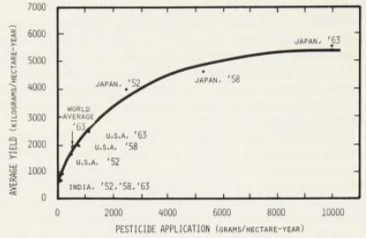

Figure 4-36 Yield and pesticide use
Source: PSAC 1967, vol. 3, p. 141.

Crop	Percentage of Loss[1] from Insects	Diseases	Weeds
Maize	12	12	10
Wheat	6	14	12
Rice	4	7	17
Grain sorghum	9	9	13
Soybean	8	14	17
Potato	14	19	3

[1]Estimate based on full production with causes eliminated.

Figure 4-37 Estimated losses to insect, disease, and weed pests in production of selected crops in the United States, 1951–1960
Source: PSAC 1967, vol. 2, p. 205.

	Corn	Wheat	Rice
Harvested crop (million metric tons)	218	266	232
Total preharvested losses (million metric tons)	121	86	207
Loss percentages			
by weed	37	37	22.5
by insects	36	25	58.0
by disease	27	38	19.5

Figure 4-38 Global preharvested losses of corn, wheat, and rice, 1965
Source: Cramer 1967.

In extreme cases one may even observe a negative marginal return to more use of fertilizer. Very high inputs of fertilizer may cause the head of the grain to grow so large that the stalk will break before harvesting, or the concentration of salts in the soil may become sufficient to damage the plants. Both processes will result in lower yields (see curves a, b, and c in Figure 4-39). The achievement of plant geneticists over the last twenty years, in what is called the Green Revolution, has been to develop new seed varieties that produce stalks capable of supporting heavy grain heads, which are thus more responsive to fertilizer than traditional varieties (see curves I, II, and III in Figure 4-39). In a sense, the new varieties have "postponed" the decreasing returns to agricultural inputs.

Because the new crop varieties have a much higher yield ceiling and mature more quickly than those formerly available, wheat and rice production can be doubled or even tripled in areas where enough irrigation water, fertilizers, and pesticides are available. In Mexico, where dwarf wheat was first introduced, production increases were spectacular and made the country independent of wheat imports. The yield increases shown in Figure 4-34 were primarily due to the introduction of the new varieties. Figure 4-40 indicates the extent to which these new seeds have been adopted around the world.

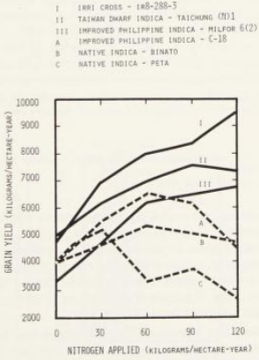

Figure 4-39 Yield responses of different seed varieties to fertilizer use
Source: FAO 1970*a*, p. 97.