ANNUAL RYEGRASS VARIETY FINAL REPORT

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BACKGROUND:

The use of annual ryegrass (Lolium multiflorum) as a winter cover crop began in the early 1990s. As no-till gained in popularity, researchers, crop advisors and Midwest corn and soybean farmers wanted to experiment with annual ryegrass, comparing its characteristics and management needs with other familiar cover crops.

The University of Illinois Extension was part of those early field trials, using successively larger plots in a wider geographic area, often comparing results (anecdotally) between acreage conventionally tilled with other adjacent acreage planted with annual ryegrass. Thus, much practical information was gained from working cooperatively each year with farmers in southern Illinois and Indiana. But the practice also raised many questions, among them: Which varieties perform the best and which are the easiest to manage?

In the fall of 2005, the University of Illinois initiated a three year variety trial to ascertain how different varieties of annual ryegrass reacted against the Midwest winter climate. Likewise, the trials also included herbicide trials, determining optimal methods for effectively eliminating annual ryegrass in the spring. Throughout, management practices were evaluated and developed to insure the highest level of success under Midwest conditions.

This report is being made available to the ryegrass industry and to Midwest producers in order to help farmers and seed growers alike with their decisions about use of annual ryegrass as a cover crop.

VARIETY TRIAL PROGRAM DESCRIPTION:

The annual ryegrass variety trial was initiated in 2005 to investigate winter hardiness of different annual ryegrass (Lolium multiflorum) varieties. Varieties were selected based on an open invitation to all seed companies, breeders and producers. The initial request was for 10 varieties. With a strong interest, 16 varieties were entered in 2006, with 3 more varieties added by the farmers in 2007.

The first variety trial was located at the Ralph Upton farm, 10 miles south of Interstate 64 and about 20 miles from the Indiana border. This site was chosen because the soil is representative of large areas of Missouri, southern Illinois, Indiana and Ohio. The soil type (*Bluford silt loam, fine, smectitic, mesic Aeric Fragic Epiaqualfs*) is a moderate claypan soil, low in organic matter with acid subsoil. Further, the land is typically eroded and exhibits poor internal drainage, restricted crop rooting and is often highly-variable in yields. The Upton site was classified as a C3 with 6-8” of top soil over highly acidic subsoil; it had been no-tilled for 9 years.

The second location was at the Terry Taylor Farm, located 15 miles north of Interstate 64. This site was chosen due to its uniform soil - of a type representative of much of the southern corn belt: poorly drained with little slope and high in fertility. Specifically, the soil type is a *Cisne gray prairie claypan silt loam, fine, smectitic, mesic Mollic Albaqualfs*. This site had little erosion and had been no-tilled for more than 15 years.

Similar research was conducted at Ohio State University by Jim Hoorman. Because of variances between those trials and ones done in Illinois, data reported herein does not include that of Ohio.

MATERIALS AND METHODS:

These annual ryegrass variety trials were blind by design, using a randomized complete block of land with three replications at each site. The only identification used on the varieties in the plots was a number representing each variety. The plots were also flagged with numbers and data was collected by numbers so that no bias was introduced.

Planting was done with a no-till drill at all locations. The use of a no-till drill ensures that the correct seeding rate is applied to each plot and seed is placed at the proper depth. A CrustBuster 15-foot drill was used at the Upton farm and a John Deere 20-foot drill at the Taylor farm. Seeding rate was 20# /acre at a depth of ½".

Planting took place following crop harvest at Locations 1 & 2, to ensure that the data would conform to farming practices in the area. Each year, the annual ryegrass was planted between September 28 and September 30th at both Illinois locations.

Plots at the Upton farm were located at the same site every year and measured 7.5 feet wide by 100 feet long. At the Taylor farm, plots were 10 feet wide and 120 feet long. Over the three years, plots were located in three different fields.

Measurements of each variety were taken at two weeks after planting, again at four weeks and then monthly, weather permitting, and at the final evaluation date. Plants were measured for height, stand, and winter hardiness (condition) in the spring. In the spring, the last measurement included rooting depth which was measured in every variety and replication. Rooting depth was taken using a 3" x 48" soil probe.

RESULTS AND DISCUSSION:

The winter weather patterns in the Midwest were highly variable during the three years of the trial. In the first year, 2005-2006 weather was fairly typical with some cold conditions.

The second year, 2006-07, had very large temperature fluctuations with temperatures varying more than 60 degrees Fahrenheit over 2 - 3 day periods. This occurred five times, resulting in severe plant desiccation and dieback. Frequent regrowth and freezing depleted the plants' nutrient reserves.

