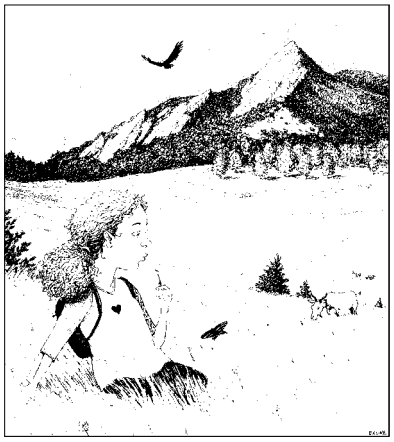
Economic and Environmental Impacts of Invasive Species and Their Management

by David Pimentel, Ph.D.

[Editor's Note: Historically, in response to an invasion of weeds, people have turned to toxic chemicals like glyphosate, an herbicide covered in our chemWATCH factsheet on pages 16 and 17 of this issue of *Pesticides and You*. The use of pesticides compounds the ecological and economic damage caused by invasive species addressed in the following piece by David Pimentel – pesticides poison our soil, air, water and bodies. Elected officials and regulators are beginning to appreciate the hazards associated with allowing a continued flow of invasive species into the U.S. and the use of pesticides to control them. For example, Executive Order 13112, signed by President Clinton on February 3, 1999, called for federal agencies to prevent, monitor, and control invasive species while researching control technologies and educating the public. Beyond Pesticides/NCAMP, and many others in the environmental community, recognize that much more needs to be done to protect public and environmental health, as well as the economic well-being of the users of the land, in the face of the growing problem of invasive species. More than ever we must move toward ecologically sound integrated weed management. Join us at our 19th annual National Pesticide Forum, May 18-20, 2001 in Boulder, Colorado. One major focus of the conference is ecological management of open space. Come to learn what you can do to make a difference in your community.]

More than 50,000 species of plants, animals, and microbes have been introduced into the United States and they cause damages totaling $137 billion per year. Invasive species predation and competition are the prime causes of native species populations declining and 42% are being placed on the threatened and endangered species list.

Approximately 5,000 species of introduced plants have escaped and now exist in agriculture and U.S. natural ecosystems. Some of the nonindigenous plants have become established and have displaced several native plant species. Non-native weeds are spreading and invading approximately 1.8 million acres of U.S. wildlife habitat per year. For example, the European purple loosestrife (*Lythrum salicaria*), which was introduced in the early 19th century as an ornamental plant and from seeds in the ballast of ships, has been spreading at a rate of about 300,000 acres per year and is changing the basic structure of most wetlands that it has invaded.



Sometimes, a non-native plant species competitively overruns an entire ecosystem. For example, in California, yellowstar thistle (*Centaurea solstitialis*) now dominates more than 10 million acres of northern California grassland, resulting in the total loss of this once productive grassland. Similarly, cheatgrass brome (*Bromus tectorum*) is dramatically changing the vegetation and fauna of many natural ecosystems in the west. This annual grass has invaded and spread throughout the shrub-steppe habitat of the Great Basin in Idaho and Utah, predisposing the invaded habitat to fires. Before the invasion of cheatgrass, fires burned once every 60 to 110 years and shrubs had a chance to become well established. Now, the occurrence of fires once every three to five years has led to a decrease in shrubs and other vegetation and to the occurrence of competitive monocultures of cheatgrass on more than 12 million acres. The animals dependent on the shrubs and other original vegetation have been reduced or eliminated.

An estimated 138 non-native tree and shrub species have invaded native U.S. forest and shrub ecosystems. These introduced trees include salt cedar (*Tamarix spp.*), eucalyptus (*Eucalyptus spp.*), Bazilian pepper (*Schinus terebinthifolius*), and the Australian melaleuca tree (*Melaleuca quinquenervia*). Some of these trees have displaced native trees, shrubs, and other vegetation and populations have been reduced. Of course, the animals dependent on the trees, shrubs, and other original vegetation have been reduced or eliminated.

Weeds are also a serious problem in crops, including forage crops. Approximately 73% of the weed species in crop systems are non-native. Each year weeds destroy about 12% of all potential crop production despite all controls. The invading weeds cause more than $23 billion per year and about $3 billion is spent on herbicides in an attempt to control invasive weeds. Thus, the total annual cost of introduced weeds to the U.S. agricultural economy is more than $26 billion.

According to former Interior Secretary Bruce Babbitt, ranchers spend approximately $5 billion each year to control invasive non-native weeds in pastures and rangelands; nevertheless, these weeds continue to spread in the wildlands.

