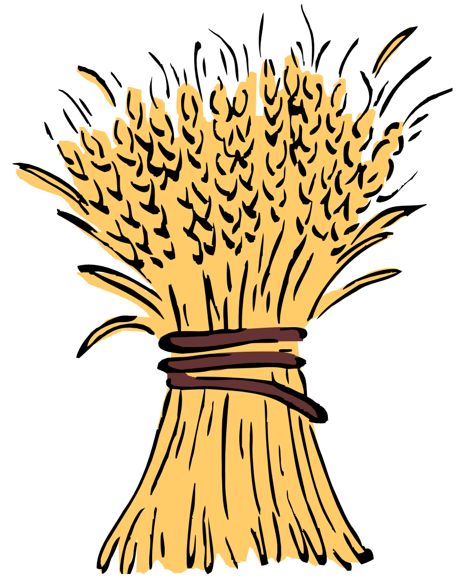

2007 - 2008
WHEAT
PRODUCTION
GUIDE

The University of Georgia

College of Agricultural and Environmental Sciences
Cooperative Extension Service

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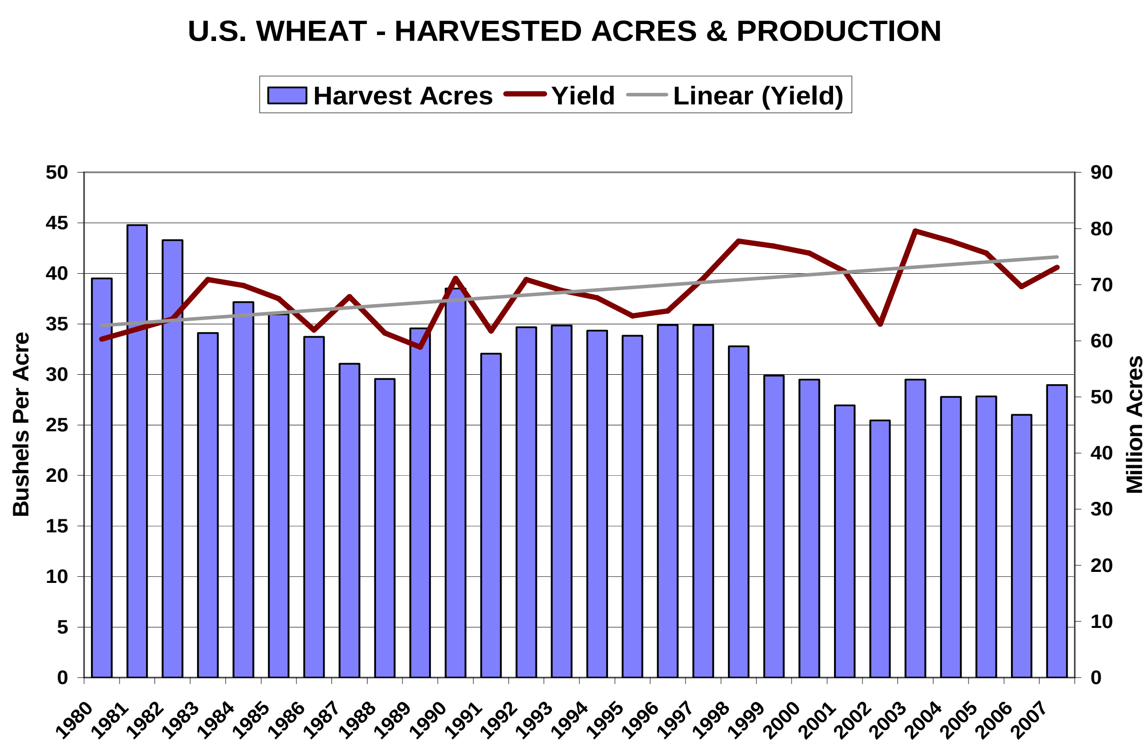
2007-08 WHEAT MARKET SITUATION

Overview

Planted wheat acres in the U.S. increased by over 3 million acres to 60.5 million acres this past year. Winter wheat acreage was up in the US and Georgia as a result of higher prices. Harvested acres for the 2007 crop are projected to average 86% of planted acres for a total of 52.1 million acres compared to 46.8 million in 2006. Georgia winter wheat growers planted 400,000 acres in 2006 for the 2007 crop year and harvested 63% or 250,000 acres. The US average wheat yield is expected to rebound over last year to 40.9 bushels per acre. The April freeze and drought conditions hurt yield prospects in Georgia. The Georgia 2007 average yield is estimated to be 38 bushels, the lowest yield since 1995.

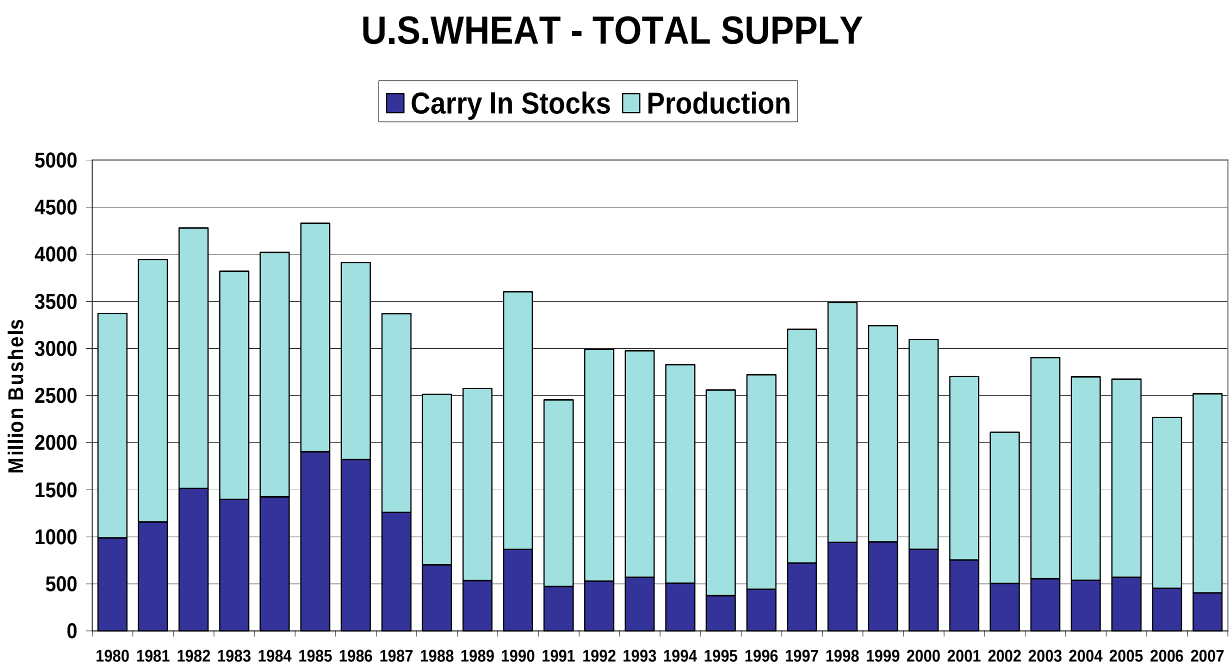
United States wheat yields show an upward trend going back to 1980 but variability has increased in the last ten years. Wheat acreage for the U.S. seems to have settled between 45 and 55 million acres after adjusting down in response to the previous farm bills on 1996 and 2002. The trend yield expectation for U.S. wheat is now around 42 bushels per acre.



The outlook for wheat appears bullish. U.S. ending stocks are projected to continue to drop to the lowest level since 1995 when prices averaged above $4.50 per bushel. At planting in 2006, Georgia and other soft red winter (SRW) wheat producers faced a different picture than growers or hard winter and spring wheat. The SRW market had plenty of supply due to higher yields and increased production. Stocks of SRW wheat increased and domestic mills had met their needs. Thus, for Georgia cash prices to follow Chicago futures, the export market needed to pick up. However, the export market was not in great need of SRW and thus, basis widened to 50 cents under Chicago futures. The basis continued to widen to over 90 cents under Chicago futures as futures prices rose to over $5 per bushel. The old crop and new crop Georgia wheat basis at local elevators continues to hover around 90 cents under futures in late summer 2007.

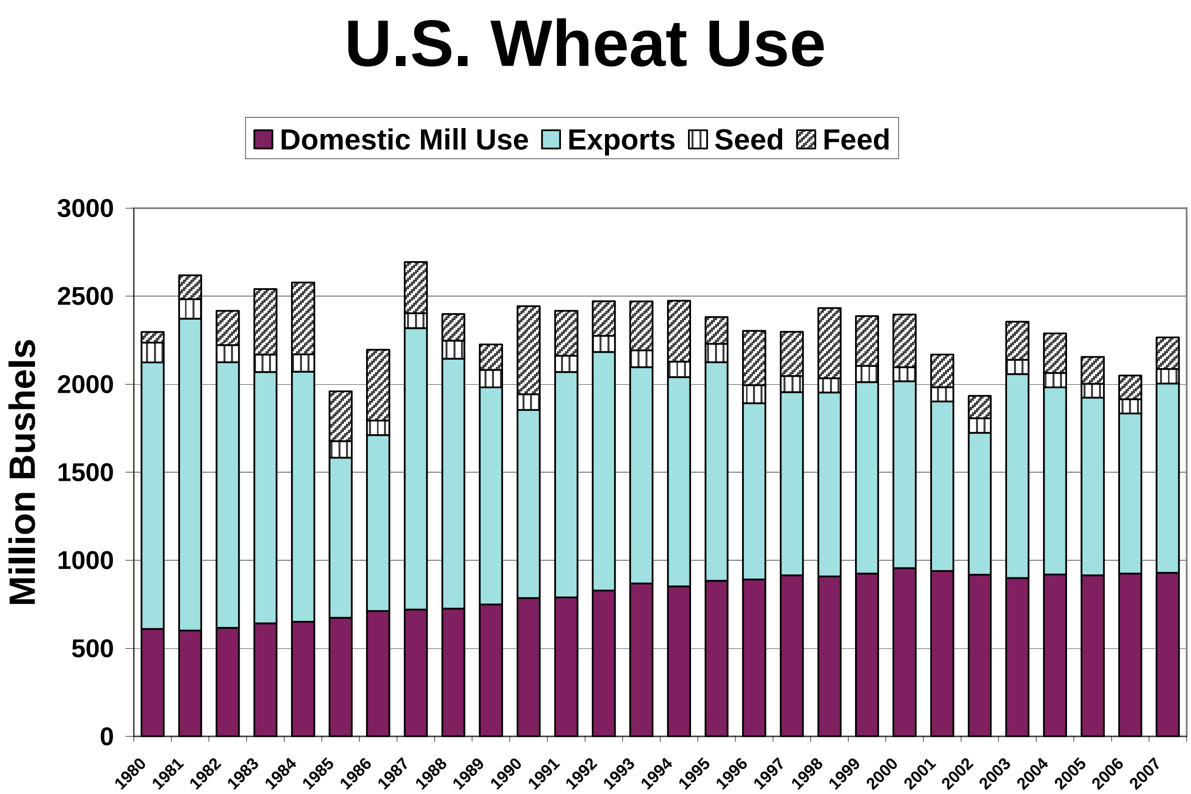
Supply

Wheat production in 2007 is projected to total 2.115 billion bushels which would be an increase of 17% over last year. Winter wheat acreage increased by almost 6.5 million acres as spring wheat acres dropped by about 3 million due to increased corn plantings in 2007. Carryover from 2006 is estimated at 454 million bushels and imports in 2007 are expected to drop from 121 million to 100 million bushels. The total wheat supply during the 2007/08 marketing year is estimated at 2.670 billion bushels.



Disappearance

Total wheat use for the 2006/07 marketing year is projected to be 2.050 billion bushels, the third year in a row to decline. The 2007/08 marketing year, however, forecasts an increase of 200 million bushels coming from higher food and feed use and even a better increase in the export market. Domestic food use is estimated to increase 5 million bushels to 930 million total. Seed use is expected to remain the same at 81 million bushels. Feed and residual use is projected to increase from 134 million to 180 million bushels. Exports are expected to increase the most rising from 908 million bushels in 2006/07 to 1075 million in 2007/08 million.

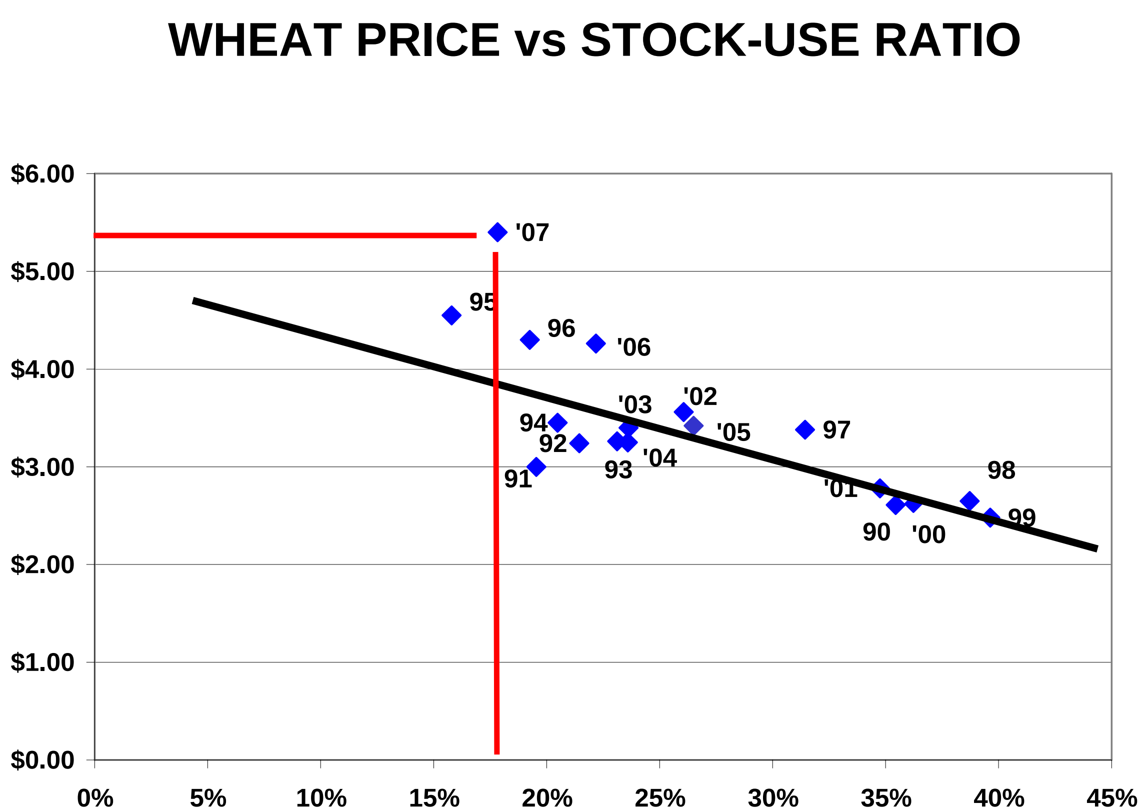


Ending Stocks

The projected U.S ending stocks, or carryover, for 2007/08 marketing year is pegged to be the lowest level since 1995. Total wheat use is forecast to increase at a greater rate than total supply in 2007. The historically low level of stocks has led to supply concerns in the market which has responded with higher prices. The 2007/08 season average price for U.S. wheat is projected to range between \$5.10 and \$5.70 per bushel. Continuing the situation from last year, global stocks are projected to decline by 10.1 million to 114.8 million tons. This is a result of slight increase in global domestic use and global exports. The global ending stocks for the 2007 crop will again be the lowest level since 1981/82.

