Restoring Our Heritage Of Wheat

John Barleycorn by Mary Azarian

Join generations of farmers who saved their own seed to create the wheat biodiversity that sustained world peoples. It takes a community to grow a loaf of bread!

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working draft

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Wheats whisper the journeys of the peoples who carried them, the trading, migrations and conquests that are kneaded into our breads. The heritage wheat grown in North America originated in the Fertile Crescent and Europe. When people immigrated to the New World, they brought landrace wheats from their homeland.[1] These are the wheats that nourished earlier peoples, but today are on the verge of extinction, replaced by modern wheats bred in agrochemical-soaked fields for high yield and uniformity.

Kansas Wheat Commission

Modern wheats bred for uniformity, dwarfed to not lodge with synthetic N

Harvesters - Pieter Breugal, 15th c

Heritage wheats have large roots for organic nutrient absorption, are tall for photosynthesis

Since the dawn of agriculture, farmers have been selecting crops to develop the foods we eat today. For over 10,000 years, heritage wheat has been the staple food for humans. However today genetic management has shifted into the hands of industrial breeders but with hidden costs. Most commercial wheats are patented to prevent farmers from saving them, replacing heritage wheats world-wide. Modern wheat, the most widely grown crop on earth, is bred for uniformity and yield. Flavor is not a criteria. Nutrition is forgotten[2]. Important characteristics, such as extensive root systems for nutrient-use efficiency, height for weed competition, and durable horizontal resistances to diseases are decreased.[3] The unprecedented erosion of diversity has resulted in fewer varieties, limiting food security, nutrition and culinary art. Organic farmers, artisan bakers and people that like to eat are seeking heritage wheats' robust health, higher nutrition and delicious taste. **Where are the heritage wheat seeds?**

[1] Classification of American Wheat, USDA Bulletin 1922, Clark, Martin and Ball.

[2] The diet of over three billion people worldwide, who depend on wheat as a primary source of micronutrients, is nutrient deficient. While wheat **yield** has increased through 'green revolution' breeding, the concentrations of minerals, including copper, iron, magnesium, manganese, phosphorus, selenium, and zinc (except calcium) have **decreased**.

Returning Wheat to the Hands of Nature and Farmers

'Every Farmer a Breeder.'

'**Northeast Organic Wheat'** is funded by NESARE is to restore a culture of seed-saving and on-farm crop improvement of our most staple foodcrop – wheat. Our program involves: 1. conducting **on-farm trials** to evaluate landrace wheats, genepools and modern varieties. 2. involving farmers in **on-farm selecting** and exchanging seed, equipment and knowledge, and 3. fostering a **farmer-baker cooperative** for a community-based seed systems with local market partnerships.

Our workplan builds year by year as follows:

Years 1-2: ***On-Farm Trials to Evaluate Heritage Wheats, Genepools and Mixtures***

We are growing-out and evaluating almost-extinct world landrace wheats contributed by traditional farmers and genebanks in European and the Fertile Crescent. EU organic breeder-partners have generously contributed genepools of '*new landraces'* for on-farm evolution by New England farmers. We are crossing superior heritage varieties with good modern varieties to combine robust resilience with high-productivity. We are observing how **mixtures** of diverse varieties may help control disease and pests.

Years 2 - 3: ***Evolution of New Landraces in the Hands of Nature and Farmers***

'Every Farmer a Breeder'

Superior landraces and genepools will be **returned to the hands of nature, farmers and bakers to evolve anew** in local conditions. Farmers will select robust plants with rich flavor, baking quality and high nutrition, with traits that confer improved productivity and stable yields in Northeast environments. Our genepools will be useful for all farmers interested in sustainable practices ie reduced herbicide, fungicide and fertilizer inputs.

Years 3-4: ***Farmer-Baker Cooperative market new varieties with local identity.***

Farmer-baker partnerships can revitalize New England wheat by working together to select ***not only*** for agronomic traits but for local cuisine and artisan palates – with baking trials and taste tests to select robust wheats with the highest baking quality and rich flavor for artisan products. We are especially interested in varieties with historic value for a Northeast 'brand identity'.

What is 'Landrace' Wheat?