An estimated 4,500 insect and mite species have been introduced into the United States. Approximately 1,000 non-native insect and mite species are crop pests. Each year, pest insects destroy approximately 13% of potential U.S. crop production despite all controls. An estimated 40% of the insect pests were introduced into the United States. It is estimated that introduced insect pests cause nearly $14 billion in U.S. crop losses each year. This estimate is conservative because it does not include the environmental costs of using insecticides and miticides or any of the increased crop losses that these exotic pests may cause. In addition, approximately $1.2 billion worth of pesticides are applied for control of all crop insects and mites each year in the United States. The portion applied against non-native insects

and mite pests is about $500 million per year. Thus, the total cost for the introduced non-native insect and mite pests is approximately $14.5 billion per year.

An introduced insect that is causing significant economic and environmental problems is the fire ant. A conservative estimate is that the fire ant causes from $1 to $2 billion in damages in the United States annually.

There are an estimated 50,000 parasitic and nonparsitic diseases of plants in the United States, most of which are caused by fungi. In addition, more than 1,300 species of viruses are plant pests in the United States. Many of these microbes are non-native and were introduced inadvertently with seeds and other parts of host plants (that were themselves introduced deliberately) and have become major crop pests. Including the introduced plant pathogens plus other soil microbes, it is conservatively estimated that more than 20,000 species of microbes have invaded the United States.

Because about 65% of all plant pathogens are introduced species, it is estimated that approximately $21 billion of crop losses are attributable to non-native plant pathogens. In addition, growers spend about $500 million per year on fungicides to combat the introduced plant pathogens. Thus, the total damage and control costs of non-native plant pathogens amount to about $21.5 billion per year.

Two vertebrate pests that are causing significant damages to agriculture and other parts of the US economy are rats and feral pigs. There are an estimated 1.25 billion rats in the United States and they cause at least $19 billion in damages each year. In addition, there are more than 4 million feral pigs in the U.S. and these animals cause at least $1 billion in damages each year.

Once an invasive species becomes well established in the United States, it is practically impossible to exterminate the pest. In fact, in 99.99% of the cases the invading species are here to stay and we must invest in control operations for those that are causing serious problems.

The best approach to dealing with invasive species is to increase efforts to prevent them from invading the nation in the first place. One of the best approaches to prevention is to educate the public concerning the risks of bringing exotic plants and animals into the United States.

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Additional Readings

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Pimentel, D. "Environmental and economic effects of reducing pesticide use in agriculture." *Agriculture, Ecosystems & Environment* 1993. 46(1/4): 273-288.

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Pimentel, D. "Amounts of pesticides reaching target pests: environmental impacts and ethics." *Journal of Agricultural & Environmental Ethics* 1995. 8(1): 17-29.

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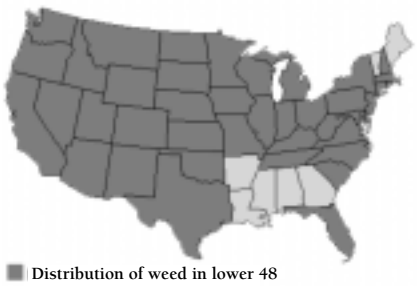
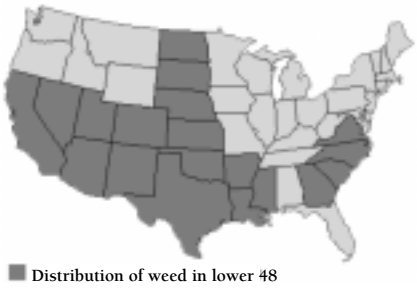
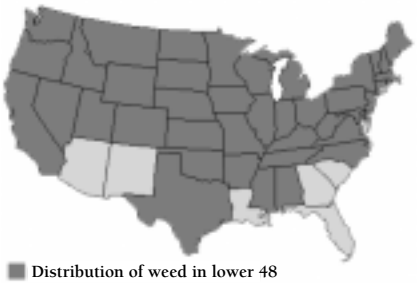
YELLOW STAR-THISTLE *(CENTAUREA SOLSTITIALIS)*



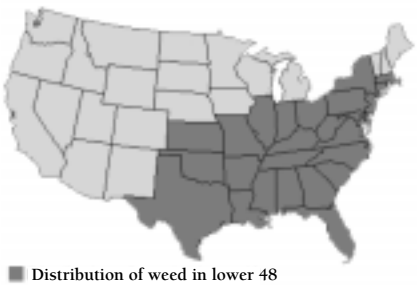
PURPLE LOOSESTRIFE *(LYTHRUM SALICARIA)*



SALTCEDAR *(TAMARIX RAMOSISSIMA)*



KUDZU *(PUERARIA MONTANA)*



Source: USDA, NRCS 1999. The PLANTS database (http://plants.usda.gov/plants).National Plant Data Center, Baton Rouge, LA 70874-4490 USA.