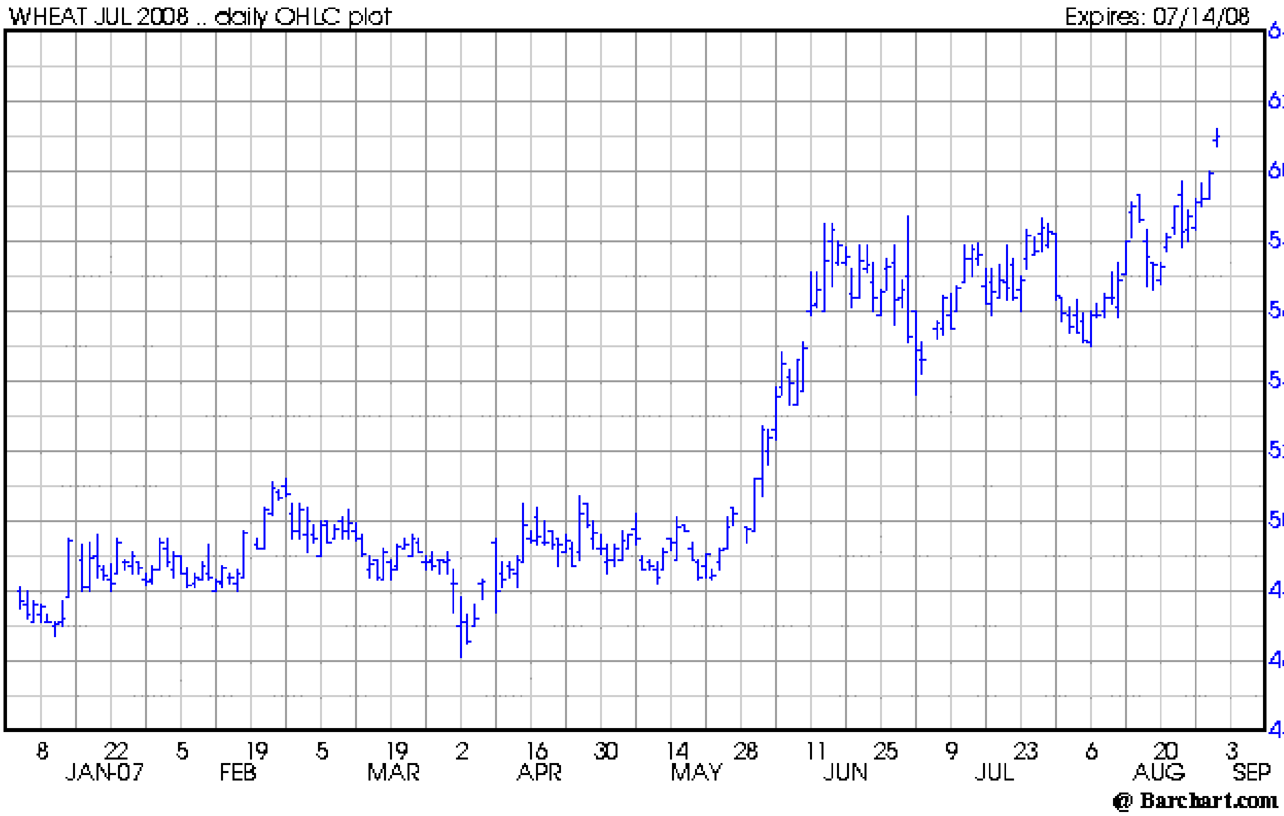
Price Projections

A pretty strong relationship exists between changes in domestic ending stocks and changes in U.S. prices for wheat. This relationship is easily seen by plotting the stocks-to-use ratio with season average prices. A negative correlation is evident going back to 1990 where prices go up when stocks are down and vis-a-versa. The 2007 price projection appears to be an outlier in relation to previous years. The 1995 and 1996 marketing years are the two most recent years to compare when ending stocks were this low. The $5.40 market price projected for the 2007 crop is influenced by low world stocks as well as being pulled up by higher U.S. corn and soybean prices. Thus, wheat prices are expected to remain high for the near term as corn and soybeans continue to bid against each other for acreage.



Outlook for the 2008 Crop Year

The bullish outlook for U.S. wheat is encouraging for wheat growers. Problems with production in the global market and in the U.S. have pushed prices higher as of late August. For soft red winter wheat growers, the outlook is better than last year. Growers have had the opportunity to contract wheat for above $5 per bushel. The basis at local elevators is around 90 cents to a dollar under Chicago futures. Soft red winter wheat yields averaged 63 bushels over 6.16 million acres in 2006 and are estimated at 50 bushels over 7.1 million acres in 2007. Thus, stocks are down but demand remains good in the export market as the U.S. has filled the role as the main exporter recently.



Higher price projections for U.S. wheat should lead to increased acres in winter wheat. How many more acres is difficult to say. Some corn acreage should rotate back to soybeans in a wheat/soybean rotation, particularly in the Midsouth and Southeast. Georgia wheat growers are encouraged to consider pricing opportunities. Last year basis levels were at their best during the planting season. Basis may improve as weather impacts the market but basis improvement is not expected unless futures prices drop significantly. Georgia wheat is marketed through local elevators but more is increasingly being marketed directly to the mill in which the producer would provide transportation. Producers are encouraged to watch for pricing opportunities and consider pricing a portion of the crop when price is above $5.00. Depending on the local basis, cash forward contracting for July delivery and buying an out-of-the-money July call option is a consideration for producers who do not want to give up upside price potential. Using put options to set a price floor above $5 per bushel is also a strategy to consider for expected production not contracted.

CHARACTERISTICS OF RECOMMENDED VARIETIES

An important aspect of wheat production is the choice of which variety to grow. Some very important differences exist among the varieties and the choice you make can play a large role in your success in growing wheat. Of course, a variety can only perform well if given the proper environment in which to grow. Tables 1-4 and the descriptions which follow were designed to give you as much information as possible concerning the wheat varieties recommended for use in Georgia.

AGS 2000: This variety is a release from the University of Georgia and is sold by AgSouth Genetics. It has good leaf rust and powdery mildew and Hessian fly resistance. AGS 2000 has demonstrated good test weight and is medium in maturity. Caution: It has large seed which should be taken into consideration at planting time. It is also susceptible to stripe rust.

AGS 2010: This is an early maturing variety that should be planted in the coastal plains in the later ¼ of the recommended planting period. (Well suited for December plantings). It has excellent disease resistance and good Hessian fly resistance. It also has a short vernalization requirement.

McIntosh: This variety sold by Vigoro has good yield potential, but does not have Hessian fly resistance. It is medium-late, has fair straw strength and is awnless.

Coker 9553: This variety from AgriPro-Coker has excellent yield potential and disease resistance. It is however, susceptible to Hessian fly. Has good stripe rust resistance.

Fleming: This release from the University of Georgia is an early maturing, medium height, stiff-strawed variety with good yield potential for the Coastal Plain Region as an early variety. It is susceptible to cold injury when planted early therefore it is recommended only for late planting. Fleming has good test weight with some resistance to powdery mildew, leaf rust and Hessian fly. It has a physiological leaf spot that can be confused with disease. Carefully examine the lesions for proper diagnosis.

Pioneer 26R61: This good yielding variety from Pioneer has fair leaf rust, but good powdery mildew, soilborne mosaic virus and Hessian fly resistance. It has good test weight and is medium maturing.

USG 3209: This variety is from UniSouth Genetics. It has very good yield potential but only fair resistance to leaf rust and glume blotch. It is susceptible to some Hessian fly biotypes. This variety is better suited for the upper coastal plains and north Georgia. It is widely adapted to the southeastern U.S. and has some of the highest yields in GA trials.

SS 520: It is a medium maturing variety suitable for north Georgia. It is susceptible to leaf rust and hessian fly but has good yield potential with limited test weight potential. It has good resistance to soil borne mosaic virus.

USG 3592: This variety has good yield potential in Georgia. It demonstrates good resistance to powdery mildew, leaf rust, and septoria glume blotch. It also has good resistance to Hessian fly. Straw strength is fair but has good test weight. It is susceptible to stripe rust.

AgriPro Panola: This variety is susceptible to Hessian Fly but in its absence has very good yield. It has good resistance to diseases and has slightly more vernalization requirement than most varieties.

AGS 2031: This variety has good yield potential with resistance to stripe and leaf rust, glume blotch and soil borne mosaic virus. It is susceptible to Hessian fly. It is medium maturing with a medium length vernalization requirement. It also has excellent straw strength.

AGS 2060: This line was developed at LSU and is very early with good resistance to stripe and leaf rust, soil-borne mosaic virus and Hessian fly. It has tolerance to powdery mildew and glume blotch. It is a good yielding variety but will lodge under high N fertilization.

USG 3295: This variety from Uni South Genetics has competive yield, equal to AGS 2000. It has good resistance to leaf and strip rust, and soil-borne mosaic virus but only fair resistance to glume blotch. It is susceptible to Hessian fly and powdery mildew. It is a medium maturing variety.

SS 8641: This variety is a good yielding line with excellent disease resistance. Its vernalization requirement is longer than AGS 2000 but has very good potential. It is also resistant to Hessian fly. It is a medium to medium-long maturing line.

Characteristics of other Varieties for Sale or Grown in Georgia

Pioneer 26R38: A wheat variety with very good yield potential. It's straw strength is slightly weaker than other Pioneer lines. It has good powdery mildew and Hessian fly resistance. It is susceptible to leaf rust so consider using a fungicide.

Pioneer 26R24: This variety has been around for several years and has high yield potential but is very responsive to environmental influences thus is not as stable as other varieties. Has a long vernalization requirement, is susceptible to leaf rust, but better adapted to upper coastal plain and piedmont area. Demonstrates good resistance to Hessian fly.

Pioneer 26R12 and Pioneer 26R15. Both are good wheat varieties though not well suited for the coastal plains of Georgia. Both have long vernalization requirements and mature later than Pioneer 26R61 or 26R31. Both have average tolerances to diseases in Georgia and would require a fungicide treatment plus both are susceptible to Hessian fly.

Pioneer 26R31: The variety from Pioneer is capable of high yields but is quite susceptible to foliar diseases. It demonstrates some resistance Hessian fly and has average test weight. Use a foliar applied fungicide to maximize its yield potential.

AGS 2485: This variety has good leaf rust, powdery mildew and Hessian fly resistance but is susceptible to soil borne mosaic virus. It has better straw strength than AGS 2000. Use a fungicide to maximize its yield potential.

Roberts: This variety from the University of Georgia is an excellent choice for forage wheat. It is susceptible to leaf rust but resistant to glume blotch and powdery mildew. Its vernalization is similar to GA-Gore. It good yield grain potential and should be used for forage only.

Pioneer 2691: This early maturing variety has fair disease and Hessian fly resistance. It will suffer cold injury if planted too early. It has good straw strength, fair test weight and high yield potential. It is a good choice if planting late.

Table 1. Characteristics of Recommended Varieties of Wheat

		Resistance										
Variety	Planting Area[1]	Leaf Rust	Stripe Rust	Glume Blotch	Powdery Mildew	BYD	SBWM[2]	Hessian Fly	Test Weight	Maturity	Straw Strength	Vernal Req
AGS 2000	S	fair	poor	fair	fair	fair	poor	good	good	medium	fair	medium
AGS 2031	S	good	good	good	fair	fair	good	poor	good	medium	good	medium
Fleming	C	good	good	fair	good	poor	poor	fair	good	early	fair	short
AGS 2060	S	good	good	fair	fair	fair	good	good	good	early	fair	short
McIntosh	S	good	good	fair	good	fair	good	poor	good	med.late	fair	med.long
Panola	C	good	good	good	good	fair	good	poor	good	med.late	good	med.long
Pioneer 26R61	S	fair	good	fair	fair	fair	good	good	good	medium	good	medium
Roberts**	P.M.	poor	very poor	good	good	fair	good	poor	good	late	fair	med.long
SS 8641	S	good	good	fair	good	fair	good	good	good	medium	fair	medium
SS 520	P M	poor	poor	fair	good	fair	fair	poor	fair	medium	good	med.long
USG 3209	S	fair	good	fair	good	fair	good	poor	fair	medium	good	medium
USG 3592	S	good	poor	good	good	fair	good	fair	good	medium	fair	medium
USG 3295	S	good	good	fair	good	fair	good	poor	good	medium	good	medium
AGS2010	C	good	good	good	good	fair	good	good	good	early	fair	medium long
Coker 9553	S	good	good	fair	good	fair	fair	poor	good	medium	good	medium

**Recommended for use as forage only.

Table 2. Characteristics of other varieties grown or for sale in Georgia.