A 'landrace' refers to a population of plants or animals that has evolved over generations of natural and human selection to be well adapted to local conditions. Landrace populations, domesticated by traditional farmers in their centers of origin, carry wide genetic diversity. The diverse traits of landrace wheats enable us to save seeds of the plants with the traits we seek, to develop new varieties best adapted to our farms.

Since there are few landrace (heritage) wheats available for New England farmers and to overcome the genetic bottleneck of modern pedigree wheat uniformity, not to mention PVP patents that prevent farmers from seed-saving, we searched in remote villages in the cradle of wheat's ancestral Fertile Crescent homeland and in the European centers of biodiversity of wheat's evolutionary journey, to find the almost-lost landrace populations with the vibrant traits we need today. ***Why?*** Agro-biodiversity is the organic farmers' key defense against disease and unanticipated stresses, such as weather extremes of climate change.

'Genepools' for On-Farm Evolutionary Breeding

Biodiversity is at the heart of a robust community food system. Increasing the genetic diversity of wheat through the generation of multi-line genepools (crosses) in combination with introducing characteristics from modern wheat as appropriate, can be an effective strategy to increase yield in organic fields. Stable yields in organic conditions favor the polygenetic traits of landraces over modern pedigree uniform varieties. Genetically diverse populations allow for adaptation through self-regulating, evolutionary natural systems that generate flexible, adaptable traits.[4]

Cultivation of locally-adapted landraces enhances agroecosystem health and stability, can improve soil structure and decreased use of chemical inputs like fertilizers, pesticides and herbicides required by widely-adapted modern varieties and enhance durable horizontal resistances to pests and disease – if farmers save seed of the plants that thrive best in their unique field conditions.

3. A.A. Jaradat. 2006
4. Dr. William Tracy. The Creative Power of Plant Breeding. Seeds and Breeds Proceedings. 2005

Restoring Biodiversity by Growing Mixtures of Different Varieties

'Looking at the field of ripening grain, Vavilov realized it was not a uniform wheat cultivar, but a panoply of intermixed strains of grain that formed a resilient polyculture. It was necessary to collect hundreds of seedheads for a representative sample of the vast biodiversity in a single field. The traditional farmers' methods of crop selection enhance landrace wheat's' biodiversity; Their criteria of complex traits include: flavor, texture, health, maturation and more.' [5]

Yusef chews his grain to decide which plants to save for seed

Yusef explained, 'I like to eat it when it's green. That's when the flavor is sweet. Each plant is a little bit different. I like the taste of this one to save seed for next season.' as he offered me a handful to munch. 'The plants with the big heads have the deepest roots to reach water in the soil. They're good ones' The seedheads were the size of small corn cobs!

A study on mixing wheat varieties[6i] documented the potential for intercropped wheats to perform comparably and even out yield wheat monocultures, confirming the age-old practice of mixtures by traditional farmers. Landrace wheat populations are typically composed of mixtures wherein one genotype dominates and others, including hybrids, appear naturally.[7ii] [iii8] This long-term dynamic process ensures the yield stability over years. However, lack of breeding knowledge and availability of quality germplasm may limit substantial improvement of landraces on traditional farms in remote regions.

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[5] Where Our Food Comes From: Retracing Nikolay Vavilov's Quest to End Famine. Gary Paul Nabhan. Island Press. 2009

[6] Effect of Intercropping and Cultivar Mixtures on Organic Wheat Production. Jacqueline Claire Pridham and Martin Entz, University of Manitoba, http://www.organicagcentre.ca/ResearchDatabase/res_mixtures_wheat.asp

The Art of On-Farm Selection

*'On-farm breeding is a combination of art and science with the emphasis on **ART**. That means you rely on your intuition. You don't need to generate a table of numbers and run it through a statistical program to tell you which plant to take seed from. Will you get somewhere by relying on your intuition? **Absolutely**!' Dr.* Mark Hutton, Maine Extension

*'People in the industrial world are distant from both agriculture and nature. It is not surprising that few understand **the power of selection**. The raw material for selection is the natural genetic variation that evolved in landraces and that is created anew by mutations and adaptation. As selection is applied, plants with favorable alleles are chosen. If the non-selected individuals are removed from the population, the remaining population will have a different gene frequency from the original population and selection will have been effective in improving the performance of the population. But, no new individuals or genotypes were created. What Darwin recognized and plant breeders harness is the creative power of selection.*[9] Dr. Bill Tracy

