7. This sweet potato crop is not directly affected by the flowering galinsoga and lady's thumb emerging through its canopy. However, the weeds will produce mature seed unless they are removed promptly. Manual pulling is feasible only on a small scale, but mowing with the mower set just above the crop canopy can knock out most weeds'

References and Citations

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