Variety	Leaf Rust	Stripe Rust	Powdery Mildew	BYD	Hessian Fly	Test Weight	Maturity	Straw Strength	Vern. Req.
Pioneer 2691	fair	----	fair	fair	fair	fair	fair	early	short
GA-Gore	poor	poor	fair	fair	good	fair	med	fair	med-long
AGS 2485	fair	poor	fair	fair	good	very good	medium	good	medium
Crawford	good	good	good	fair	good	good	early	good	short
Pioneer 26R24	poor	poor	good	fair	poor	good	medium	good	medium
Pioneer 26R31	poor	poor	good	fair	fair	good	medium	good	medium
Pioneer 26R38	poor	poor	good	fair	good	good	medium	good	short
Vigoro Tribute	good	poor	good	fair	poor	very good	late	good	med. long

Table 3. Yield and test weights of certain varieties tested at Tifton, Plains and Midville, Georgia, 2006

	Tifton				Plains				Midville			
	3-Yr	2-Yr	2006		3-Yr	2-Yr	2006		3-Yr	2-Yr	2006	
Brand/Variety	**Avg**	**Avg**	**Yield**	**Test Wt.**	**Avg**	**Avg**	**Yield**	**Test Wt.**	**Avg**	**Avg**	**Yield**	**Test Wt.**
	------------bu/Ac-----------			---lb/bu---	------------bu/Ac--------------			---lb/bu---	----------bu/Ac-------------			---lb/bu---
Pioneer 26R31	91.7	92.7	90.6	60.0	83.1	81.4	114.0	62.4	57.2	63.3	60.5	…
USG 3209	889.0	83.0	80.3	57.7	94.6	96.2	104.6	58.2	59.0	60.9	57.7	…
AGS 2031	88.8	82.9	77.5	56.6	95.3	95.2	101.0	61.2	61.1	59.5	52.5	…
AGS 2000	86.7	85.5	78.5	61.4	85.8	81.0	104.8	59.5	61.8	60.7	57.2	…
AGS 2060	86.7	81.2	76.0	62.8	92.9	92.4	96.1	63.5	59.8	56.2	52.4	…
USG 3295	84.4	80.5	70.4	56.1	89.3	90.8	98.0	58.1	59.8	58.7	55.0	…
Pioneer 26R61	84.4	80.2	77.0	60.4	90.6	92.6	97.6	59.6	61.1	59.2	60.7	…
Coker 9553	84.2	79.7	71.4	60.3	92.9	93.2	92.7	58.8	60.7	55.0	55.7	…
SS 8641	83.3	80.2	77.2	59.7	97.3	99.6	104.1	59.8	47.6	50.8	46.0	…
AGS 2010	83.1	80.9	80.0	62.5	88.8	88.5	97.4	61.5	50.9	56.5	55.4	…
Panola	82.1	79.0	74.1	57.5	88.4	92.8	97.9	58.5	57.8	54.1	49.2	…
McIntosh	81.5	80.2	81.6	57.9	86.7	92.3	95.6	60.9	49.7	50.5	45.3	…
USG 3592	81.0	75.8	67.4	60.2	80.3	76.3	95.5	60.6	57.3	58.0	48.8	…
Pioneer 26R12	79.8	75.0	66.0	58.9	76.9	73.6	87.1	58.5	56.6	53.3	50.3	…
Dominion	78.9	80.1	74.4	57.7	84.6	90.1	93.1	56.5	53.6	54.5	51.1	…
SS8308	77.7	79.5	72.7	60.0	82.9	81.4	90.8	59.7	64.7	57.9	53.0	…
Fleming	77.0	84.6	82.3	57.6	82.2	85.5	101.9	63.6	60.9	61.0	61.2	…
Chesapeake	76.0	72.4	72.1	59.0	69.9	68.3	94.7	63.9	55.1	56.7	56.2	…
Roberts	75.8	78.9	68.4	57.7	74.3	76.4	98.9	58.4	55.4	54.0	46.2	…
SS520	75.0	75.9	65.7	58.9	71.8	71.1	95.9	58.7	54.5	57.2	58.3	…
USG 3665	…	82.2	75.1	57.7		77.5	83.8	59.0		56.5	53.	
26R87	…	78.2	63.1	57.5	…	97.8	99.0	62.6	…	54.5	50.8	…
LSD @ 10%	**NS[4]**	**5.6**	**9.4**	**2.8**	**4.9**	**N.S.[4]**	**7.6**	**3.3**	**N.S.[3]**	**4.7**	**8.3**	**…**

[1]Adapted from the 2007 Small Grains Performance Test Bulletin.
[2]The F-test indicated no statistical differences at the alpha = 0.10 probability level; therefore, an LSD value was not calculated.

Table 4. Yield and test weights of certain varieties tested at Griffin and Calhoun, Georgia[1]

	Griffin				Calhoun			
	3-Yr	2-Yr	2006		3-Yr	2-Yr	2006	
	Avg	Avg	Yield	Test Wt.	Avg	Avg	Yield	Test Wt.
USG 3295	…	…	74.5	62.7	…	…	20.4	61.6
AGS 2031	…	…	64.6	62.6	…	…	14.9	58.2
USG 3665	…	…	62.3	61.8	…	…	42.5	62.5
Pioneer 26R12	…	…	60.8	63.2	…	…	19.2	63.6
Dominion	…	…	59.3	62.7	…	…	24.5	61.7
Roberts	…	…	58.4	62.8	…	…	13.1	59.7
SS520	…	…	52.1	61.2	…	…	13.1	56.0
McIntosh	…	…	46.2	62.2	…	…	18.3	61.0
USG 3592	…	…	44.9	60.5	…	…	26.4	61.4
SS 8641	…	…	43.7	60.5	…	…	20.2	60.3
26R87	…	…	37.3	58.4	…	…	10.7	57.1
GA-Gore	…	…	34.8	60.5	…	…		
AGS 2000	…	…	34.1	60.9	…	…	13.1	58.8
USG 3209	…	…	28.6	60.3	…	…	13.9	58.5
Coker 9553	…	…	28.6	61.4	…	…	10.1	55.7
AGS 2060	…	…	27.5	62.3	…	…	9.6	54.7
Pioneer 26R61	…	…	24.2	61.7	…	…	15.9	62.6
Pioneer 26R31	…	…	16.5	59.3	…	…	12.5	57.1
Fleming	…	…	…	…	…	…	16.2	62.1
LSD @ 10% Level	**…**	**…**	**6.4**	**2.8**	…	…	**4.2**	**4.4**

[1]Adapted from the 2007 Small Grains Performance Test Bulletin.
[2]The F-test indicated no statistical differences at the alpha = .10 probability level; therefore, an LSD value was not calculated.

AGRONOMIC PRACTICES

LAND PREPARATION AND TRAFFIC PATTERNS

Tillage can greatly affect wheat yields. Alabama, Georgia and South Carolina research have consistently shown increased wheat yield with deep tillage. Deeper tillage allows for easier root penetration, burial of diseased debris, possible dilution of root pathogens and improved water infiltration. In wet years, low soil-oxygen conditions are enhanced by compacted, dense soils. This condition will reduce yield of most small grains due to the detrimental effects of poor root production and nutrient uptake.

No-till is not used much in wheat production due to poorer yield production. Yield reductions range from 5-20%. Disking is a common tillage practice in wheat production. It can provide an excellent seedbed but may lead to the formation of a compacted layer of soil. The weight of the implement is concentrated in a very small area at the tip of the disk and when disking is repeated several times a hardpan can form. As far as wheat yields are concerned, deep tillage (bottom or paraplowing) is the best tillage option available. It is slower and more costly than disking, but the yield increase is usually cost effective. In situations where double-cropping makes it impractical to deep till, chiseling or subsoiling may be an acceptable alternative.

Establishing a row traffic pattern for all post-emergence field traffic can have merit for reducing injury to wheat and allowing for the crop following wheat to be planted no-till without stunting. No-tilling the crop after wheat can increase yield and soil/water conservation of the secondary crop.

Traffic patterns or tramlines can be established by closing one or more openings in the drill when planting the crop. This can be done by mechanically retrofitting the drill with clutches attached to the metering cup so as to close the opening to leave unplanted rows designed to fit the wheel spacing of your sprayer or tractor. Devices for drills can be purchased to establish tramlines on any tractor width in any multiple of drill widths.

Tramlines may also be formed after the crop has emerged by chemically killing the rows that match the width of the implement used to apply fertilizer or pesticides. Precision agriculture tools such as light bars and GPS guidance systems can help reduce the error of overlapping when attempting to chemically kill rows to produce a tramline.

Using tramlines in intensively managed wheat makes applying uniform sprays of nutrients and pesticides much easier. They improve the precision of applications. They can be used as guides for repeated applications and save on the cost of aerial applications. They reduce the chance of disease development when compared to plants that are crushed by running over standing wheat. Studies have shown that the border plants will compensate for yield losses whereas plants damaged by tires rarely produce good grain.

PLANTING DATES

Planting date is a critical component of successful wheat production. Planting too early or too late reduces yield potential. Always plant late maturing varieties first since their varieties most often have the longest vernalization requirements. Recognize though that some medium maturing varieties may have lengthy vernalization requirements which makes them less suited for late planting.

Vernalization requirement varies widely with variety. In order for wheat to vernalize, temperatures must be low and remain that way for a specific length of time. In the absence of cold weather wheat waits until enough heat units are accumulated before heading. This delay in heading usually results in wheat filling the grain during a hot and dry time of the year.

If planting late in the season, choose an early maturing variety because they have, in general, very little vernalization requirements. This ensures the crop will vernalize properly even in a mild or warm winter. Caution should be taken to avoid planting these types of varieties too early in the season. Due to their short season growing abilities, these varieties may enter the jointing and heading phase too quickly and therefore be subject to severe winter kill or damage from late spring freezes.

In fact, varieties such as AGS 2010, Fleming etc., on average perform best when planted between December 1 and December 15th. In this case, the recommended planting dates are two weeks later than the recommended dates for most other varieties.

The effect of planting dates have on three popular varieties are shown in Table 5. Notice the loss in yield at the late planting date with the late maturing variety. This variety requires longer vernalization and growing days than the early or medium maturing varieties. The effects of late planting can be severe depending on variety.

Table 5. Effect of Planting Date on Yield (bu/A) of Soft Red Winter Wheat, Tifton, Year 1

Planting Date	Early	Medium	Late
Nov 23	76.8	78.6	76.5
Dec 7	71.4	69.2	68.8
Dec 20	54.2	47.1	25.3

Data in Table 6 illustrates how severely wheat yields are penalized as planting is delayed into the winter. It is important to plant within the recommended planting time for high yields.

Table 6. Effect of Planting Date on Yield (bu/A) of Soft Red Winter Wheat, Tifton, Year 2

Planting Date	Early	Medium	Late
Nov 15	64.5	60.4	56.1
Dec 7	42.2	38.6	39.6
Dec 15	39.6	31.9	33.4
Jan 5	11.1	7.5	6.7

Table 7 lists the recommended planting dates for different regions of the state. These dates represent a trade off between planting early enough to allow for adequate tillering before cold weather begins and planting late enough to avoid excessive heat and moisture stress. In many parts of the country planting dates are set late in order to avoid problems with the Hessian fly, but in Georgia there is no such thing as a "fly-free date".

Table 7. Recommended planting times for most wheat varieties grown in Georgia.

Region	**Planting Period**
Mountain, Limestone Valley	October 10 - November 1
Piedmont	October 25 - November 15
Upper & Middle Coastal Plain	November 7 - December 1
Lower Coastal Plain	November 15 - December 1
Lower Coastal Plains**	December 1 – December 15

**Only varieties with short vernalization requirements

SEEDING RATES

In a normal year, wheat cultivars vary between 10,000 and 18,000 seeds per pound. This difference can impact the actual seeding rate if a grower seeds wheat in bushels per acre. For example, in Table 8 seeds per pound of variety 4 and variety 6 vary by 35%. If a grower planted in bushels per acre, he would plant 35% more seed of variety 6 than variety 4, potentially over-planting or under-planting one of the cultivars.

Table 8. Example of seeds per pound of wheat grown in one year in Georgia.

Variety	Seed/pound
1	9,610
2	11,340
3	14,823
4	12,064
5	11.172
6	16,316
7	12,741
8	14,538
9	15,534
Average # seeds per pound	13,126

Seeding based on seeds per acre is much more accurate than seeding based on weight per acre. Generally, a seeding rate of 30 - 35 seeds per square foot is desirable. Information in Table 9 provides appropriate seeds per row foot for various row widths.

When planting on 7.5 inch row widths each linear foot of row should contain 20-25 seeds depending on germination. If planting date is delayed, seeding rates should be increased by 15-20%. The use of certified seed will help insure you are planting seed with a minimum germination of 85% and free of noxious weeds.

Table 9. Seeds per row foot needed to achieve certain seeds per square foot at different seeding widths.

	Seeds /sq. ft.			
Row widths in.	30	35	40	45
6	15	18	20	23
7	18	20	23	26
7.5	19	22	25	28
8	20	23	27	30
10	25	29	33	38

It is important that any seed you plant is tested for germination. Thorough seed cleaning will often increase the germination of a seed lot because it eliminates some non-viable seed.

Information in Table 10, illustrates the differences in pounds per acre between two lots of seed planted at various row widths and seeds per row foot.

Yield potential is maintained when wheat is planted as accurately as possible. Therefore calibrate grain drills each time you change cultivar or seed lots.

Table 10. Pounds of seed per acre as determined by row width, seeding rate and seeds per pound.