Seed-saving and adaptive selection has been the right and responsibility of farmers since the emergence of agriculture. Farmers are the original breeders, however our traditional knowledge and community seed systems are as threatened as the heritage wheats. Our program introduces a participatory approach to on-farm breeding, by conserving and breeding wheats within the farming systems where they need to evolve. On-farm conservation maintains vital breeding material through a dynamic evolution of the crop with its pathogen and pest complexes, and to climate change. On-farm breeding can generate genetically diverse genepools that will respond rapidly to on-farm selection in organic farms. Genetically diverse genepools and landraces evolve and adapt to our local conditions, echoing the natural interactions that evolved landrace characteristics.[10]

Quality traits, such as flavor, that are not directly influenced by natural selection, can be enhanced through on-farm selection and by crossing in varieties with the traits we seek, such as delicious flavor, baking quality and robust health. Maintaining quality

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[9] 4. Dr. William Tracy. The Creative Power of Plant Breeding. Seeds and Breeds Proceedings. 2005. Dept of Agronomy. UW-Madison, Wi 53706 *wftracy@wisc.edu*

2. A.A. Jaradat. 2007 'Restoring Ancient Wheat' Workshop Proceedings-IGB. USDA-ARS NCSN Research Lab, 803 Iowa Ave. Morris, MN, 56567. *abdullah.jaradat@ars.usda.gov*

characteristics in a bulk wheat population is a key objective for value-added organic local markets.[11] A population-based breeding using ***recurrent mass selection,*** combined with ***introgressing improved traits,*** can be effective to increase yield and quality under participatory breeding systems.

Women are the seed-savers in the traditional farming communities where I collected wheats in the Mideast. The art of seed-saving was passed down from generation to generation by grandmothers. In Palestine, the villagers in Wadi Fukin (see: growseed.org/wadifukin.html) proudly explained that they brought their elder grandmothers to the field to select the seeds to save for next year.

Culinary uses of landraces by traditional peoples are based in the unique characteristics, flavors, textures and colors of their heritage varieties. Selecting crops for yield and agronomic traits alone excludes essential aspects of producing food for nourishing, culturally diverse cuisines.

In developing countries, the selection criteria of small-scale farmers reflects the traditional knowledge of generations. However, in developed countries, the farmer is a member of a larger system that encompasses wheat breeders, farmers, end-use processers, markets and consumers. New organic market channels are developing where the history, origin, flavor and the specific end use directly inform selection criteria in the field. As we re-discover the world of heritage wheats, reclaim artisan breeding skills and exchange seed with each other, small grains can once again become a sustaining staple foodcrop in our culture and local economies.

This is new for most of us. Your questions and experiences will help everyone build our community knowledge and skills for on-farm breeding. If you have suggestions, experience, please contact us so we can share them.

[5] Jaradat, Abdullah, 2006

Where do I get heritage wheat seed?

The Heritage Wheat Conservancy has field-tested 112 varieties and offers elite lines and historic varieties on <growseed.org/seed.html>. Google: 'heritage wheat' for a plethora of small seed companies. The national genebank has about 50,000 wheat accessions! Soon enough seed will be grown out that we can share our best seed with our neighbors to build a locally-adapted community seed supply.

How do I fertilize the soil?

Dig as deep as possible. Provide balanced fertility with ample mineral amendments so that the plant has great fertility to achieve its full potential for stock seed. *In future years, after we have an ample supply, we'll screen varieties under adversity to learn which populations adapt well and to build resilient populations.* Grains can "lodge" or fall over in highly fertile soil, so plant in your typical good organic soil treatment. Do not baby them. Treat the wheat like corn in your rotation. Rotate fields with a cover crop right before the wheat crop, and after, perhaps with vegetables

Which variety should I trial? There are so many!