The 2007-08 growing season was similar to the average temperature, but had 300% greater rainfall than normal, resulting in plant stress and freeze damage.

The Upton farm site - a continuous no-till corn field - had many problems during the study. In the first year, the site had very limited rainfall for establishment of annual ryegrass and resulted in reduced stands as well and reduced winter hardiness. In year two, the ryegrass was planted on September 30 but did not receive any rainfall for almost three weeks, thus delaying emergence until November. The resulting stand was very poor and, when combined with the extreme weather conditions, the entire plot died over winter (winterkill). In year three, the plot was planted on September 7th in moist soil conditions (from a .3" rain, the first rain in 45 days.) The area had experienced a severe drought that year, with less than 3" of rainfall in the growing season and extended high temperatures. Plants emerged but did not receive any additional rainfall until Oct 10th. All the varieties had sprouted and then died due to the lack of moisture. The trial was replanted on November 1 in cold, wet conditions. The planting was not established when cold winter conditions arrived and the majority of the varieties did not survive the winter. Consequently only one year of data from the Upton trials was included in the summary results. One significant note is that of the three replications, the one replication that was located on a higher organic matter soil had a significant increase in survival. The variety trials at the Taylor farm were located in a different field each of the three years. The soil type was the same in each field, and all the fields were located within ½ mile of each other. All the fields had organic matter

greater than 2% and high levels of fertility. Planting dates were September 28, September 30, and September 21 for the 3 years. All varieties achieved good stands going into winter all three years.

Table 1, below, lists the performance of all varieties, based on when they normally would be killed in the spring for a Midwest farming operation. This varied from March 15 in 2006 to April 16 in 2007 and April 23 in 2008. The data shows significant differences between varieties as evidenced by stands. The "means" column numbers indicate the percentage of the stand thriving at the date it was killed.

Table 1 is a composite of both Illinois locations for the three year trial. Individual tables, by year, are available allowing further comparison of the impact of the weather for each year. As mentioned before, each calendar year's data represents the mean of the three replicated trials done at each location. Table #2 lists root depths achieved by variety.

Table 1. Summary of Annual Ryegrass Varieties' Winter Hardiness

	2006 STAND MEANS	2007 STAND MEANS	2008 STAND MEANS	3 YEAR MEAN
A055-30r	72.7	17.3	34.3	41.4
Angus 1	65.0	5.7	36.0	35.6
Bartissimo	82.0	21.7	45.0	49.6
Bounty	82.3	81.7	65.7	76.6
Commission Blend	90.7	38.3	45.0	58.0
Fantastic*		28.3		28.3
Florina	41.0	50.0	53.3	48.1
Flx2002	29.3	38.3	63.3	43.7
Flying A	70.0	17.7	36.7	41.4
Gulf	88.3	2.0	40.0	43.4
Jackson**		63.3	67.7	65.5
King	81.3	71.7	83.3	78.8
Marshal	77.3	60.0	65.0	67.4
Passerel +**		58.3	60.0	59.2
Ribeye	74.3	48.3	41.7	54.8
Saddle Butte	59.0	66.7	61.7	62.4
Saddle Pro	74.3	66.7	61.7	67.5
Soil Builder	86.0	59.3	49.0	64.8
Tam90	57.7	36.7	58.3	50.9
LSD 0.05***	12.8	13.5	13.0	21.7
LSD 0.10	10.6	11.3	10.8	18

** 1 year data; ** 2 years data*

****The Least Significant Difference (LSD) Test is a statistical procedure that determines if the difference found between two treatments is due to the treatment or if the difference is simply due to random chance. For each set of data a value (LSD 0.05) is calculated at a chosen level of significance. If the difference between two treatment means is greater than this calculated value then it is said to be a 'significant difference' or a difference not due to random chance.*

Table 2. Summary Table of Annual Ryegrass Root Growth

VARIETY	3 YEAR MEAN OF ROOT GROWTH IN INCHES
A055-30r	19.7
Angus 1	18.9
Bartissimo	21.1
Bounty	24.1
Commission Exp	22.7
Fantastic*	11.0
Florina	22.8
Flx2002	25.2
Flying a	21.4
Gulf	16.9
Jackson**	19.1
King	23.7
Marshal	24.1
Passerel +**	20.4
Ribeye	23.4
Saddle butte	26.4
Saddle pro	24.4
Soil builder	24.1
Tam90	19.2
** 1 year data; ** 2 years data*	
LSD 0.05	**6.6**
LSD 0.1	**5.5**

HERBICIDE EFFECTIVENESS

Ryegrass cover crop varieties must be controlled by herbicides in the spring in order to plant a row crop. The following tables, summarizing three years of trials, shows the herbicides tested and their effect on the different varieties. The 2006 trial was sprayed March 16 in vegetative stage of growth. The 2007 trial was sprayed April 16, a week after a freeze, when plants were at the vegetative to first joint stage. The 2008 trial was sprayed April 23, when plants were at first joint.