	Row width					
	6"		8"		10"	
Seed/row ft.	12,000	15,000	12,000	15,000	12,000	15,000
18	130.7	104.5	98.0	78.4	78.4	62.7
22	159.7	127.8	119.8	95.8	95.8	76.7
26	188.8	151.0	141.6	113.3	113.3	90.6
30	217.8	174.2	163.3	130.7	130.7	104.5

Straw Utilization

Straw utilization has become increasingly important in the economic value of wheat production. There are many uses of wheat straw such as; residue for conservation tillage, landscaping, residue to reduce soil erosion during road or building construction, mushroom production, horse bedding, hay feeding and others.
Varieties vary in their ability to produce straw from year to year. Table 11 is provided to demonstrate differences found in varieties. It appears the difference in dry matter production between varieties that are over 36" tall versus those less than 36" on average is about 30 lbs/A. Therefore, height is a good indicator of total dry matter production. If the straw is removed from the field, remember to apply the same amount of nutrients to the subsequent crop that are removed by the straw.

Table 11. Straw Yield of Soft Red Winter Wheat (lbs/A), Griffin, 2003-2004.

Variety	Ht-in.	Griffin
AGS 2000	38	2572
USG3209	36	3149
Pioneer 26R61	38	2021
Pioneer 26R24	37	2777
USG 3259	40	2666

Table 11. Straw Yield of Soft Red Winter Wheat (lbs/A), Griffin, 2003-2004.

Variety	**Ht-in.**	**Griffin**
Pioneer 26R12	36	2173
Crawford	34	2352
SS535	34	2235
Coker 9152	33	2478

FERTILITY RECOMMENDATIONS

Soil fertility is one of the primary yield building components of small grain management. A properly managed fertility program, including recommended fertilization and liming practices, can improve yield and quality more than any other single management practice. Such a program includes soil testing, knowledge of crop nutrient requirements and removal, timely application of nutrients and record-keeping.

Nutrient uptake and removal varies with yield (Table 12). Most fertilizer recommendations account only for nutrients removed in the grain. When straw is also removed, additions of phosphorus (P), potassium (K), and sulfur (S) should be increased for the following crop.

Table 12. Nutrient uptake and nutrient removal by wheat at different yield levels. Removal based on grain only.

	Yield bu/A					
	40		70		100	
Nutrient	Uptake	Removal	Uptake	Removal	Uptake	Removal
	------------------------------pounds per acre-----------------------------					
N	75	46	130	80	188	115
P_2O_5	27	22	47	38	68	55
K_2O	81	14	142	24	203	34
Mg	12	NA	21	NA	30	NA
S	10	NA	18	NA	25	NA

Nitrogen (N)

Nitrogen rates and timing of application are key management factors for making good wheat yields. Nitrogen rates should be based on soil potential, cultivar, realistic yield goal, previous crop and residual N. For expected wheat yields of 40 to 70 bushels per acre, use a total N rate of 80 to 100 pounds per acre. Adjust this rate based on the preceding crop. If following peanuts or soybeans, decrease the N rate by 20 to 40 pounds per acre. If following grain sorghum or cotton, increase by 20 to 40 pounds N per acre. Timing of N fertilization should be based on the pattern of uptake by the crop. Demand for N is relatively low in the fall but increases rapidly in the spring just prior to stem elongation. Therefore, apply 20 to 40 pounds of nitrogen per acre at planting, and the remaining N prior to stem elongation. Use the lower rate at planting on heavier-textured soils and the higher rate on sandy soils. Also, excessive N rates applied in the fall could result in a number of problems including surplus vegetative growth, winter kill, disease incidence and lodging, reduction in milling properties and flour quality, and possibly nitrate contamination of the groundwater.

When the yield goal exceeds 70 bushels per acre, use a total N rate of 120 pounds acre. Adjust this rate for the preceding crop as above. Also, on sandy soils, use two topdress N applications, one at early tillering and another at early jointing. This can improve yields when N leaching conditions occur. Although yields may not always be improved, this practice can also reduce the amount of N released into the environment, and offers the chance to adjust N rates downward if climatic or economic conditions do not warrant the added expense of the last N application.

Nitrogen fertilizer prices have increased significantly in recent years. Therefore, choosing the proper rate and timing of application is even more critical in terms of making an economic yield. Also, there are still a good number of different nitrogen fertilizers to choose from that vary in characteristics and price. Be careful not to choose a nitrogen fertilizer based on price alone. In addition, there is currently a shift away from ammonium nitrate to urea. Urea volatilization is a concern under hot and dry conditions. The timing of N applications on wheat are typically not that conducive to losing large amounts of N from urea. Irrigation or rainfall can reduce N losses from volatilization of urea. Urease inhibitors are also commercially available that when added to urea can reduce volatilization losses.

Other Nutrients

Since 65% of the total P uptake and 90% of the total K uptake occurs before the boot stage, these nutrients should be applied according to soil test before planting and thoroughly incorporated into the rooting zone. When double cropping after wheat, apply P and K for fall and spring crops prior to fall planting, except on deep sands. In this case, split K applications between the fall and spring crops.

Sulfur (S) leaches readily in sandy soil horizons, but accumulates in subsoil clay horizons. If the depth to clay is greater than 16 inches, apply at least 10 pounds of S per acre. Best results are obtained when S is supplied with topdress N applications.

Micronutrient levels in Georgia's soils are usually adequate for wheat production unless soils have been over-limed. Low zinc (Zn) levels may occur in soils of the Coastal Plain. A soil test readily detects these conditions, and it is easily corrected by applications of three pounds of elemental Zn per acre in the preplant fertilizer. Manganese (Mn) deficiency occurs most frequently in poorly drained soils of the Flatwoods region. Availability of Mn declines significantly as pH increases above 6.2 to 6.5 in these soils. Soil applications seldom correct the problem since Mn is readily converted to unavailable forms. Foliar applications of 0.5 pounds of Mn per acre as $MnSO_4$ or 0.25 pounds of Mn per acre as Mn chelate will correct deficiencies, but two or more applications may be required.

Poultry Litter

Managed properly, poultry litter (manure mixed with bedding material) can be a valuable source of plant nutrients for wheat production. It is most like a complete fertilizer, containing significant amounts of primary, secondary and micronutrients except for boron. On average, broiler litter contains approximately 3 % N, 3 % P_2O_5 and 2 % K_2O (fertilizer value of 3-3-2). Based on this average, one ton of poultry litter contains 60 lbs of N, 40 lbs of P_2O_5 and 40 lbs of K_2O. Based on current fertilizer prices for N, P and K, poultry litter is valued at approximately $25/ton. The nutrient content of litter vary significantly however, depending on moisture content, type of bird, feed ration and especially storage and handling methods. Therefore, it is highly recommended that litter be analyzed for nutrients by a reputable laboratory before determining application rates and value.

Application rates of poultry litter for fertilizer are usually based on the nitrogen requirement for the crop grown. Buildup of phosphorus however is an increasing concern due to water quality issues. Therefore poultry litter is best used as a preplant incorporated, complete fertilizer to supply P, K, secondary and micronutrients to the crop on a timely basis. For wheat, an application of 2 ton/a of poultry litter (preplant incorporated) will supply an adequate amount of fall N and should meet the P and K requirements of even a soil testing low in P and K. The availability of P and K in poultry litter is considered comparable to commercial fertilizer. For N, it is estimated that only 25 % of the N in poultry litter is readily available. The remainder is in a slower released organic form. Therefore, excessive N in the fall should not be a problem. Release of adequate amounts of N from litter in the spring will depend on a number of factors, especially weather conditions. Therefore, the crop should be monitored in the spring and topdress N applications should be adjusted accordingly.

WEED CONTROL IN WHEAT

Effective weed management is one of many critical components of successful wheat production. Weeds compete with wheat for light, nutrients, water, and space. Severe weed infestations can reduce wheat yields by at least 70% if left uncontrolled. Additionally, weeds can harbor deleterious insects and diseases and decrease harvest efficiency. The presence of weedy plant fragments may also reduce the food and feed value of wheat. These factors result in dockage and lower yields thereby reducing profits.

Weeds that most often cause problems in wheat are winter annual broadleaf weeds such as mustards, radish, common chickweed, and henbit; perennials such as wild garlic and curly dock; and Italian ryegrass. One of the best tools for suppressing weeds in wheat is a healthy, vigorous crop. Good crop management practices that result in rapid wheat stand establishment and canopy development minimize the effects of weeds.

Cultural Control Methods

Weeds are often controlled most effectively through cultural practices that result in rapid wheat stand establishment and canopy development, thus providing an undesirable environment for weed growth. Cultural practices include the following:

1) Planting certified seed (free of weed seeds and garlic bulblets)
2) Good seedbed preparation including free of weeds
3) Proper fertilization
4) Seeding at the proper rate and time
5) Management of diseases and insects

Site selection also can play a significant role in weed management. Rotation away from fields infested with troublesome weed species, such as Italian ryegrass and wild radish, may reduce the presence of these weeds and allow for the use of alternative crops and control methods. Additionally, so as to prevent weed spread from field to field during harvest, equipment should be cleaned when moving from infested areas. This precaution can be of significant consequence in preventing or minimizing the introduction of new weed species into ‘clean areas’ when commercial combine operators who travel long distances are used for harvest.

Planning a Herbicide Program

Before selecting herbicides, growers should know what weeds are present or expected to appear, the soil characteristics (such as texture and organic matter content), the capabilities and limitations of the various herbicides, and how best to apply each herbicide.

Weed Mapping

The first step in a weed management program is to identify the problem; this task is best accomplished by weed mapping. Surveys should be developed each spring to provide a written record of the species present and their population levels.

In-season Monitoring

Fields should be monitored periodically to identify the need for postemergence herbicides. Even after applying herbicides, monitoring should be continued to evaluate the success of the weed management program and to determine the need for pre-harvest control measures.

Proper weed identification is necessary since weed species respond differently to various herbicides. Table 15 lists distinguishing characteristics for several commonly found weeds. Contact your local Extension office for aid in weed identification.

Managing Weeds with Herbicides

If applying herbicides, read and follow label recommendations. Information concerning weed response to herbicides, herbicide rates, and grazing restrictions for wheat are provided in Tables 16, 17, and 18. Refer to product labels for up-to-date suggestions and restrictions.

Generally, larger weeds are more difficult to control than smaller weeds; therefore, timely herbicide applications are critical. Many of the herbicides used in wheat affect growth processes within the target weed. In essence, the more actively the plant is growing, the better the control. Applications made to stressed weeds (i.e. drought, cold, etc.) will often result in decreased control.

Many herbicides should be applied only during certain stages of wheat development to avoid crop injury. Although the stage of development provides a good indicator for application timing, factors such as environmental conditions, health of the crop, and variety (early vs. late maturity) also have an impact on crop tolerance. For example, applications made in wheat during periods of stress may result in crop injury.

Herbicides for Controlling Broadleaf Weeds

2,4-D. This phenoxy herbicide is available in several formulations (amines, esters, and acid + ester mixtures). Ester or acid + ester formulations tend to be more effective under cooler conditions as compared to amine formulations. Additionally, ester and acid + ester formulations mix well with liquid nitrogen. Amine formulations can usually be mixed with liquid nitrogen, but the amine herbicide must first be premixed with water (one part herbicide to four parts water) and then the water-herbicide mixture added to the nitrogen with good agitation. Amines tend to cause less burn on the wheat than esters when nitrogen is used as the carrier.

An amine formulation is MUCH safer to use when plants that are sensitive to 2,4-D are nearby. Ester and acid + ester formulations of 2,4-D will more likely volatilize and move off target to susceptible species.

2,4-D controls several common winter broadleaf weeds such as buttercups, cornflower, cutleaf eveningprimrose, wild mustard, and wild radish (Table 16). However, 2,4-D often does not adequately control chickweed and henbit.

Timing of application of 2,4-D is critical to avoid injury to wheat. The critical period for 2,4-D application is after wheat is fully tillered but before jointing (Feekes stages 4 and 5, Figure 1). Application before this growth stage may cause a “rat-tail” effect whereby the leaf does not form and unfurl properly. The crop may appear stunted and delayed in maturity, and tiller development may be adversely affected. Conversely, application after jointing has commenced may result in malformed seed heads.

MCPA. Similar to 2,4-D, MCPA is a phenoxy herbicide that controls a broad spectrum of broadleaf weeds (Table 16). Timing of application of MCPA is after wheat tillers (preferably 2+ tillers) but before jointing (Figure 1). Injury, similar to 2,4-D injury, can be observed if applied before or after the critical period of application for wheat. In general, MCPA causes less injury to wheat than 2,4-D, but it is also less effective on larger weed species (particularly wild radish). MCPA and Express tank mixtures are very effective on most Georgia weed infestations.

Harmony Extra. Harmony Extra is a prepackaged mixture of the sulfonylurea herbicides thifensulfuron-methyl and tribenuron-methyl.

Harmony Extra controls most of the common winter annual broadleaf weeds (Table 16). However, cornflower is the major exception. Wild radish must be small (less than four inches diameter) for adequate control by Harmony Extra. 2,4-D or MCPA at 0.25 to 0.375 pound active ingredient per acre may be mixed with Harmony Extra for improved wild radish control and for control of cornflower. Harmony Extra is very effective on curly dock and wild garlic (see section on wild garlic).

A nonionic surfactant at the rate of 1 quart per 100 gallons of spray solution is recommended when Harmony Extra is applied in water. Harmony Extra also may be applied using liquid nitrogen as the carrier. In this case, premix the herbicide in water and add the mixture to the nitrogen with agitation. Adding surfactant when using nitrogen as a carrier will increase burn on the wheat foliage. Thus, when applying Harmony Extra in nitrogen, reduce the surfactant rate to 0.5 to 1.0 pint per 100 gallons of spray solution. For easy-to-control weeds, consider eliminating the surfactant when nitrogen is the carrier. However, do not eliminate surfactant when treating wild garlic. Do not use surfactant when mixtures of Harmony Extra and 2,4-D are applied in nitrogen.

An advantage of Harmony Extra compared to 2,4-D is the wide window of application. Harmony Extra can be applied in wheat after the two-leaf stage but before the flag leaf is visible (Figure 1). Application no later than the fully tillered stage is recommended for better spray coverage on weeds.

Express (tribenuron) and **Peak** (prosulfuron)**.** Similar to Harmony Extra, Express and Peak are sulfonylurea herbicides that are effective on many winter annual broadleaf weeds (Table 16). Comparing these herbicides to Harmony Extra, Harmony Extra is superior to Express in controlling henbit, shepherd's-purse, cutleaf eveningprimrose, and wild garlic. Peak is often the most effective in controlling wild garlic but, as mentioned later, there are significant rotational restrictions for Peak.