For seed-savers, select heritage varieties that you feel a personal connection to. Seeds have a cellular memory carried to the present. Grow seeds from a culture or place you care about. Grow as large a population as possible of healthy plants to maintain a diverse pool of traits. For larger-scale market growers, consult field trials results from cooperative extension and the Vermont-based: <northerngraingrowers.org>. Results from the NOW Maine, Vermont and Massachusetts trial sites will be posted on: growseed.org. HWC offers individualized support to select varieties for your end-use needs or educational projects.

How far apart do I plant the seeds?

You'll receive about 100 seeds per variety from HWC. Plant each seed **ONE FOOT** apart in all directions for good root development and to observe each plant fully. Yes – one foot! The young roots will sense the greater availability of room and nutrients and tiller out to give a higher yield and develop fat seed. Plant to a depth of an inch or two by hand. Next season when you have a more ample supply, broadcast thinly, rake in or use a cultivator. Sow an understory of low-growing clover in a few weeks to suppress weeds. Third year you may have enough for equipment.

Replications: Plant three small plots the same size for **each** variety in a random pattern. Label each plot and make a map for back-up so you know what's what if labels are lost.

Will the different varieties cross pollinate?

Rarely. Wheat is self-pollinating. There is a natural out-crossing of about 3%, which would product a new variety with rich combinations of traits. That would be cool.

When do I plant?

Winter wheats are planted in the fall from late August to mid-September and put their energy into setting roots before freezing, then become dormant under snow cover until spring. A period of about six weeks of winter vernalization, freezing weather, stimulates the plant to flower in spring. The wheat grows harvest in July to early August. Hard winter wheats tend to be high in protein and gluten. **Spring wheat** can be planted as early as the ground can be worked. Both fall and spring plantings are harvested before August, opening possibilities for mid-summer sowings of other crops.

How much yield can I expect?

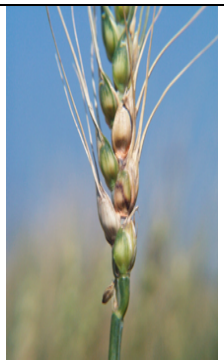
Each variety is different. One seed may produce from 200 to 500 seeds on the new plant. The yield is measured by the weight and size of the seed harvested from a plant. Our highest yielding heritage variety (so far) is from the southern Ukraine to northern Caucasus region. It averages 985 seeds per plant, but each plant had both large and small seedheads. We saved 2 pounds of the larger seedheads. Our harvest of two pounds this year can yield 400 pounds next year. We encourage folks *to save the seed of the biggest heads from the healthiest plants*. In the beginning the yield is lower since you only save the largest heads but soon you'll reap abundant returns by growing varieties

selected to thrive on your farm. The lowest yielder in our trials was einkorn, but it is drought hardy, giving stable yields in harsh conditions when the modern cultivars do not yield at all. If you want to try your own hand at cross-pollinating to combine traits from different plants, download instructions on: growseed.org/now.html.

Weed Suppression: Weed suppression from alleopathic[12] root exudates and competition resulting from the plant height and shading is important to evaluate in organic variety trials. Planting low clover (a few weeks after wheat planting) for a ground cover may help suppress weeds. Ground cover by the crop at the end of tillering may be correlated with weed suppression.[13]

Wheat Diseases and Pests will be addressed in future resources

See: http://wheat.pw.usda.gov/ggpages/wheatpests.html

			
Leaf Rust	*Fusarium Head Blight*	*Powdery Mildew*	*Hessian Fly*

In this first stage of our program we are developing evaluation methods for organic systems that are useful for farmers in the field. Observe from the moment that the seed starts to germinate. Look at the whole plant. See chart in appendix for details.

- overall robustness, dark green color and health (disease resistance)
- height (weed competition/weed suppression and root alleopathic suppression) x sturdy stalks and no lodging
- winter hardiness (survival rate)
  yield as measured by number of tillers (spikes), seeds per average ten tillers, and grain weight per plant (indicator of efficient nutrient scavenging/use potential)
  1,000 kernel weight

[12] Allelopathy is the release of plant-produced phytotoxins that suppress weeds.
[13] Bertholdsson and Jönsson, 1994

Key post-harvest quality traits to evaluate:

- glutin elasticity/strength as measured by chewingin the field, and loaf volume,
- flour protein content and
- rich, complex flavor, aroma, texture, color.

