The Land Institute

For 31 years, The Land Institute has worked for ecological sustainability through "Natural Systems Agriculture"—modeled on a natural ecosystem—by developing perennial grain crops of mixed species for farming. These perennial crops mimic natural ecosystems in their efficient use of water, capacity to protect soil, wildlife, and biodiversity, and potential to provide food without intensive use of agricultural chemicals—leading to a sustainable food supply.

Method

The first step in Natural Systems Agriculture is crossing high-yielding annual plants with deep-rooted perennials to obtain grain productivity from one parent and a perennial habit from another. This is possible because the world's major grain crops, including wheat, sorghum, corn, and rice, have wild, perennial relatives. Land Institute scientists are developing various hybrids with perennial traits.

Plant breeding for 2008 at The Land Institute includes work on small grains (wheat, triticale, and intermediate wheatgrass), sorghum, sunflowers, and a legume. Though most of the schedule depends on weather and time of planting, a second "season" to develop some hybrids is made possible with a greenhouse. All new crosses are evaluated for perennialism and fertility. Whenever a new hybrid with these traits is attained, subsequent generations are bred for such agronomic traits as yield, shatter resistance, and plant height that lends itself to mechanical harvesting.

Related research in agroecology/ecology also is being conducted that compares prairie meadows, farm fields, and the field plots of The Land Institute's hybrid crops. In these investigations, soil-nutrient cycling and water management are assessed and techniques are developed for growing new crops that will redefine agricultural sustainability.

Specifically, The Land Institute's research in Natural Systems Agriculture during 2008 includes

- Breeding perennial small grains (wheat, triticale, and wheatgrass species). In addition to strengthening perennial traits, The Land Institute's goal is to improve seed fertility, genetic stability, regrowth, and post-harvest survival in populations descended from crosses between wheat, triticale, and a perennial wheatgrass. Heat tolerance is a necessary trait for perennial wheat.

- Breeding perennial sorghum. The Land Institute continues to identify individual plants that are perennial and have desirable traits for future generations. For sorghum, this means the perennial plants will be uniform in height, produce early in the year, and have high-seed production, large seeds, semi-compact heads, and strong stalks. Winter survival and plants with superior agronomic characteristics are key to breeding the next generation.

- Breeding perennial sunflowers. With strong productivity in 2007, goals for 2008 are the combination of sunflower families with shorter stature, larger seed heads, larger seeds, and reduced shattering. Selecting progenies from hybrid crosses will focus on higher seed fertility and multiple-species hybrids that will generate new breeding populations.

- Breeding a perennial legume. Work continues to develop a perennial legume that fixes nitrogen in the root zone. Specifically, Land Institute scientists are investigating the possible domestication of Illinois bundleflower. Other work, in cooperation with the University of Minnesota, is testing the nutritional value of bundleflower in swine-feeding trials.

- Agroecology/ecology research. Perennial crop mixtures provide many of the benefits of natural ecosystems. The diversity helps make fields more resistant to pests and plant diseases. Inclusion of nitrogen-fixing plants—legumes—in the farm landscape provides natural fertilizer. Deep roots hold soil and manage water and nutrients more effectively than in monoculture fields.

To quantify the impact of perennial crops, The Land Institute studies different research plots, including ones with natural ecosystems, ones with native perennials that have been hayed or grazed, and others with traditional crops. This research includes a multi-year study of productivity in native meadows; agroecology studies; and soil-ecology research investigating links between soil biota and nutrient cycling. The latter is being conducted in cooperation with Washington State University, Stanford University, Agriculture and Agri–Food Canada, and USDA–ARS Southwest Watershed Research Center.

Results

Each generation of plant breeding brings The Land Institute closer to its goal of perennial crops. In a successful plant-breeding program, each year means additional plants to hybridize and grow. Continued completion of hybridization mileposts has necessitated a 20% increase in The Land Institute's budget this year.

The Land Institute Natural Systems Agriculture is designed to help farmers who will benefit from economies inherent in perennial crops. With a perennial system, they will not need to purchase and plant seed each year, will save fuel, and will see significant reduction in the need for agricultural chemicals (for pests and fertilizer). Because deep-rooted plants store and utilize water efficiently year-around, they are more resilient to climate change. An agriculture that is economical for farmers can revitalize rural communities.

In the long term, Natural Systems Agriculture is designed to benefit all consumers. With development of high-yielding perennial crops, food production becomes less dependent on fossil fuels and fertilizers. Perennial crops also absorb precipitation more efficiently.

Although The Land Institute's work is conducted in the heart of the Kansas grain belt, it has broad applicability for food production around the globe because Natural Systems Agriculture is founded in basic ecological principles.

Sources

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