Express can be applied after the wheat has two leaves but before the flag leaf is visible (Figure 1). Peak can be applied after wheat has reached the three-leaf stage but before the second detectable node of stem elongation. These herbicides also have an advantage over the phenoxy-type compounds such as 2,4-D because they can be used later in the season. However, they may not be the most economical treatment. Similar to Harmony Extra, Express may be tank mixed with 0.25 to 0.375 lb active ingredient of 2,4-D or MCPA for improved control of wild radish.

Express may be slurried with water and then added to liquid nitrogen solutions. Use 0.5 pt to 1.0 qt of surfactant per 100 gallons of spray solution.

Wild Radish Control

Tables 13 and 14 outline herbicide activity on wild radish and their injury potential to wheat.

Table 13. The Effect of Stage of Growth on Wild Radish Control in Wheat.

	Stage of Growth[1]			
Herbicide	0-4 inches	4-8 inches	8-12 inches	Bolting/Flowering
2,4-D	>95%[2]	>90%	>80%	<65%
MCPA	>95%	>90%	>70%	<50%
Peak	>90%	>90%	75-85%	<50%
Express	>90%	>60%	50%	<50%
Harmony Extra	>90%	>75%	50%	<50%
Express + MCPA	>95%	>90%	>80%	<65%
Osprey	>95%	60-80%	<60%	<50%

[1]Wild radish size in diameter of leaf rosette.
[2]Percent control as compared to untreated areas.

Table 14. The Effect of Stage of Growth on Wheat Injury by Various Herbicides.

	Stage of Growth[1]			
Herbicide	0-1 tiller	2-3 tillers	full tiller	Jointing
2,4-D	>80%[2]	30%	0-10%	70-90%
MCPA	>40%	5%	0-5%	50-70%
Peak	0-5%	0-5%	0-5%	5-10%
Express	0-5%	0-5%	0-5%	5-10%
Harmony Extra	0-5%	0-5%	0-5%	5-10%
Express + MCPA	>40%	5%	0-5%	50-80%
Osprey	0-5%	0-5%	0-5%	0-5%

[1]Refer to Figure 1 and the small grain production guide for growth stages.
[2]Percent injury (visual chlorosis or necrosis or tiller malformation).

Wild Garlic

Wild garlic is virtually noncompetitive with small grains. However, the aerial bulblets harvested with the grain imparts a garlic flavor to flour made from infested wheat. Off-flavor milk products result when dairy cows are fed infested small grains. Growers receive a substantial discount for garlicky wheat.

A combination of adequate nitrogen fertilization and herbicide application is needed for wild garlic control. Application in wheat of 2 pints per acre of an ester formulation of 2,4-D will reduce aerial bulblet formation and bend over the tops of wild garlic plants so that a combine header can be set high enough to pass over most of the aerial bulblets. Control by 2,4-D, however, can be inconsistent. Additionally, 2,4-D at 2 pints per acre can injure wheat.

Harmony Extra at 0.5 to 0.6 ounce per acre is very effective on wild garlic. Wild garlic should be less than 12 inches tall and should have 2 to 4 inches of new growth (if treated in the spring) when Harmony Extra is applied. Temperatures of 50^0 F or higher will enhance control. Add nonionic surfactant according to the label.

Peak will also control wild garlic very well. It is at least as effective on wild garlic as Harmony Extra, but it is less effective on several broadleaf weeds. Add a nonionic surfactant or crop oil according to label directions.

There are no rotational restrictions following wheat treated with Harmony Extra. **There is a 10-month rotational restriction for all soybeans, cotton, peanuts, and tobacco following application of Peak.** Soybeans should not be double-cropped behind small grains treated with Peak.

Italian Ryegrass

Research has shown that wheat yields are reduced 0.4% for every ryegrass plant per square yard. Heavy infestations, if uncontrolled, can reduce yields 70% or more.

Italian ryegrass is an annual and is spread by seed. Management practices to reduce seed spread will greatly decrease ryegrass problems. Such practices may include the following: cleaning equipment from field to field, maintaining clean fence rows and ditch banks surrounding the fields, avoiding those fields with heavy ryegrass populations, and avoiding saving and then planting seed harvested from fields infested with ryegrass the previous season. Burning after harvest may help to reduce seed numbers, but little research has been performed in that area.

Hoelon

Hoelon, containing the active ingredient diclofop-methyl, can be applied in wheat to control annual ryegrass. Hoelon does not control broadleaf weeds, wild garlic, or annual bluegrass.

Hoelon is an aryloxyphenoxy propionate-type herbicide. Herbicides of this type work slowly. It is not unusual for two to three weeks to pass before Hoelon symptoms appear, and up to eight weeks before the ryegrass is dead.

Hoelon can be applied postemergence in wheat anytime before the first node, or joint, develops (up to Feekes stage 6, Figure 1).

Timely application of Hoelon to annual ryegrass is essential for good control. Best control is obtained when treating one- to three-leaf ryegrass (about 2 to 3 inches tall). Higher rates are required for larger ryegrass, and even then control decreases.

Postemergence Hoelon rates for ryegrass

Ryegrass growth stage	Hoelon rate (pints per acre)
1 to 3 leaves	1.33
3 to 4 leaves	1.33 to 2.0
5 leaves to 2 tillers	2.0 to 2.67

Postemergence Hoelon effectiveness

Ryegrass height	Percent control
2 inches	100
4 inches	70
6 inches	40

It is typically best to apply Hoelon postemergence from mid-November to mid-December; during this period of time, the weather is generally more favorable for field operations as well as herbicide activity as temperature has a significant impact on Hoelon activity on ryegrass. Better activity is obtained under warmer temperatures; night-time temperatures should be above 35^0 F for three days before and three days after application.

The Hoelon label allows for addition of crop oil concentrate. A crop oil is usually not necessary, and it may increase the risk of crop injury under stressful conditions. However, a crop oil can improve control under dry conditions or when treating large ryegrass.

Hoelon should NOT be applied postemergence in nitrogen or tank mixed with other herbicides. Either of these situations can reduce ryegrass control. Additionally, to avoid reduced ryegrass control, do not apply 2,4-D within five days of applying Hoelon. Hoelon may be tank mixed with fungicides, but fungicides are typically applied in the spring, which is after the optimum timing of Hoelon application.

Hoelon may be applied preemergence in wheat. Applied preemergence, Hoelon can be very effective if adequate rainfall for activation is received prior to ryegrass emergence. However, Hoelon is consistently more effective applied postemergence.

Injury may occur if Hoelon is applied after the use of at-planting organophosphate insecticides.

Ryegrass resistant to Hoelon has been confirmed in Georgia. See comments below on Osprey for control of Hoelon-resistant ryegrass.

Finesse
Finesse, active ingredients chlorsulfuron and metsulfuron-methyl, may be applied preemergence or postemergence in wheat but only preemergence application is suggested for control of ryegrass. Hoelon-resistant ryegrass is susceptible to Finesse. Finesse also controls most common broadleaf weeds.

Ryegrass control by Finesse is highly dependent upon timely rainfall after application. Although good control is sometimes obtained with Finesse, one should anticipate suppression only. Rainfall of one-half inch or more within seven to 10 days after preemergence application enhances control. Some stunting of wheat has been observed on very sandy soils.

If soybeans are to be planted following wheat treated with Finesse, use only an STS variety of soybean. Finesse has a long soil residual, and injury to non-STS soybeans can occur. Corn, cotton, grain sorghum, or non-STS soybeans can be planted the year following the STS soybeans.

Osprey
Osprey, active ingredient mesosulfuron-methyl, is a postemergent herbicide that should be applied to young actively growing ryegrass. For adequate annual ryegrass control, applications must be made from 1-leaf to the 2-tiller stage of ryegrass growth. If applied properly and timely, Osprey controls ryegrass very well and very consistently, including Hoelon-resistant ryegrass.

Osprey is a sulfonylurea-type herbicide, and similar to other sulfonylureas, Osprey works slowly. Symptoms appear two to four weeks after application, and four to eight weeks may pass before ryegrass dies.

Osprey is formulated as a water dispersible granule. It should be applied at a rate of 4.75 ounces per acre in winter wheat from emergence up to the jointing stage of wheat growth (up to Feekes scale 6, Figure 1).

An adjuvant is required with Osprey. Although the Osprey label suggests several possible types of adjuvants, the manufacturer is recommending a nonionic surfactant containing at least 80% surface-active agents plus an ammonium nitrogen source for wheat in Georgia. The nonionic surfactant should be used at a rate of 0.5% by volume (2 quarts per 100 gallons spray solution). In addition to the nonionic surfactant, also include 1 to 2 quarts per acre of urea ammonium nitrogen fertilizer (28-0-0, 30-0-0, or 32-0-0) or ammonium sulfate fertilizer at 1.5 to 3 pounds per acre (21-0-024).

Do NOT apply Osprey within 14 days of topdressing. Occasionally, injury has been observed when wheat has been topdressed shortly after Osprey application.

Separate Osprey and 2,4-D applications by at least 5 days.

Osprey should be applied in 10 or more gallons of water per acre while using at least 15 gallons of water in densely populated ryegrass areas. Do not use liquid nitrogen as a carrier.

Osprey may be mixed with Harmony Extra to improve control of broadleaf weeds. The label also allows a mixture with MCPA ester at 0.25 to 0.375 lb active per acre; however, antagonism (reduced ryegrass control) with Osprey/MCPA mixtures has been noted in several Georgia trials.

Osprey will also provide good control of henbit, wild radish, and common chickweed if applied when these weeds are small ($\leq$2 inch) at time of application. Osprey is also effective on small bluegrass but does not control little barley.

The rotational restriction following Osprey application is 30 days for barley and sunflower, 90 days for cotton, peanut, soybean, rice, lentils, peas, and dry beans, 12 months for corn, and 10 months for other crops.

Sulfonylurea herbicides, such as Osprey, appear to be prone to resistance evolution. A resistance management program for Osprey should be strongly considered prior to use of Osprey. In areas with Hoelon-susceptible ryegrass, rotation of Osprey and Hoelon on alternate years is encouraged. This practice can prolong the useful life of both herbicides. See the following section on *Herbicide Resistance Management*.

Herbicide Resistance Management

Herbicide resistance is a natural inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide that normally controls that plant species. Resistant plants are not responsive to a particular herbicide because of a change or genetic shift within the plant population. Herbicides do not "create" resistant plants; resistant plants are naturally present in very low numbers. Repeated use of the same herbicide, or those with the same mode of action, may select for resistant plants (in other words, allow the resistant plants to become the predominant type present). Resistant weed populations are allowed to flourish as competition from susceptible species is eliminated by the herbicide treatment.

Hoelon-resistant Italian ryegrass has become a problem in Georgia. These resistant populations are a response to repeated use of Hoelon for several years.

One effective way to avoid or delay buildup of herbicide-resistant weed populations is rotation of herbicides with different modes of action. Additionally, integration of non-chemical controls, such as crop rotations and cultural control methods, can help avoid or at least delay resistance evolution.

Early detection of herbicide-resistant weeds is important to limit their spread to other fields and farms currently not infested. Since most control failures are not due to weed resistance, growers should eliminate other possible causes of poor herbicide performance before assuming they have resistance. These causes include the following:

1) improper herbicide choice or rate
2) poor/improper application
3) POOR TIMING OF APPLICATION
4) unfavorable weather
5) later weed flushes
6) antagonism by other pesticides

After eliminating possible causes for control failure, then look for known indicators of resistance:

1) performance poor on one species, other species controlled well
2) product normally controls weed in question
3) poor control confined to spots in field, at least initially
4) some plants of species in question controlled well, others controlled poorly
5) field history of heavy use of herbicides with same mode of action

For additional assistance in identifying weed resistance, contact your local Extension office.

Liquid Nitrogen Tank Mixes

Although several herbicides used in wheat may be mixed with liquid nitrogen, (see label of individual herbicides), herbicide and nitrogen timing for wheat applications may not coincide. For example, nitrogen should be applied at full tiller and prior to jointing, whereas herbicides should be applied when the weeds are small and the wheat will not be injured. Stretching the window for effective weed control to accommodate nitrogen fertilization may result in poor weed control and possibly greater wheat injury.

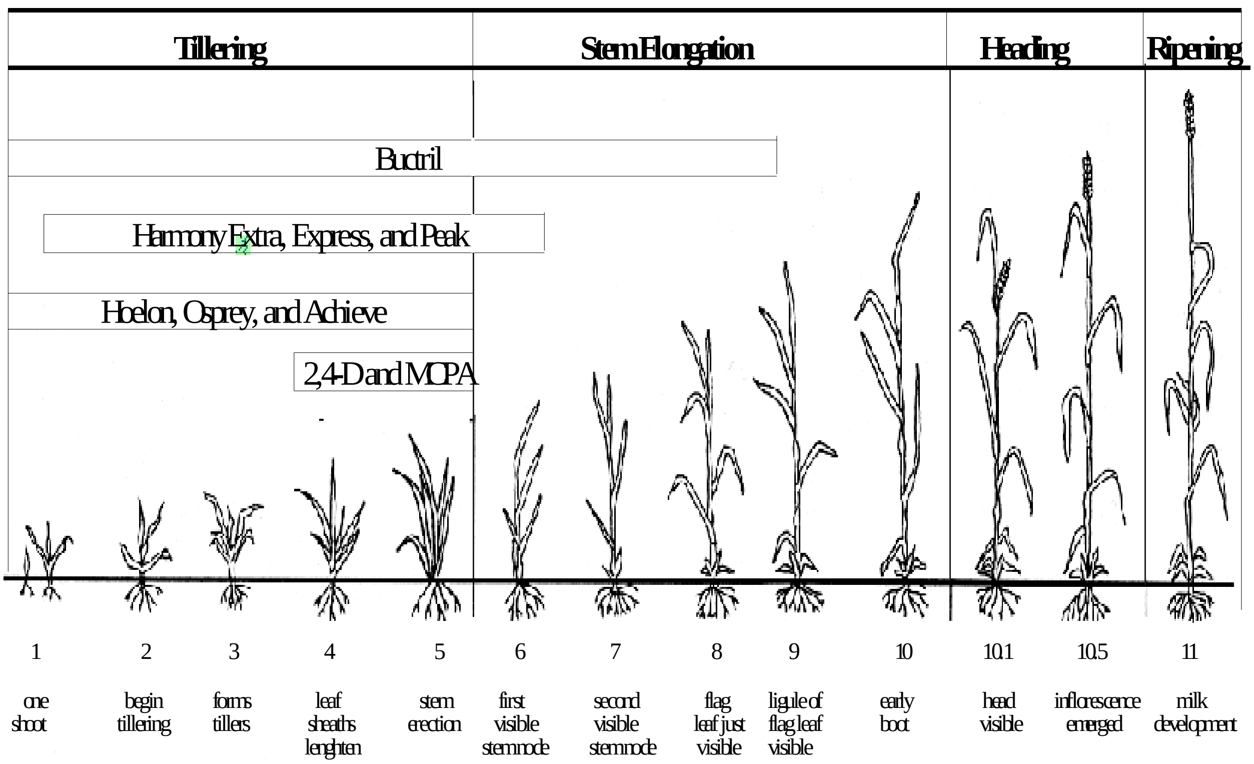
Additional Considerations for No-Till Wheat Production

In no-till production systems, weed control at planting is critical because many winter annual weeds such as chickweed, henbit, annual bluegrass, and Italian ryegrass are already established at planting time.