Since organic fertility management differs from conventional fertility management, the genetic variability of wheat varieties' capacity to scavenge and accumulate protein and minerals is a key trait. Protein content has a greater influence on flour quality than any other factor

Threshing Wheat in Macedonia <aegilops.gr>

Harvest ripe seed when the plants have dried completely brown – before the birds get them! Pick or cut the most fat heads of the healthiest plants. Look at the whole plant. Be highly selective. As interest in small-scale grain production burgeons, methods for threshing are burgeoning as well, as will beposted on growseed.org, or do a web-search.

The simplest way is to thresh by hand or foot rubbing. Dan Jason of <saltspringseeds.com> uses a wooden threshing box about 3 feet by 4 feet by 1 foot high with thin slats screwed onto the inside bottom for extra abrasion. I cut off the seedheads, examing for the healthiest, and put on an upside-down car mat on a tarp. A foot twist, rub or shuffle over the seed heads removes the chaff from the kernels. Winnow off the chaff by pouring it outdoors on a windy day, over large basket or tarp, in front of a fan, or blow off the chaff with a hair dryer. Involving local kids is fun.

Each seed is a unique Noah's Ark of unique traits. Each person is an essential link in building a community seed system. Conserving and increasing the diversity of wheat varieties not only can improve the livelihoods of farmers and gardeners at the local level, but is a key link for robust local food systems for a planet facing unprecedented climate change and globalization pressures.

Northeast Heritage Wheats

The heritage wheat varieties grown in colonial to the late 1800s were well-adapted to each state's climate, and have fascinating stories to tell spanning 'Red Lammas', the first wheat grown in colonial Massachusetts by the English settlers, delicious heritage wheats brought by the French, Cyrus Pringle's 1800s Vermont-bred wheats, the Baltic and Siberian wheats grown in 1800s Maine, and Elbert Carmen's 'Rural New Yorker' are some of the few we are restoring.

 Red Lammas colonial MA	 Maine Heritage 'Siberian'	 Cyrus Pringle's' Champlain' and Hungarian	 Elbert Carmen's 'Rural New Yorker'

Red Lammas

the earliest wheat grown in colonial New England, brought over by British farmers in the 1600's, is excellent for scones and light breads. In the Modern Husbandman, 1784, William Ellis wrote: 'Red Lammas is deemed the 'King of Wheats' for having deservedly the reputation of the finest, full bodied flour. It fetches the best price at market.'

Red Lammas

is a almost soft red winter wheat with aromatic flavor and crispiness enjoyed in light breads and pastries. It is the earliest recorded wheat grown in America; grown before the American Revolution by British settlers. It is the same or a direct descendent of ***Red Lammas***, an old Celtic wheat grown in Britain from the time Romans carried it up from the Fertile Crescent. Ancient Celts celebrated the midsummer wheat harvest in a festival called *Lughnasad* (Lugh means Sun-King) when light dwindles after summer solstice. *Lammas* (Middle English 'Hlammasse' or loaf - mass) refers to the Celtic wheat festival where the first sheaf of wheat was ceremonially reaped, threshed, milled and baked into a loaf. As Christianity entered, the community's first loaf was consecrated at 'Loaf-Mass' in thanksgiving for the harvest.

We offer seed generously contributed by Glenn Roberts of Anson Mills, NC.

Turkey Red - Crimean

is a hard red winter wheat with a rich nutty flavor from Crimean landraces that survive harsh Ukrainian winters. Turkey Red was brought from the Ukraine by Mennonites who migrated to Kansas in 1873. *Samuel Zook, bishop of River Brethren Church* reported in 1880*:*

'I sowed eighty acres of Russian wheat introduced by Mennonites. We have been interviewing that field very closely all winter and have come to the conclusion that it is by far the hardiest wheat we have seen in Kansas. Our advice is to sow a larger breadth of this hardy variety next fall. If millers insist upon having the finer tender varieties let them rise up and out of their easy chairs, take to a farm and grow tender varieties themselves.'

Turkey Red was heartiest wheat and soon became the favored Kansas wheat until modern breeding created shorter, higher yield varieties.

