



# **LONG-TERM DRYLAND ROTATION RESULTS 1990 TO 2005**

**THE DAKOTA LAKES STAFF**

## **INTRODUCTION:**

The most important mission of the research enterprise at Dakota Lakes is to create conditions appropriate for research scientists from the main campus and/or from cooperating institutions like the USDA-ARS. For this reason three base rotations were established on the dryland portion of the main station starting with the 1990 growing season. These rotations were Winter Wheat-Corn-Broadleaf; Spring Wheat-Winter Wheat-Corn-Broadleaf; and Winter Wheat-Broadleaf-Corn-Broadleaf. The broadleaf crop options in 1990 were very limited. It is not that way today.

By default, the broadleaf crops grown prior to winter wheat at Pierre normally has to be a cool-season broadleaf to allow enough time for moisture recharge between broadleaf harvest and winter wheat seeding. Peas, canola, lupine, lentil, chickpea, flax, and several forages have been used as cool-season broadleaf crops. The broadleaf crop grown prior to spring wheat or corn can be either warm or cool-season species. Soybean, sunflower, safflower, and cowpea have all been used as warm-season crops.

The three rotations used presented a very diverse set of rotational intervals and crop sequences. This creates differing conditions that are important for testing treatments such as new varieties. For instance, the alternate year broadleaf rotation (Winter Wheat-Broadleaf-Corn-Broadleaf) was designed to present an environment that had low disease pressure and high winter-kill potential for the winter wheat. It is used for AYT trials by the wheat breeding project. Conversely, the Spring Wheat-Winter Wheat-Corn-Broadleaf rotation presents a situation for winter wheat that is low in winter-kill potential because of the spring wheat stubble. This same stubble can harbor leaf diseases, so it provides the opportunity to test for disease reaction. Similarly, rotations where corn follows one or two years of wheat production experiences the best moisture conditions possible at Pierre, but it also has cold soil conditions with the potential for it to be excessively wet.. Corn following a broadleaf will have better early growth but may have less available moisture depending on the preceding crop and the weather. When combined with the irrigation capability of the station, an almost unlimited suite of conditions can be created.

The other goal of maintaining these three rotations is to document long-term trends that occur in soil properties, weed populations, etc. Hopefully, problems that will be encountered by farmers in the future will be encountered at Dakota Lakes in time for solutions to be found before it is a widespread. Conversely, positive trends might also appear. Most research is focused on very short-term goals with little attention being paid to long-term changes. These rotations have been 25%, 33%, and 50% low-residue broadleaf crops. There is a definite difference between the rotations in terms of the amount of surface residue that can be maintained. The good performance of the rotations with more residue during dry periods will spur more research. Information gleaned from this production information and from the Wheat Commission No-till Rotation studies at Redfield and in Northern Lyman County have been incorporated into tools like the diversity index and intensity rating tools. This information is also used to develop training material like that used for the NRCS Nation Agronomists in 2004. The handout from that meeting is attached at the end of this report.

**PERFORMANCE OF DRYLAND ROTATIONS AT THE  
DAKOTA LAKES RESEARCH FARM – MAIN UNIT  
1993-2005**

WINTER WHEAT  
CORN  
COOL SEASON BROADLEAF

	WINTER WHEAT	CORN	FLAX/Pea/ CHICKPEA <sup>1</sup>
1993	83	131	30
1994	41	105	22
1995	51	90	18
1996	60	95	17
1997	65	127	1650 <sup>1</sup>
1998	85	102	2187 <sup>1</sup>
1999	78	95	1169 <sup>1</sup>
2000	81	66	705 <sup>1</sup>
2001	56 <sup>3</sup>	86	2364 <sup>1</sup>
2002	28/56 (pea)	3	8 bu/a (pea)
2003	34	38	45 bu/a (pea)
2004	63	123	45
2005	92	43	28
AVE	60	84	22/1600/28

