Biotech In focus

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How Can We Farm with Minimal Harm?

All agriculture, crop and pastoral, organic and conventional modify the natural environment. The types of environmental impact can vary among the farming approaches we've discussed in this series, but no form of agriculture is free from environmental impact.

Fertilizers, pesticides, and herbicides can unintentionally alter organisms and ecosystems, especially when used in wasteful or inappropriate ways. For example, excess fertilizer in runoff from farm fields can flow into bodies of water, triggering a process that consumes the water's oxygen and suffocates aquatic animals. Some pest-management products can harm accidentally exposed workers, may be broadly toxic to helpful or harmless organisms as well as pests, or can persist in the environment and accumulate in animals at the top end of the food chain.

Organic agriculture, which only uses fertilizers from plant or animal wastes and pesticides derived from natural products, tends to support higher numbers of species and overall abundance of birds, insects, microbes, and nematodes. This greater biodiversity may reflect the small size of most organic farms and their scattered nature. Weed control is a major issue in organic farming and often must be control by cultivation that can expose the soil to erosion and soil run-off.

However, in the developed world, organic agriculture yields are typically 10–30% less than yields for conventional agriculture, so that more land is needed to grow the same amount of product. Land and water are limited, and clearing new land for agriculture destroys or seriously modifies habitat for wild plants and animals.

For more information and past issues, please visit our website at www.ctahr.hawaii.edu/biotechinfocus

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Farming "Green"

So what's the "greenest" way to farm? In recent years, interest has grown in developing **sustainable agriculture** practices. These practices combine tools from diverse forms of agriculture to conserve valuable resources such as arable land, topsoil, water, nutrients, energy, and biodiversity. We saw some aspects of this approach in our bulletin on **integrated pest management. IPM** shares many pest control methods with organic agriculture crop rotations, disease and insect monitoring to determine control measures, trapping pests, using pest predators as biocontrol agents, and planting companion crops that attract beneficial insects to a field or attract pests away from the crop plant.

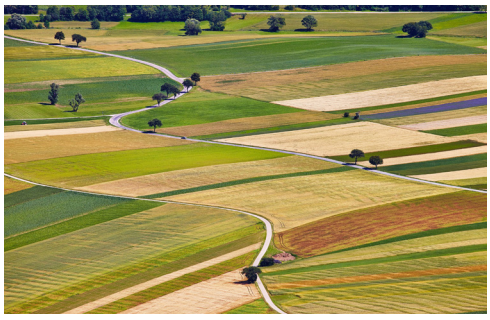
Employing Pesticide

When biological methods are insufficiently effective, IPM may also employ pesticides. Conventional farmers can use both natural pesticides such as Bt, a bacterium, and synthetic pesticides while organic farmers can only use natural pesticides.

Affecting Non-Targets

Like the other methods we've discussed, IPM is not universally environmentally friendly. Even when used appropriately, many natural and synthetic pesticides can affect non-target organisms and injure beneficial species.

Crop Rotations



Crop rotation that involves growing different crops on the same field in different seasons or leaving the land fallow has been practiced since agriculture started. These rotations are used by conventional and organic farmers to limit the build-up of disease and insect pests, and to improve soil fertility when a crop is ploughed back into the soil.

Are genetically modified (GM) crops compatible with sustainable agriculture? Each GM plant variety represents a unique event in which one or more genes (DNA recipes for proteins) has been added or changed. In each case, how GM plants differ from their conventionally bred cousins and how they are used by farmers dictate the extent of the possible environmental impacts and whether those impacts differ from conventional crops. GM crops also expand the possible farming approaches that can be used to maximize sustainability by reducing the need to plough frequently to control weeds and reduce pesticide applications and the energy needed for ploughing and applying pesticides

In our next bulletin, we'll consider how the two most common genetically engineered traits, herbicide resistance and the insecticidal Bt proteins, have influenced the environmental consequences of farming.

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