Note: In the following tables, the rating indicates the percent of control, with **100** meaning no plants survived the treatment.

Table 3. Annual Ryegrass Control with Gramoxone, Atrazine, Princep

2006 VARIETY	Gramoxone Inteon 3pt.	Gramoxone Inteon 3 pt Atrazine 4L 2 qt	Gramoxone Inteon 3pt Princep 4L 1 qt	Gramoxone Inteon 3pt atrazine 4L 2 qt. Princep 4 L 1 qt
Tam 90	78	85	82	89
Saddle Pro	85	85	78	88
Ribeye	75	87	82	89
Flx2002	73	88	77	89
Bartissimo	76	85	81	90
Angus1	78	89	84	90
Saddle Butte	73	86	77	88
Flying A	77	89	82	89
Soil Builder	73	87	80	87
Commission Exp	73	85	75	88
King	72	85	78	88
A055-30r	73	87	83	92
Bounty	73	83	78	89
Gulf	78	87	83	92
Florina	77	86	78	89
Marshall	75	83	78	86
LSD 0.05	**7**	**3**	**5**	**3**

Table 4. Annual Ryegrass Control with Roundup, Steadfast

2006 VARIETY	Roundup Weather Max 22oz	Roundup Weather Max 32oz.	Roundup Weather Max 22 oz. Degree Xtra 3 qt	Steadfast 75wg .75oz
Tam 90	98	99	86	47
Saddle Pro	98	98	81	42
Ribeye	97	98	84	47
Flx2002	97	97	85	42
Bartissimo	99	99	87	45
Angus1	99	99	87	48
Saddle Butte	96	98	86	45
Flying A	96	99	87	42
Soil Builder	98	99	86	38
Commission Exp	97	99	85	41
King	95	99	86	45
A055-30r	99	99	90	45
Bounty	98	99	88	40
Gulf	98	99	87	48
Florina	95	99	87	43
Marshall	96	99	89	45
LSD 0.05	**3**	**1**	**6**	**6**

Table 5. Annual Ryegrass Control with ClearOut/Basis

2006 VARIETY	ClearOut 41 + 1 qt	ClearOut 41+ 1.5 qt	ClearOut 41+ 1.5qt Basis 75df .33oz
Tam 90	93	98	98
Saddle Pro	92	97	97
Ribeye	95	98	97
Flx2002	95	97	97
Bartissimo	97	98	99
Angus1	96	98	97
Saddle Butte	95	98	97
Flying A	95	98	97
Soil Builder	93	98	98
Commission Exp	93	98	98
King	95	98	98
A055-30r	97	99	99
Bounty	96	98	98
Gulf	95	99	98
Florina	95	98	97
Marshall	95	98	98
LSD 0.05	**3**	**1**	**2**

Table 6. Annual Ryegrass Control with Select Max, Clearout and Roundup Weather MAX

2007 VARIETY	Select Max 12 oz./a	Clearout 41+ 48 oz/a	Roundup Weather Max 32 oz/a
A055-30r	53	99	99
Angus1	66.3	99	99
Bartissimo	91.7	96	99
Bounty	81.7	96	99
Commission Exp	80	99	99
Fantastic	80	97.7	95.7
Florlina	26.7	94.2	99
Flx 2002	35	96.3	96
Flying a	53.3	99	95.3
Gulf	94.7	99	99
Jackson	63.3	99	97.7
King	38.3	99	97.7
Marshal	43.3	99	99
Passerel+	60	99	94.7
Ribeye	26.7	99	99
Saddle Butte	55	97.6	94.7
Saddle Pro	41.7	96.7	99
Soil Builder	51.7	97.7	99
Tam 90	61.7	97.7	97.7
LSD 0.05	**33.1**	**3.7**	**4.4**

