THE PROMISE OF PERENNIALS: WHEAT AS A SUSTAINABLE CROP IN MINNESOTA

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INTRODUCTION:

Our nation's agricultural soils are being lost at unprecedented rates due to conventional tilling practices and the resulting long-term soil exposure. Soil erosion has been known to decrease agricultural productivity and increase the need for harmful agricultural inputs. The extensive root systems, year-round cover, and deposition of plant material in perennial fields protect the soil and aid in its production (see Figures 1 & 2). Research and plant breeding is currently underway to develop a perennial grain crop that would improve agricultural sustainability continue to supply the demand for conventional grains. What stands in the way for planting perennial grain crops? A case study on planting perennial wheat in Minnesota examines these barriers on a local scale. If we are to overcome these challenges, planting perennial wheat could bring about a host of ecological benefits including but not limited to decreased soil loss, improved soil fertility, as well as reduced pesticide and fertilizer inputs (see Table 1). However research and breeding needs to continue in order develop a viable crop, which in turn requires that current projects maintain sufficient funding.

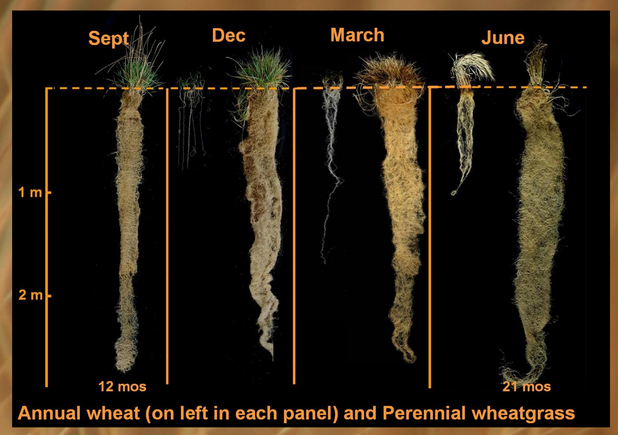

Figure 2: The sheer difference in root biomass between annual and perennial wheat.
Photo credit: *http://upload.wikimedia.org/wikipedia/commons/a/a7/4_Seasons_Roots.jpg*

Table 1: The Benefits of Perennial Compared to Annual Agriculture

Crop and Other Benefits	Soil Benefits
• Higher root biomass • Longer growing season • Increased water uptake efficiency • Store more carbon and have higher net primary productivity • Require less fertilizer • Require less frequent planting and tilling	• Limit soil erosion • Can be grown on otherwise unsuitable land • Provide higher inputs of organic matter • Soils in perennial fields have higher levels of total soil nitrogen • Higher microbial biomass (indicator of soil health)

Figure 1: Researchers at the Land Institute compare soils from an annual wheat field (left) and a perennial intermediate wheatgrass field (right). Soils in perennial fields are known to have higher soil organic matter content and nutrient availability.

Photo credit: *http://www.landinstitute.org/vnews/display.v/ART/4f1de1dba2689*

METHODS:

First, a literature review was done to assess the current state of industrial agriculture in the U.S., and more specifically the treatment and health of our agricultural soils. Second, the soil characteristics of perennial and annual fields were compared through a review of scientific literature. Third, an assessment of the latest research on the progress in breeding perennial grain crops was done to better understand the breeding process as well as any current barriers. Finally, in order to further understand the barriers that prevent the implementation perennial grain crops in the U.S., a case study was done on planting perennial wheat specifically in Minnesota. Interviews were conducted with agricultural researchers, plant breeders, agricultural economists, and wheat farmers in Minnesota to determine these barriers and to realize potential solutions.

For further reading:

- Cox, T.S., et. al. "Progress in Breeding Perennial Grains." Crop and Pasture Science 61 (2010): 513-21.
- DuPont, S.T., et.al. "No-Tillage Conversion of Harvested Perennial Grassland to Annual Cropland Reduces Root Biomass, Decreases Active Carbon Stocks, and Impacts Soil Biota." Agriculture, Ecosystems and Environment 137, no. 1-2 (2010): 25-32.
- Kimbrell, Andrew. Fatal Harvest: The Tragedy of Industrial Agriculture. Washington: Published by the Foundation for Deep Ecology in arrangement with Island Press, 2002.

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Table 2: Barriers to Planting Perennial Wheat in Minnesota

Barriers	Description	Potential Solution
Biological	• Grain size: Perennial wheat (PW) tends to produce smaller seeds. • Threshability: PW is harder to remove from glumes.	• Continue breeding and selection for plants with larger grain sizes and greater threshability.
Breeding	• Longevity: Early PW varieties fail to survive beyond the first growing season. • Fertility: Chromosomal differences between breeding varieties often lead to sterility in offspring.	• Continue and expand breeding projects through increased funding. • Wait. The breeding process is complicated and timely.
Profitability Concerns	• Due to decreased grain size profitability of yields may decline. • Seed prices and decreased seed demand: Less frequent purchases	• Farmers will save in other ways (i.e. less tractor use) and ideally profits will balance out. • Farmers can allow grazing in the fall to increase profitability. • PW seed prices are likely to be more expensive.
Agricultural Subsidies	• Current agricultural subsidies support annual agriculture. • The Farm Bill provides little monetary support for Research and Development (R &D).	• Provide direct payments for PW • Increase Farm Bill funding for R & D and Sustainable Agriculture Program.
Farm-Level Concerns	• Changes in equipment and farmer responsibilities • Risk of crop and market failure	• Wheat farmers will still be able to use traditional planting and harvesting methods. • Provide crop insurance similar annuals

CONCLUSION:

From interviews it was determined that there are five main barriers for planting perennial wheat in Minnesota (see Table 2). First and foremost, the fact that breeders have yet to find a reliable wheat crop to grow commercially is clearly the most concerning barrier. In order to overcome this challenge, research must be continued and expanded to address both the biological and breeding concerns. Due to the fact that the breeding process is both complicated and requires a lot of time, we must simply wait until a successful cultivar is developed. In the meantime, funding from the 2012 Farm Bill needs to increase allocation for R & D to support and expand current projects. Once a viable crop becomes commercially available, the government must provide economic incentives for sustainable agricultural practices to encourage farmers to make the switch.