Paraquat (Gramoxone, etc) or glyphosate may be applied after planting **but before wheat emerges** (Table 17) for control of emerged weeds.

A burndown herbicide is recommended in nearly every case of no-till wheat production. Without a burndown application, winter annuals can quickly get too large to control easily and can cause substantial yield reduction. Therefore, a burndown herbicide application at planting would most likely be of benefit. Higher rates of these herbicides may be needed for dense weed populations, under drought or cool or cold growing conditions, or for specific problem weeds

Figure 1. Ideal Postemergence Timing of Herbicides Relative to Wheat Development in Georgia.



Feekes Scale of Wheat Development

Table 15. Key Characteristics of Common Weeds Infesting Georgia Wheat.

Common Name	Description
annual bluegrass	Small tufted to clumped winter annual. Leaf blade, smooth on both surfaces, with two distinct, clear lines, one on each side of the mid-rib. Leaf tip keeled or boat-shaped. Ligule membranous.
annual ryegrass	Bunch or clump grass, often has shiny green leaves, deep green in color. Auricles, or clasping structures, are present at the point of leaf attachment to the stem. Leaves rolled in the bud. Ligule is membranous.
Carolina geranium	Long leaf petioles, densely hairy. Leaves roundish and deeply dissected into segments.
cheat	Summer or winter annual, 5 to 25 inches in height, clump-forming and erect to spreading. Leaves rolled in the bud, young leaf blades are twisted and appear to be spiraling upward. Blade with short dense hairs.
curly dock	Perennial, forming a rosette of leaves often exceeding 12" in diameter. Leaf margins often curly or wavy, tapering at the base.
cutleaf evening-primrose	Leaves formed in rosette with notched/lobed margins. Distinctive white mid rib of leaves.
henbit	Stems 4-sided with a purplish cast. Leaves opposite with long internodes. Small purple flowers are formed in whorls arising from the base of the leaves.
little barley	Bunch or clump grass, light green leaves. Membranous ligule present at base of leaf near connection to the stem. Seedheads similar in appearance to barley or wheat only much smaller with short, stiff awns.
swinecress	Leaves highly serrated, formed in a rosette. Strong odor present when the leaves are crushed.
vetch	Winter legume with compound leaves containing 3-9 pairs of leaflets. Climbing plant with tendrils present at the ends of stems.
wild garlic	Onion-like leaves, hollow and tube-like.
wild mustard	Dark yellow flowers, leaves slightly segmented and not attached to the stem by clasping leaf stems. Cotyledons are heart-shaped but first true leaves are almost rectangular in shape and only slightly pubescent. Hypocotyl is generally green.
wild onion	Onion-like leaves, flat and not hollow.
wild radish	Light yellow flowers, highly segmented leaves giving the appearance of long slender stems. Lower portion of the stem with stiff, downward pointing hairs. Cotyledons heart-shaped with a purple hypocotyl. Young true leaves are densely hairy.
wild turnip	Dark yellow flowers, uppermost leaves clasp or wrap-around the stem.

Table 16. Weed Responses to Herbicides Used in Wheat.

WEEDS	2,4-D[1]	MCPA[1]	Express[1]	Express + MCPA[1]	Buctril[1]	Harmony Extra[1]	Peak[1]	Finesse[2]	Hoelon[1]	Osprey[1]
Annual bluegrass	N	N	N	N	N	N		N	N	G
Annual ryegrass	N	N	N	N	N	N	N	F	E[3]	E
buttercup	G					G			N	
common chickweed	P		G	G	PF	G		G	N	F-G[4]
common ragweed	G	F			E	PF	E		N	
cornflower	G				GE	P			N	P
cudweed	GE	GE			G	E			N	
curly dock	P	P			PF	E			N	
dandelion	E	E			E				N	
dogfennel	G	F			GE	E			N	
eveningprimrose	E	E			G	G	G		N	
field pennycress	G				G	G			N	
goldenrod	F	G			F				N	
hairy vetch	FG	FG			F	P			N	
henbit	P	P	PF	FG	F	G	FG	G	N	F-G[4]
horsenettle	F	G			F				N	
horseweed	F	F			F	FG			N	
knawel	P				P	G			N	
lambsquarters	G	G			E	E	G		N	
plantains	E	E			E	E			N	
shepherd's-purse	GE	GE			G	E	G		N	
swinecress	G	G			GE	E			N	E
thistles	G	G			G	FG	FG		N	
Virginia pepperweed	E				FG	G			N	
wild garlic	F	P			P	GE	E		N	P
wild mustard	GE	G	FG	GE	G	G	GE	G	N	G-E[4]
wild radish	GE	G	FG	GE	FG	G	GE	G	N	G-E[4]

[1] Timely postemergence application.
[2] Applied preemergence
[3] Will not control Hoelon-resistant ryegrass
[4] Weeds must not be larger than 2 inches at time of application.

Key: E = excellent control, 90% or better; G = good control, 80% to 90%; F = fair control, 70% to 80%; P = poor control, 25 to 50%; N = no control, less than 25%

Table 17. Chemical Weed Control in Wheat

Weeds Controlled	Herbicide and Formulation	Amount of Formulation (broadcast rate/acre)	Pounds Active Ingredient (broadcast rate/acre)	REMARKS AND PRECAUTIONS (read all labels)
PREPLANT NO-TILL				
Emerged annual broadleaf and grass weeds	paraquat MOA 22 (Gramoxone Inteon) 2 SL (Gramoxone Max) 3 SL (Firestorm) 3 SL MOA: 22	 2 to 4 pt 1.33 to 2.7 pt 1.33 to 2.7 pt	0.5 to 1.0	Apply before crop emerges. Rate depends on weed size; see label. Add nonionic surfactant at 1 pt per 100 gal of spray or crop oil concentrate at 1 gal per 100 gal of spray. See label for application directions.
Emerged annual broadleaf and grass weeds, control or suppression of perennial weeds	glyphosate 3.57 SL (3 lb a.e.) 4 SL (3 lb a.e.) 5 SL (3.7 lb a.e) 5.5 SL (4.5 lb a.e.) 6 SL (5 lb a.e.) MOA 9	 1 to 3 pt 1 to 3 pt 0.8 to 2.4 pt 11 to 32 fl oz 10 to 28 fl oz	0.38 to 1.13	Apply before crop emerges. Rate depends upon weed size; see label. Numerous other brands of glyphosate are available. Follow label directions on brand used. Adjuvant recommendation varies by glyphosate brand.
PREEMERGENCE				
Annual ryegrass	chlorsulfuron + metsulfuron-methyl (Finesse) 75 WDG MOA 2+2	0.5 oz	0.0195 + 0.0039	Ryegrass control is variable; expect only suppression. May stunt wheat on sandy soils. Use suggested primarily in areas where Hoelon-resistant ryegrass is suspected. **Plant only STS soybeans following wheat harvest.** See precautionary statements on label concerning late-planted wheat and cold conditions. Crop injury may result if organophosphate is used. SEE ROTATIONAL RESTRICTIONS.
POSTEMERGENCE				
Annual ryegrass	diclofop-methyl (Hoelon) 3 EC MOA 1	 1.33 to 2.67 pt	0.5 to 1.0	Apply when ryegrass is in the one- to four-leaf stage and prior to first wheat node (joint) developing. See label for specific rates depending on weed size and environmental conditions. Do not make more than one application per season. Do not tank mix with broadleaf herbicides or use liquid nitrogen as the carrier. May add 1 to 2 pt per acre of crop oil concentrate when conditions are dry or when ryegrass is large. In most cases, crop oil is not necessary. Crop injury may result in organophosphate is used. **Warning:** Will not control Hoelon-resistant ryegrass.
	mesosulfuron-methyl (Osprey) 4.5 WDG MOA 2	 4.75 oz	0.013	Controls ryegrass, including Hoelon-resistant. Apply to ryegrass between one-leaf and two-tiller while wheat is emerged but before jointing. Add a non-ionic surfactant (at least 80% active) at 2 qts per 100 gal. spray solution with ammonium nitrogen fertilizer (28-0-0, 30-0-0, 32-0-0) at 1 to 2 qt per acre. DO NOT topdress within 14 days of Osprey application. Do not use liquid nitrogen as the carrier. May mix Osprey with Harmony Extra or MCPA. MCPA mixtures may be antagonistic. Do not mix with 2,4-D. In fields with Hoelon-susceptible ryegrass, rotate Osprey and Hoelon every other year for resistance management.
	pinoxaden (Axial) 0.83 EC MOA 1	8.2 fl oz	0.053	Apply to wheat with two leaves up to pre-boot when ryegrass has one leaf to two tillers. Add Adigor Adjuvant at 9.6 fl oz per acre. If mixing with Harmony Extra, add Harmony first, then Axial, and then adjuvant. May be applied in water/nitrogen mixtures containing up to 59% liquid nitrogen by volume. Add water to tank, then add Axial, and then the adjuvant; mix thoroughly and add the nitrogen. Axial usually, but not always, controls Hoelon-resistant ryegrass. Limited research has been conducted with this product in Georgia. Try on very limited acreage only.

Weeds Controlled	Herbicide and Formulation	Amount of Formulation (broadcast rate/acre)	Pounds Active Ingredient (broadcast rate/acre)	REMARKS AND PRECAUTIONS (read all labels)
POST EMERGENCE (continuted)				
Wild radish, wild mustard, wild garlic, curly dock, and most winter annual broadleaf weeds	thifensulfuron-methyl + tribenuron-methyl (Harmony Extra) 75 WDG	0.3 to 0.6 oz	0.0094 to 0.0188 + 0.0047 to 0.0094	Apply after two-leaf stage of wheat but prior to flag leaf being visible. Most winter annuals can be controlled with 0.3 to 0.4 oz/A; however, 0.5 to 0.6 oz/A is recommended for controlling wild garlic or wild radish. Add 1 qt of nonionic surfactant per 100 gal of spray solution. For best results, apply when weeds are in the two- to four-leaf stage, temperatures are above 50 F, and not drought stressed. Garlic should be less than 12 inches tall and should have 2 to 4 inches of new growth. Liquid nitrogen may be used as the carrier. May tank mix with 0.25 to 0.375 lb active ingredient of 2,4-D or MCPA for improved control of wild radish. Follow instructions on labels when mixing 2,4-D, MCPA, or using nitrogen as carrier. Reduce surfactant rate according to label when using nitrogen as the carrier or when mixing with 2,4-D. May be tank mixed with Axial or Osprey.
Wild mustard, chickweed, field pennycress	tribenuron-methyl (Express) 75 DF (Express TotalSol) 50 SG	0.167 to 0.33 oz 0.25 to 0.5 oz	0.008 to 0.0155	Apply after two-leaf stage of wheat but prior to flag leaf being visible. Add 1 qt of nonionic surfactant per 100 gal of spray solution. Only partial control of wild garlic, henbit, shepherdspurse, and wild radish. Apply when weeds are small and not drought stressed. May be applied in mixture with some liquid fertilizers; however, some discoloration and stunting may occur when tank mixed with liquid nitrogen; see label. May tank mix with 0.25 to 0.375 lb a.i. of MCPA for improved control of wild radish when wheat has at least 2 tillers but before jointing. Add 1 pt/A of surfactant with this Express plus MCPA mixture.
Most winter annual broadleaf weeds except chickweed, henbit, and knawl	2,4-D amine (various brands) 3.8 L 2,4-D ester (various brands) 3.8 L 2,4-D ester (various brands) 5.7 L 2,4-D acid/ester (Weedone 638) 2.8 L	1.0 to 1.25 pt 1.0 to 1.25 pt 0.67 to 0.84 pt 1.0 to 1.25 pt	0.48 to 0.6 0.48 to 0.6 0.48 to 0.6 0.35 to 0.43	Apply after wheat is fully tillered (stages 4 and 5 on Feekes scale) but before jointing. Spraying wheat too young or after jointing may reduce yields. Better results obtained when day-time temperatures are above 50 F. Increase rate by 50% to control corn cockle. For wild onion or wild garlic, increase rate according to respective labels for better control. Georgia research has shown greater injury by 2,4-D when using liquid nitrogen as the carrier. Ester formulations can be added directly into nitrogen. If using amine formulation, premix in water (1 part 2,4-D to 4 parts water) and add mixture to nitrogen with strong agitation. Amine formulations give less burn than ester formulations in nitrogen. Ester formulations may be more effective on weeds. May be tank mixed with several other herbicides; see labels.
	MCPA (various brands) 4.0 L (various brands) 3.7 L NIA 4	0.5 to 1.0 pt 0.5 to 1.0 pt	0.25 to 0.5 0.23 to 0.46	Apply to wheat after tillering (preferably 2+ tillers) but before jointing. Apply before weeds are in the four-leaf stage or two inches in height. Rosette weeds should be treated when less than one inch in diameter. Rates may be increased according to labels. Wheat should be fully tillered before high rates are applied. No spray additive required. May be tank mixed with several other herbicides; see labels. <u>MCPA tank mixtures with Express have often been more effective than MCPA applied alone in Georgia fields.</u>

Weeds Controlled	Herbicide and Formulation	Amount of Formulation (broadcast rate/acre)	Pounds Active Ingredient (broadcast rate/acre)	REMARKS AND PRECAUTIONS (read all labels)
		PRE-HARVEST		
Annual broadleaf and grass weeds, suppression of perennial weeds	glyphosate 3.57 SL (3 lb a.e.) 4 SL (3 lb a.e.) 5 SL (3.7 lb a.e) 5.5 SL (4.5 lb a.e.) 6 SL (5 lb a.e.) MOA 9	 1 to 2 pt 1 to 2 pt 0.8 to 1.6 pt 11 to 22 fl oz 10 to 20 fl oz	0.38 to 0.75	Apply after hard dough stage of grain (30% or less grain moisture) but at least 7 days before harvest. Do not apply to wheat grown for seed.
Annual broadleaf weeds	2,4-D amine (various brands) 3.8 SL 2,4-D ester (various brands) 3.8 SL 2,4-D ester (various brands) 5.7 SL 2,4-D acid/ester (Weedone 638) 2.8 SL MOA 4	 1 to 2 pt 1 to 2 pt 0.67 to 1.3 pt 1 to 2 pt	 0.48 to 0.95 0.48 to 0.95 0.48 to 0.95 0.35 to 0.7	Apply when grain is in the hard dough stage (30% or less grain moisture) or later. Do not allow drift to sensitive crops. Amine formulations STRONGLY ENCOURAGED.