In the 1922 USDA Agriculture Bulletin No. 1074, the exact origin of Turkey Red is revealed. Turkey Red is a Ukrainian landrace hard winter wheat from the Crimean regions encompassing the Krymka and Kharkiv areas. With this information, I have searched out Crimean landrace wheats collected by Nickolai Vabvilov in the 1930s. I was able to secure one modest packet of 100 authentic grains of Red Turkey entered in 1890 in a genebank, and one packet collected by Mark Carleton . In 1898, Mark was sent by the USDA on his first plant exploration trip to Russia. He brought back new durum and hard red wheat varieties most of them from Crimea, to grow in the United States. Five years after the introduction of wheat from Russia, wheat production in the United States exploded from 60,000 to 20 million bushels a year. Not only did the drought tolerance of these new varieties open up the Great Plains and the Northwest for wheat growing, the durum wheat tasted better in pasta, and the hard red wheat made better bread.

M.A. Carleton in 1900

The official who sent Carleton on his 1898 collecting trip would later write, "We have forgotten how poor our bread was at the time of Carleton's trip to Russia. In truth, we were eating an almost tasteless product, ignorant of the fact that most of Europe had a better flavored bread with far higher nutritive qualities than ours." [14] Vavilov thought that the spring wheat line in Crimea is Halychanka (Red Fife). It was known in Maine as 'Scotch Red'.

[14] http://www.ars.usda.gov/is/timeline/germplasm.htm

Maine's Heritage Wheats

Crimean Winter

Siberian Spring

'There was a time when wheat was a sure crop in Maine. It was raised without serious difficulty in quantities adequate to the wants of the people. It was the most common and reliable of crops. Wheat was a surer crop than Indian corn, more bushels of it were annually harvested and consumed. The only flour brought into our State was borne hither from vessels from Baltimore and Richmond, but seldom used except in small measure by families in our seaport towns for pastry purposes. The Erie Canal had not yet opened. NY's Gennessee flour was unknown here.

For wheaten bread our population relied upon the home article. Few stores were without ample bins of wheat. Our wheat was not white like the brands of St. Louis. It was sweet and nutritious but of brownish hue. Much of the bran was mingled in the flour.

The best variety of winter wheat cultivated in Maine is known as the Banner wheat. In 1844 we received a small package of this grain from the Patent Office, just imported from the Baltic. We sowed it and its proceeds, till three years afterwards, a harvest of thirty-two bushels was obtained. We distributed it in various parts of the State for cultivation. As uniformly as with us, it proved a good success. Siberian, aka Java or China Tea, and Black Sea winter wheats also have been grown with great success.

The Banner wheat has been raised to this day. It is a splendid grain. Sowed on grounds that the frosts do not heave badly, it is found to survive the winter nearly as well as herdsgrass or clover. But it should be sown in August that it may get firmly rooted before winter. If a pasture is

plowed in July, fertilized, harrowed, sown and rolled in August, or if the seed is scattered in the cornfield previous to the last hoeing, the chance is sure of an ample harvest in July following.' Maine Agriculture Society Report of 1857

What was the origin of the Banner wheat that did so well Maine? I want to run out and plant it on my Maine farm today! Why would the U.S. Patent Office send wheat to Maine? With this clue, I researched the Patent Office activities of the period and discovered the following puzzle pieces. Henry L. Ellsworth wrote in his report of 1837:

'The introduction of a new variety of wheat promises the most gratifying results in securing production under the adverse effects of severe winters. A short time ago, the most eastern State of our Union was, in a measure, dependent on others for her bread-stuffs. That State is now becoming able to supply its own wants, and will soon have a surplus for exportation; and this is effected by the extensive introduction of new wheat. Among the varieties of this wheat, however, there is great room for selection; there is at least 20 percent difference, if regard is paid to the quality and quantity of the crop.' [15]

Reports from the USDA wheat researcher, Mark A. Carleton shed light on cold-hardy varieties from Eastern Europe. In his 1894 monograph 'Successful Wheat Growing', Carleton states that the hardiest winter wheats originate from the Crimean regions of Karkov, Kuban and Samar. *'The very best winter wheat is Kharkov wheat - the most hardiest of all known winter wheats'*.