<sup>1</sup> 1997-2001 Broadleaf Crop – Lbs/Acre

<sup>3</sup> Spring Wheat – Due to winter kill

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SPRING WHEAT  
WINTER WHEAT  
CORN/SORGHUM  
WARM SEASON BROADLEAF

	<b>SPRING WHEAT</b>	<b>WINTER WHEAT</b>	<b>CORN</b>	<b>SOYBEAN/ SUNFLOWER</b>
1993	69	72	120	33/1670
1994	32	41	120	28/950
1995	51	56	111	36/1700
1996	58	58	105	24/1698
1997	49	71	115	43/1912
1998	64	84	137	29/1608
1999	66	77	121	45/1678
2000	32	53	68	23/1800
2001	56	54 <sup>3</sup>	91	24/1804
2002	5	12	8	2/200
2003	46	26	42	10/900
2004	40	56	110	34
2005	44	56	32	22
<b>AVE</b>	<b>47</b>	<b>55</b>	<b>90</b>	<b>28/1450</b>

<sup>3</sup> Spring Wheat – Due to winter kill

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WINTER WHEAT  
WARM SEASON BROADLEAF  
CORN/SORGHUM  
COOL SEASON BROADLEAF

	WINTER WHEAT	SOYBEAN/ SUNFLOWER	CORN	LENTIL/ F. PEA <sup>4</sup>
1993	54	41/1580	120	1150
1994	32	28/1050	65	1200
1995	60	32/1140	108	800
1996	58	24/2135	75	1000
1997	45	47/1960	142	-/42
1998	94	34/1843	114	-/20
1999	92	43/1634	119	-/63
2000	81	26/1900	50	-/33
2001	51 <sup>3</sup>	24/1560	86	-/37
2002	28	6/300	0	6
2003	24	6	2	47
2004	64	41	56	47
2005	57	20	5	39
AVE	57	28/1400	72	1050/40

<sup>3</sup> Spring Wheat – Due to winter kill

<sup>4</sup> Field Peas in Bushels/Acre. Lentils were not planted in 1998-2001.

**Profitable No-till Systems Designed for Producers  
in the North American Great Plains and Prairies**  
Dwayne L. Beck, Ph.D. Dakota Lakes Research Farm  
South Dakota State University

The full text of this title can be found at the proceedings of the 2003 South Dakota No-till Conference [www.sdno-till.com](http://www.sdno-till.com). It is strongly recommended that “No-till Guidelines for the Arid and Semi-arid Prairies” be used as a reference. It can be found at the [www.dakotalakes.com](http://www.dakotalakes.com) web site.

### **An Emphasis on Rotations**

Determining what to grow as rotational crop(s) and how they will be sequenced can be a complex process. There are however some general guidelines that can be extremely helpful in beginning the process. Consider this to be Beck’s **TOP 10 LIST**. The order they appear does not denote their importance.

1. Reduced and no-till systems favor the inclusion of alternative crops. Tilled systems may not.
2. A two season interval between growing a given crop or crop type is preferred. Some broadleaf crops require more time.
3. Chemical fallow is not as effective at breaking weed, disease, and insect cycles as are black fallow, green fallow, or production of a properly chosen crop.
4. Rotations should be sequenced to make it easy to prevent volunteer plants of the previous crop from becoming a weed problem.
5. Producers with livestock enterprises find it less difficult to introduce diversity into rotations.
  - a. Use of forage or flexible forage/grain crops and green fallow enhance the ability to tailor rotational intensity.
6. Crops destined for direct human food use pose the highest risk and offer the highest potential returns.
7. The desire to increase diversity and intensity needs to be balanced with profitability.
8. Soil moisture storage is affected by surface residue amounts, inter-crop period, snow catch ability of stubble, rooting depth characteristics, soil characteristics, precipitation patterns, and other factors.
9. Seedbed conditions at the desired seeding time can be controlled through use of crops with differing characteristics in regard to residue color, level, distribution, and architecture.
10. Rotations that are not consistent in either crop sequence or crop interval guard against pest species shifts and minimize the probability of developing resistant, tolerant, or adapted pest species

## Classification of Rotation Types

It is sometimes easier to discuss concepts if they are placed into categories of some sort. We have developed the following scheme with this in mind. This classification is totally arbitrary and is meant to serve only as a tool to help understand rotation planning.