[1]**Mode of Action (MOA) code developed by the Weed Science Society of America. MOA codes can be used to increase herbicide diversity in a weed management program to delay the development of resistant weeds.**

Important Note: Observations in Georgia wheat fields indicate crop damage when 2,4-D is tank mixed with liquid nitrogen. This also may be evident with other herbicide-nitrogen mixtures. To avoid possible damage and obtain better weed control, herbicides and nitrogen should be applied separately.

Table 18. Forage, Feed, and Grazing Restrictions for Wheat Herbicides.

Trade Name	Restrictions
Axial	Do not graze livestock or harvest forage for hay from treated areas for at least 50 days after application.
Express	Do not graze livestock in treated areas. Do not feed forage or hay from treated areas to livestock. Harvested straw may be used for bedding and/or feed.
Harmony Extra	Do not graze livestock in treated areas. Do not feed forage or hay from treated areas to livestock. Harvested straw may be used for bedding and/or feed.
Hoelon	Do not allow livestock to graze treated fields for 28 days after treatment. Do not harvest forage, hay, or straw from treated fields prior to grain harvest.
Finesse	No grazing restrictions.
MCPA	Do not forage or graze meat animals or dairy cattle within 7 days of slaughter.
Osprey	Do not apply within 30 days of harvesting wheat forage, and 60 days for hay, grain, and straw.
Roundup WeatherMax	Stubble may be grazed immediately after harvest.
2,4-D	Do not graze dairy cattle within 7 day s of application. Do not apply within 30 days of cutting for hay. Remove meat animals from treated areas 3 days prior to slaughter.

INSECT MANAGEMENT

Insect pests can reduce both grain yield and quality of small grain crops in Georgia. Historically, the Hessian fly, aphids, and cereal leaf beetle are the pests of significant economic importance. Aphids can directly damage wheat, but are of concern mostly because they transmit a viral disease called barley yellow dwarf. True armyworm and other insects also occasional damage cereal grain crops. This chapter discusses the primary insect pests of wheat. It emphasizes scouting procedures, insect identification and best control methods for each pest.

Major Insect Pests of Wheat

***Aphids*:** Aphids are small soft-bodied insects that can be found in wheat anytime during the growing season. The most common aphids found on wheat are the bird cherry-oat aphid, rice root aphid, greenbug, corn leaf aphid, and English grain aphid. The first four occur mostly in the fall and winter. Only the greenbug causes direct feeding damage that appears speckled brown and discolored with some leaf curling. The other aphids do not cause obvious feeding damage. The

English grain aphid is mainly present in the spring and can reach large numbers on flag leaves and developing grain heads. Damage from this pest often results in reduced kernel size and low test weight grain. For the most part, beneficial insects such as lady beetles are not active during the winter and only exert some control over aphids during the spring in wheat.

Aphids also vector a viral disease named barley yellow dwarf (BYD). Wheat and barley can be severely damaged, but oats are most susceptible to this disease. Infection can occur from seedling emergence through heading, but yield loss is greatest when plants are infected as seedlings in the fall. Although all aphids can potentially transmit certain strains of the virus, infections in Georgia are mostly associated with infestations of bird cherry-oat aphid. BYD in most fields in most years throughout Georgia. Yield losses of 5-15% are common but losses can exceed 30% during severe epidemics.

Planting date is the single most important management practice affecting aphid infestation and BYD infection in the fall. Early plantings generally have greater aphid numbers and greater BYD incidence than late plantings. Recent studies show that a single, well-timed insecticide application of the insecticide lambda cyhalothrin (Warrior, Karate, Lambda, Silencer, others) can reduce the incidence of BYD and increase yields. The best time for treatment in northern Georgia usually is about 25 - 35 days after planting although an application at full tiller also may be beneficial. In southern Georgia, the best treatment time usually is at full-tiller stage in early to mid-February. But, fields should be scouted for aphids at 25 - 35 days after planting and during warm periods in January to determine if an insecticide application is needed. Lambda cyhalothrin treatment at full tiller can be applied with top-dress nitrogen. Recent high commodity prices may justify a preventive strategy of foliar insecticide sprays at 25 - 35 days after planting and at full-tiller stage to suppress aphids and BYD incidence.

New systemic insecticide seed treatments, Gaucho and Cruiser, can be effective in controlling aphids in the fall and thereby reducing BYD levels. These seed treatments are more effective in the northern half of the state and are only recommended for growers planting for maximum yields in an area with a history of BYD. Seed treatments in the southern half of the state have been inconsistent in control and are not recommended. Granular systemic insecticides, such as Di-Syston, are not longer labeled for use on wheat.

To sample aphids, inspect plants in 12 inches of row in fall and 6 inches of row in winter. In spring, inspect 10 grain heads (+ flag leaf) per sample. Count all aphids on both the flag leaf and head for making control decisions. Sample plants at 8 to 16 locations per field. Treat when populations reach or exceed to the following thresholds:
Seedlings: 2 per row foot.
2 or more tillers per plant: 5 aphids per row foot.
Stem elongation to just before flag leaf emergence: 2 aphids per stem.
Flag leaf emergence: 5 aphids per flag leaf.
Heading emergence to early dough stage: 10 aphids per head.
Do not treat for aphids after mid-dough stage.

***Hessian Fly*:** The Hessian fly, *Mayetiola destructor*, had been a major factor limiting in wheat production throughout the southern United States. Wheat is the primary host of the Hessian fly, but the insect also will infest triticale, barley and rye. Hessian fly does not attack oats. Little barley is the only important non-crop host in Georgia.

Adult Hessian flies are small black flies about the size of a mosquito. Adults live about two days and females lay about 200 eggs in the grooves of the upper side of the wheat leaves. Eggs are orange-red, 1/32 inch long and hatch in three to five days. Young reddish larvae move along a leaf groove to the leaf sheath and then move between the leaf sheath and stem where they begin to feed on the stem above the leaf base. Maggots become white after molting and appear greenish white when full grown. The entire life cycle requires about 6 weeks at 70ºF. Newly hatched larvae are prone to drying while they are exposed on the leaf surface. Once larvae move to the stem base, they are protected from weather extremes.

Maggots suck sap and stunt tillers presumably by injecting a toxin into the plant. Feeding by a single larva for several days is sufficient to completely stunt and kill vegetative tillers. Infested jointed stems are shortened and weakened at the joint where feeding occurs. Grain filling of infested stems is reduced and damaged stems often lodge before harvest. Generally, three generations occur in the Piedmont region and four generations occur in the Coastal Plain region of Georgia. The fall and winter generations stunt and kill seedling plants and vegetative tillers. The spring generation infests jointed stems during head emergence and grain filling. Yield losses usually occur when fall tiller infestations exceed 8% of tillers and when spring stem infestations exceed 20% of stems.

The Hessian fly is a cool season insect and is dormant over the summer as a puparia in wheat stubble. Adults begin to emerge about September 1. Since wheat is not yet planted, the first generation develops entirely in volunteer small grains and weed hosts. Thus reduced tillage, lack of crop rotation, and lack of volunteer wheat control in summer crops tends to enhance problems with Hessian fly in autumn.

Planting a Hessian fly-resistant variety is the most effective way to control Hessian fly. Varieties in the state wheat variety trials are evaluated for Hessian fly resistance each year. Results are available in the Small Grain Performance Tests Bulletin and are also summarized in the "Characteristics of Recommended Varieties" section in the first part of this publication.

For susceptible varieties, systemic seed treatments such as Gaucho or Cruiser when applied at high rate will suppress fall infestations but will not prevent Hessian fly infestation in winter or spring. Granular insecticide applied at planting, such as Di-Syston, Thimet or Phorate, are not longer labeled for use on wheat. Studies in Georgia indicate that foliar applications of insecticides in late winter and spring for Hessian fly control are highly variable in effectiveness and are not currently recommended.

Cereal Leaf Beetle**:** Cereal leaf beetle, *Oulema melanopus*, was first discovered in northwest Georgia in 1989. The insect is spreading southward and now occurs throughout the mountain and Piedmont regions in most of the upper coastal plain region. Cereal leaf beetle larvae feed on many grasses including oats, wheat, barley, rye, orchard grass, and annual ryegrass, but the insect is a problem mostly on oats and wheat. Newly emerged adults also will feed on summer grasses such as corn, sorghum and crabgrass.

Adult beetles are 5 mm long and blue-black with a reddish thorax (neck) and legs. Larvae are yellow-white and up to 6 mm long, but appear shiny and black, because they are covered with fecal material. Adults and larvae defoliate or skeletonize long narrow sections of the flag and upper leaves. Adults are present in wheat during March and April when they mate and lay eggs. Larvae are present during head emergence through the dough stage of wheat development, which typically occurs in late March and April in the Coastal Plain region and in April and early May in north. Larval damage reduces grain yield and test weight mostly by reducing seed size. There is one generation per year; newly-emerged adults over summer and overwinter in fence rows and wooded areas. These adults will feed on green grasses in adjacent fields before moving to over-summering sites. Corn planted next to wheat fields can be extensively damaged by the beetles, although damage to corn usually is confined to field margins.

Yield losses usually do not occur until flag leaf defoliation exceeds 50%. Cereal leaf beetle can be effectively controlled by one application of an insecticide to foliage. Fields should be scouted by counting the number of larvae and adults on 10 stalks at 6 to 10 locations per field. Treatment should be considered when populations exceed 1 larva per 2 stems. Most insecticides should be applied after most eggs have hatched but before larval damage becomes extensive. Lambda cyhalothrin (Warrior, Lambda, others) also can be applied early when egg hatch is occurring. This treatment can prevent virtually all larval damage and may coincide with an application of foliar fungicide for leaf rust control.

***True Armyworm*:** The true armyworm looks much like other armyworm species. It is brown to black in color. Larvae have three, orange, white and brown stripes running the length of each side. The larvae will also have a narrow broken stripe down the center of its back.

Wheat fields should be checked for the presence of true armyworms when wheat is heading usually in March and early April, two weeks later in north Georgia. Armyworms generally are active at night and rest during day under plant residue at the bass of stems. Armyworms chew large irregular holes in leaves generally from the bottom up. Sometimes they climb stems and cut grain heads off the plant. They also will feed on the tips of the developing wheat seeds causing lower yields and lighter test weights. Very large infestation sometimes will march en-mass out of defoliated wheat fields to continue feeding on crops in nearby fields.

Treatment should be considered if 4 or more worms per square foot of row are found before pollen-shed stage and if 8 or more worms per square foot of row are found after pollen-shed stage. Several materials are labeled that give excellent control in wheat. The most cost effective treatment is an aerial application of methyl parathion 4E at 1 pt/acre. If methyl cannot be used, lambda cyhalothrin (Warrior, Karate, Lambda, Silencer, others), Mustang MAX, Baythroid XL or Lannate also are effective.

Stink bugs: Wheat is often infested with stink bugs in spring during grain fill. The brown and southern green stink bugs may reproduce and have a complete generation in wheat before harvest. Rice stink bug adults also are common in wheat. Stink bug adults will disperse to nearby summer crops as wheat dries down. Stink bugs almost never require control in wheat. Treat if 1 or more bugs per square foot are present at milk stage. Treatment is not needed in the dough stage, except to prevent dispersal to adjacent summer crops as wheat matures.

Sampling for Insect Pests

Wheat should be scouted aphids, cereal leaf beetle and secondary pests. Scout the entire field. Insects tend to clump, and thus a thorough examination of the whole field should be made. There is no effective way to control Hessian fly after planting, so sampling for Hessian fly is only to verify its presence and assess losses. Fields should be inspected soon after planting to verify timely emergence. If emergence is poor, the field should be checked for soil-inhabiting insects such as lesser cornstalk borer or fall armyworm before replanting.

After stand establishment, fields should be scouted for aphids at 4 critical times: 25 - 45 days after planting, warm periods in January, full-tiller in mid-February, and boot stage to head emergence. The first two periods are intended to control barley yellow dwarf infection and some direct aphid damage; the last period is to prevent damage by grain aphids, armyworms and cereal leaf beetle.