Table 6. Annual Ryegrass Control with Glyphosate 51 Plus Other Herbicides

Trial Shows Results from Across all 18 varieties

2008 TREATMENT	Rate Per Acre	Control Rating
Glyphosate 51	22 oz	97
Glyphosate 51	32 oz + 2,4-D	100
Glyphosate 51	32 oz + Calisto 7oz	63
Glyphosate 51	32 oz + Prowl H2O 3 pt	99
Glyphosate 51	32 oz + Resolve 2 oz.	99
Glyphosate 51	32 oz + Basis 1 oz	99
Glyphosate 51	32 oz + Balance Pro 4oz	99
Glyphosate 51	32 oz	99
	LSD 0.05	**0.6**

YIELD ADVANTAGES:

One of the main selling points of the use of annual ryegrass as a cover crop is its benefits to soil quality and the resulting increase in crop yields. After two years of replicated trials, the following tables show that effect on highly eroded Bluford soils on the Upton farm. Yield differences varied depending on soil type and rainfall.

Table 7. Yields at Upton Farm– Conventional Till vs No-Till with Annual Ryegrass

2006- 07 TREATMENT	Harvested 8-24-07 Mean Yield Bushels/Acre
No-till	79.0
Conv. Till. Fall 06/Spring07	52.5
Conv. Till 06/No-Till 07	61.5
No-Till Ryegrass Cover	121.0
LSD 0.05	**16.3**
LSD 0.1	**13.4**

Ryegrass tillage trial – ryegrass planted Sept.28, 2006 at 13#/a.
Soil type Bluford C3. Plot has been in no-till since 1995.
Corn planted April 15th, at 32,000, Dekalb 63-81.
Rainfall was approximately 3 inches May to October.
Fertility, popup, starter, 150# N. sidedressed mid May

Table 7. Yields at Upton Farm– Conventional Till vs No-Till with Annual Ryegrass

2005 - 06 TREATMENT	Mean Yield in Bushels/Acre
No-till w/ ARG	155.7
Conventional Tillage	102.0
LSD 0.05	**12.3**
LSD 0.1	**9.9**

Conventional tillage, disk in fall, disk
Field cultivate spring
Ryegrass planted Sept 29, 2005 at 15#/a
Corn planted May 4, 2006, at 30,000, harvested Sept. 18, 2006
Rainfall–was 2.6 inches April to October

SUMMARY

A key to the success of annual ryegrass as a cover crop in the Midwest is timely planting which may conflict with corn and soybean harvest. Later plantings are not always successful. Planting in September is suggested in the northern Corn Belt and by mid October in southern Corn Belt.

Variety selection is just one criterion in utilizing annual ryegrass in a Midwestern cropping system. In addition, early planting, planting method, as well as fertility levels, will influence winter hardiness. These southern Illinois results should be taken as a guide but results may be different as one moves further north in the Corn Belt.

Planting annual ryegrass too late or broadcasting the seed in dry soil conditions with 2-3 weeks before a rain may result in a very small plant when freezing temperatures arrive and result in winterkill. Snow cover throughout the winter appears to dramatically reduce winterkill potential.

If varieties are planted early, some will establish quicker which means they may get too tall by winter unless grazed or cut for haylage. Freeze damage may or may not cause loss of the stand, but the large root development will still provide many of the benefits, even though the plant was winter killed. Root development of 14-20" was documented by some varieties at the first week of December, when planted the last week of September. However, more research is needed to document the benefits or loss of benefits if winter kill does occur. Many of the varieties that showed good winter hardiness also were able to quickly establish and develop a good crown for the winter.

Applying nitrogen, 30-40 lbs of N/ac or manure, will increase annual ryegrass fall growth and decrease the potential of winterkill.

Annual ryegrass is not hard to kill in the spring but may require more than one burndown application as glyphosate does not translocate well with cold temperatures. The burndown effectiveness varies somewhat among annual ryegrass varieties but timing, rate, and temperature have more of an influence. A full rate of glyphosate should always be applied and one should always consult the label to confirm rate needed with formulation used. Adding residual herbicides such as atrazine with the glyphosate will causes antagonism, thus greatly reducing annual ryegrass control. Although adding Basis did not improve burndown effectiveness, it does provide residual control.

Annual ryegrass as a cover crop will enhance several soil properties and improve nutrient cycling which may increase yields. However management, especially timing, is important for success. Soils with a restricted layer, natural or man made, which limits rooting depth and soil moisture availability have the most to gain from using annual ryegrass as a cover crop especially in a dry year.