[15] http://www.ipmall.fplc.edu/hosted_resources/PatentHistory/poar1839.htm

Red Fife - Halychanka

is known as *Galician Spring* in Europe and as *Halychanka* in its home in the Ukraine. In 1842 David Fife of Ontario received from a friend in Scotland a packet of wheat from a Ukrainian ship from Danzig (Gdansk). Fife planted the grains but only five plants germinated. Of those, some were eaten by the family cow before the last plants were saved by Mrs. Fife. Most of the wheats were winter lines, but the plants that headed in spring became known as 'Red Fife'. Soon this cold-hardy spring wheat spread throughout Canada. Red Fife was introduced to the US in the mid-1850s and was called in Maine 'Scotch Fife'.

The old landrace wheats of the Carpathian mountains, the birthplace of Red Fife - Halychanka, belong to one basic landrace with winter hardiness, resistance to drought and excellent baking qualities. These are mostly winter wheats but in northwestern Ukraine (Galicia) spring wheats such as Red Fife – Halychanka thrive.

We are growing Halychanka from the Vavilov Institute in Russia. In our trials the Halychanka was significantly more robust abnd higher yielding that the Canadian Red Fife lines provided by Sharon Rempel.

Vermont's Defiance

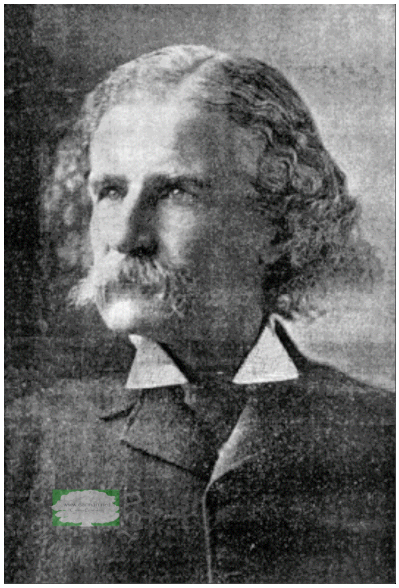
When Vermont became the 14th state in the Union in 1791, wheat was a common crop with good yields. In the mid-1800s, Cyrus Pringle, a farmer-breeder from Charlotte, Vermont, developed a strain of wheat better-adapted to northern New England.

In the mid-1800s, Cyrus Pringle, a farmer-breeder from Charlotte, Vermont, bred a wheat for northern New England. However Pringle's work was interrupted by the Civil War. With an abiding belief in non-violence, Pringle was imprisoned in a military camp in 1863 for refusing to fight. President Lincoln intervened and released Pringle and the three other Quakers. Pringle's journal: *The Record of a Quaker Conscience* gutenberg.org/files/16088/16088-h/16088-h.htm

After recovering from his ordeal, Pringle returned to his family farm in Charlotte, Vermont. From 1864 to 1880, he bred wheat, oats, grapes and potatoes. Pringle wheats:

Defiance - a soft white spring,
Champlain - hard red spring, and
Surprise - a soft white spring club

Elbert Carman and the Rural New Yorker



'His earliest experiments with wheat involved testing all known varieties of England, France, Russia, and the United States to ascertain which were the hardiest and most productive. Then followed exhaustive tests as to best depth, quantity of seed, mode of sowing and best fertilizers, such as salt, ashes, plaster and lime. Potash, phosphoric acid and nitrogen, singly and in various combinations were thoroughly tested. he work of crossing varieties of wheat was begun and has continued down to date, with results valuable to science and to agriculture. In 1881 Carman succeeded in crossing rye with wheat, the first and only successful attempt on record so far as we know. This crossing was followed up for years with the progeny. Most of the hybrids resembled the wheat parent, rather than the rye. Last year a large proportion of the plants and heads came true, and it is believed that a tolerable stability has been reached. The stems are twice as thick as those of wheat, and leaves broader, the color brighter, the tendency to tiller stronger, and the plants seem not subject to winter-killing. Several of the wheat and rye-wheats are now offered by seedsmen.'[16] Carman's 'Rural New Yorker' soft red winter wheat was released in 1884.

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[16] http://www.carman.net/elbert.htm

[ii] Jaradat, A. 1992, *Euphytica 52: 155-174*
[iii] Jaradat, A. 2006, J Food Agriculture & Environment, 4: 186-191