**SIMPLE ROTATIONS:** Rotations with only one crop of each crop type used in a set sequence. This is the most common type.

EXAMPLES: Winter Wheat-Corn-Fallow; Wheat-Canola;  
S. Wheat-W. Wheat-Corn-Sunflower; Corn-Soybean; Winter Wheat-Corn-Pea

**SIMPLE ROTATIONS WITH PERENNIAL SEQUENCES:** Simple rotations that are diversified by adding a sequence of numerous years of a perennial crop.

EXAMPLES: C-Sb-C-Sb-C-Sb-Alf-Alf-Alf-Alf and many others.

**COMPOUND ROTATIONS:** Combination of two or more simple rotations in sequence to create a longer more diverse system.

EXAMPLE: S. Wheat-W. Wheat-Corn-Soybean-Corn-Soybean.

**COMPLEX ROTATIONS:** Rotations where crops within the same crop type vary.

EXAMPLE: Barley-W.Wheat-Corn-Sunflower-Sorghum-Soybean or Barley-Canola-Wheat-Pea. This is similar to the example cited for compound rotations. Barley has been substituted for one of the wheat crops; sorghum for one corn; and sunflowers for one soybean.

**STACKED ROTATIONS:** One of the less well-known approaches is one we call stacked rotations. This includes rotations where crops or crops within the same crop type are grown in succession (normally twice) followed by a long break.

EXAMPLE: Wheat-Wheat-Corn-Corn-Sb-Sb; Barley-Wheat-Pea-Canola

Stacked Rotation Concepts: This should not be an unfamiliar concept because it is the way that plants sequence in nature. The concept behind stacked rotations (as with some of the other types of rotations as well) is to keep both crop sequence and crop interval diverse.

**ROTATIONS UTILIZING BOTH STACKED AND NORMAL SEQUENCES:**

Examples include Canola-W.Wheat-Soybean-Corn-Corn and S.Wheat-W.Wheat-Pea-Corn-Millet-Sunflower.

It is hoped that the above discussion has been helpful. It is meant to be an overview of some rotations strategies that will allow producers and those working with them to better understand the “art” of rotation planning.

The following are some statements concerning rotations:

Government programs provide economic disincentives for inclusion of alternative and cover crops. This includes programs such as crop insurance. Bankers will not allow producers to grow crops that do not have a crop insurance program and loan rates associated with them.

I have no better chance of designing the best rotation for you than I have of choosing the best spouse for you. There are things in life that you have to do on your own. I can point out some factors you should consider when choosing a rotation.

There is no “BEST” rotation. No one can design a rotation that will work every year under every circumstance. It is a probability game. There are bad rotations that work well for a while. There are good rotations that fail at times due to weather or other uncontrollable factors. Poor gamblers make money at times; good gamblers lose money at times.

Rotations can be designed that work well in dry years but they fail to take advantage of good years. Or even worse, they fail badly in good to wetter than normal years.

Producers with more risk tolerance (financially and psychologically) will be more comfortable with riskier rotations. Properly designed “risky” rotations can make more money in the long run but can result in substantial losses over the short-term.

The best approach to spreading risks is to use more than one rotation (preferably sequentially to make an even longer complex rotation).

Rotations used may differ depending on the soils involved. In other words, some of your land may require a different rotational approach than other land you farm. Some of the reasons for this include inherent soil characteristics, past history, weed spectrum, distance from the farmstead, landlord, etc.

Most farmers are good at designing rotations once they start trying.

The rotations used may have to change as market, soil, climate, and enterprise, conditions change. That is to be expected. When designing a rotation, be thinking of ways you could change it.

Don't be afraid to ask for advice, but accept no recipes from others. **DO YOUR OWN COOKING.**