To sample aphids, inspect plants in 12 inches of row in fall and 6 inches of row in winter. In spring, inspect 10 grain heads (+ flag leaf) per sample. Sample plants at 8 to 16 locations per field. Treat according to thresholds listed for aphids. Inspect fields for cereal leaf beetle adults and larvae weekly for several weeks beginning at boot stage. Count the number of larvae and adults on 10 stalks at 6 to 10 locations per field. No other insect pest justifies routine sampling in wheat except possibly inspecting fields for armyworms during a boot stage while sampling for aphids and cereal leaf beetle.

Insecticides

Insecticides generally are not widely used in wheat in the Southeast. Except for the Hessian fly, most other insect pests can be controlled by applying foliar insecticides when population densities exceed economic thresholds (Table 19). Consult the Georgia Pest Control Handbook and Table 20 for specific chemical recommendations.

Granular insecticides, such as phorate and Di-Syston 15G, are no longer registered for use on wheat. Systemic seed treatments such as Gaucho 480/600 or Cruiser 5FS when applied at a high rate will suppress Hessian fly infestations in fall, but will not prevent infestations in late winter or spring. Studies in Georgia indicate that foliar applications of insecticides in the spring for Hessian fly control are highly variable in effectiveness and are not currently recommended.

Systemic seed treatments, Gaucho and Cruiser, can be effective in controlling aphids in the fall and winter and can substantially reduce infection rates of BYD virus. However, these seed treatments are usually effective in suppressing BYD infection in the northern half of the state; but are not recommended for routine use in the coastal plain region. They also may reduce fall infestations of Hessian fly when applied at maximum rates. However, insecticide seed treatments are expensive and conditions for damage must be expected. Gaucho or Cruiser should be considered when (1) grain yield potential is high (>60 bu/acre), (2) a field has a history of BYD infection, (3) early plantings will be made, and/or (4) a Hessian fly susceptible variety is being planted. Aphids and barley yellow dwarf infection also can be effectively reduced by a well-timed application of lambda cyhalothrin (Warrior, Karate, others). Other registered insecticides, such as dimethoate, will control aphids but are less effective in preventing barley yellow dwarf infection.

Lambda cyhalothrin, Baythroid, Mustang MAX and many other insecticides registered for use on wheat are **NOT** registered for use on oats, rye and barley. For current insecticide recommendations for oats, rye, and barley see the most recent edition of the Georgia Pest Management Handbook, Commercial Edition.

Summary of Management Practices for Insect Pest Control

1. If possible, avoid continuous planting of wheat in the same field.
2. Control volunteer wheat.
3. Plow fields to bury wheat debris (burning wheat stubble alone is not effective without tillage).
4. Do not plant wheat for grain before the recommended planting date for your area.
5. Plant rye, oats, or ryegrass instead of wheat for grazing.
6. Select a Hessian fly resistant variety that is adapted to your area.
7. On Hessian fly susceptible varieties, consider using a systemic seed treatment if the field has a history of Hessian fly damage, is reduced tillage, or if planting before the recommended planting date.
8. Scout wheat for aphids at 25 - 35 days after planting and in mid-February. Scout at boot and heading stages for aphids, true armyworms, and cereal leaf beetles. Apply a foliar insecticide if numbers exceed treatment thresholds.

Table 19. Damage Symptoms and Economic Thresholds of Insect Pests of Wheat.

Insect	Damage Symptoms	Treatment threshold
Aphids	Suck plant sap and may cause yellowing and death of leaves. Reduce grain size when grain heads infested. Transmit barley yellow dwarf virus.	Seedlings: 2/row ft., 6-10 inch plants: 5/row ft., Stem elongation: 2 per stem, Flag leaf - head emergence: 5/stem, Full heading: 10 per head to include flag.
Hessian fly	*Vegetative plants*--tillers stunted dark green, tiller death;	Fall - early winter: 8% infested tillers.
	Jointed stems--stunted, weakening of stem at point of feeding injury. Reduced grain size and weight. Infested stems may lodge before harvest.	Spring: 20% infested stems.
Cereal leaf beetle	Adults chew elongated holes in upper leaves, larvae remove leaf tissue leaving low epidermis causing "window pane" effect.	2 larvae or adult per stem.
Chinch bugs	Suck plant sap causing discoloration.	Seedlings: 1adult per 2 plants, Spring: 1 adult per stem.
True armyworm	Primarily occur in late winter and spring from stem elongation to maturity; chew foliage and seed head glumes, also clip awns and seed heads.	Before pollen shed: 4 or more worms/sq. ft. After pollen shed: 8 or more worms/sq. ft.
Fall armyworm, beet armyworm & yellow-striped armyworm	Primarily occurs in the fall; small larvae cause "window pane" feeding on leaves; larger larvae consume leaves and plants and destroy stands	Do not treat unless seedling damage exceeds 50% defoliation and 3 or more armyworms per sq. ft are present.
Grasshoppers	Destroy leaves of seedlings during fall. Damage common along field margins.	Do not treat unless damage exceeds 50% defoliation and 3 or more grasshoppers/sq. yd. are present.
Flea beetles	Destroy leaves of seedlings in fall. Damage common along field margins.	Do not treat unless seedling damage exceeds 50% defoliation and 2 beetles /row ft. are present.
Lesser corn stalk borer	Larvae bore into base of seedlings in fall. Usually only in early plantings for grazing.	Not established.
European corn borer	Small larvae chew holes in leaves; large larvae tunnel in stem killing developing grain head.	Control almost never practical; Treat when larvae are small and borer numerous and before they bore into stems.
Mites	Suck plant sap; cause leaf discoloration.	Treat when leaf discoloration appears over large areas of a field.
Thrips	Suck plant sap; may cause leaf discoloration.	Injury not economic; do not treat. Thrips may disperse to adjacent summer crops as wheat matures.
Stink bugs	In spring, feed on developing grain from milk to hard dough stage.	Almost never require control in wheat. Treat if 1 or more bugs/sq. ft at milk stage. Do not treat in dough stage.

Table 20. Insecticide recommendations for wheat insect pests.

CROP / PEST	INSECTICIDE[1]	AMOUNT OF FORMULATION PER ACRE	LBS. ACTIVE INGREDIENT PER ACRE	REMARKS
Aphids	Seed Treatments Gaucho 480 Gaucho 600 Gaucho XT Cruiser Wheat-pack (5FS) Foliar Treatments Baythroid XL Dimethoate 4EC, 400 2.67EC Methyl 4EC Penncap-M Warrior 1CS Karate Z 2.08CS Proaxis 0.5	 1.0 fl. oz./100 lbs. seed 0.8 fl. oz./100 lbs. seed 3.4 fl. oz./100 lbs. seed 1.0 fl oz/100 lbs. of seed 2.4 fl. oz. 0.5 to 0.75 pt. 0.75 to 1 pt. 0.5 to 1.5 pt. 2 to 3 pts. 2.56 to 3.84 fl. oz. 1.28 to 1.92 fl. oz. 2.56 to 3.84 fl. oz.	 0.03 lb./100 lbs. seed 0.03 lb./100 lbs. seed 0.03 lb./100 lbs. seed 0.04 lb./100 lbs. seed 0.019 0.25 to 0.375 0.25 to 0.375 0.25 to 0.75 0.5 to 0.75 0.02 to 0.03 0.02 to 0.03 0.01 to 0.015	**NOTE:** Gaucho 480 available as commercial seed treatment and hopper box treatment. Gaucho XT formulation also contains Raxil and Apron fungicides. **NOTE:** Cruiser 5FS is available as a commercial seed treatment. Cruiser Wheat-pack also contains fungicides.
Armyworm	Baythroid XL Lannate 2.4LV 90SP Methyl 4EC Penncap-M Mustang MAX 0.8EC Tracer 4SC Warrior 1CS Karate Z 2.08CS Proaxis 0.5	1.8 to 2.4 fl. oz. 1.5 pts. 0.5 lbs. 1 to 1.5 pt. 2 to 3 pts. 3.2 fl. oz. 3 fl. oz. 3.2 fl. oz. 1.6 fl. oz. 3.2 fl. oz.	0.014 to 0.019 0.45 0.45 0.75 0.5 to 0.75 0.025 0.094 0.025 0.025 0.0125	ARMYWORM (True armyworm): Usually late winter and spring at boot/head stage. Treat when larval numbers exceed 4 larvae per square foot before pollen shed and 8 larvae per square foot after pollen shed. **NOTE:** Tracer is most effective against small larvae.
Fall armyworm, Beet armyworm, Yellowstriped armyworm, and Cutworms	Lannate 2.4LV 90SP Mustang MAX 0.8EC Sevin 80S XLR Plus, 4F Tracer 4SC Warrior 1CS Karate Z 2.08CS Proaxis 0.5	1.5 pts. 0.5 lbs. 3.2 to 4.0 fl. oz. 1.875 lbs. 1.5 qts. 1.5 to 3.0 fl. oz 3.2 fl. oz. 1.6 fl. oz. 3.2 fl. oz.	0.45 0.45 0.025 1.5 1.5 0.047 to 0.094 0.025 0.025 0.0125	FALL, BEET, and YELLOWSTRIPED ARMYWORMS and CUTWORMS: Usually in fall on seedling plants. Treat when larval populations of any one or any combination of these insects exceed 3 larvae (1/2 inch long or larger) per square foot. **NOTE:** Tracer is more effective against small larvae. Tracer is not labeled for cutworm control.
Cereal Leaf Beetle	Baythroid XL Lannate 2.4LV 90SP Malathion 57EC, 5EC/ Atrapa 5E Malathion 8EC/ Atrapa 8E Mustang MAX 0.8E Sevin 80S XLR Plus 4F Warrior 1CS Karate Z 2.08CS Proaxis 0.5	1.0 to 1.8 fl. oz. 0.75 to 1.5 pts. 0.25 to 0.5 lbs. 1.5 pt. 1.5 pt. 1.0 to 1.25 pts. 1.0 to 1.25 pts. 2.6 to 3.2 fl. oz. 1.25 to 1.875 lbs. 1 to 1.5 qts. 1 to 1.5 qts. 2.56 to 3.2 fl. oz. 1.28 to 1.6 fl. oz. 2.56 to 3.2 fl. oz.	0.008 to 0.014 0.225 to 0.45 0.225 to 0.45 0.94 0.94 1.0 to 1.25 1.0 to 1.25 0.02 to 0.025 1 to 1.5 1 to 1.5 1 to 1.5 0.02 to 0.025 0.02 to 0.025 0.01 to 0.0125	CEREAL LEAF BEETLE: Treat when an average of ½ larva per stem are found. Warrior and Poraxis can be applied at 50% egg hatch. Other materials should not be applied until after 90% egg hatch.

Grasshoppers	Baythroid XL Furadan 4F Malathion 57EC Malathion 5EC Malathion 8EC Atrapa 8E Methyl 4EC Penncap-M Mustang MAX 0.8E Sevin 80S XLR Plus 4F Warrior 1CS Karate Z 2.08CS Proaxis 0.5	1.8 to 2.4 fl. oz. 0.25 to 0.5 pts 1.5 to 2 pts. 1.5 pt. 1.0 to 1.25 pts. 1.0 to 1.25 pts. 0.75 to 1 pt. 2 to 3 pts. 3.2 to 4.0 fl. oz. 1.25 to 1.875 lbs. 1 to 1.5 qts. 1 to 1.5 qts. 2.56 to 3.84 fl. oz. 1.28 to 1.92 fl. oz. 2.56 to 3.84 fl. oz.	0.014 to 0.019 0.125 to 0.25 0.94 to 1.25 0.94 1.0 to 1.25 1.0 to 1.25 0.375 to 0.5 0.5 to 0.75 0.02 to 0.025 1 to 1.5 1 to 1.5 1 to 1.5 0.02 to 0.03 0.02 to 0.03 0.01 to 0.015	GRASSHOPPERS: Treat when populations are causing excessive (greater than 50%) defoliation. **NOTE: Furadan** can NOT be applied after grain heads emerge from boot.
Green June beetle larvae	Sevin 80S XLR Plus 4F	1.875 lbs. 1.5 qts. 1.5 qts.	1.5 1.5 1.5	GREEN JUNE BEETLE LARVAE: Treat before planting if populations average 1 or more grub per square yard. Apply to infested pastures before seeding small grains. **Sevin** is not registered for use on barley, oats or rye.
Chinch bug	Baythroid XL Mustang MAX 0.8E Warrior 1CS Karate Z 2.08CS Proaxis 0.5	2.4 fl. oz. 4.0 fl. oz. 3.84 fl. oz. 1.92 fl. oz. 3.84 fl. oz.	0.019 0.025 0.03 0.03 0.015	Gaucho and Cruiser seed treatments may provide control for a few weeks after planting. Chinch bugs are difficult to control in headed wheat.
Hessian fly	Seed Treatments Gaucho 480 Gaucho 600 Gaucho XT Cruiser 5FS	 1.5 to 2 fl. oz./100 lbs. seed 1.2 to 1.6 fl. oz./100 lbs. seed 3.4 fl. oz./100 lbs. seed 1.0 to 1.33 fl oz./100 lbs. seed	 0.045 to 0.06 lb./100 lbs. seed 0.045 to 0.06 lb./100 lbs. seed 0.03 lb./100 lbs. seed 0.04 to 0.06 lb./100 lbs. seed	Systemic seed treatments, **Gaucho** and **Cruiser**, may need highest rates for effective suppression. Gaucho XT rate may not provide good control. **NOTE:** Di-Syston 15G and 8E are no longer labeled for use on wheat. Apply in-furrow at planting.
Mites	Methyl 4EC Penncap-M Karate Z 2.08CS	1 to 1.5 pts. 2 to 3 pts. 1.92 fl. oz.	0.5 to 0.75 0.5 to 0.75 0.03	**NOTE:** Karate for suppression only.
Stink bugs	Baythroid XL Methyl 4EC Penncap-M Mustang MAX 0.8E Warrior 1CS Karate Z 2.08CS Proaxis 0.5	1.8 to 2.4 fl. oz. 1 to 1.5 pts. 2 to 3 pts. 3.2 to 4. 0 fl. oz. 3.2 fl. oz. 3.2 fl. oz. 3.2 fl. oz.	0.014 to 0.019 0.5 to 0.75 0.5 to 0.75 0.02 to 0.025 0.025 0.025 0.0125	

Abbreviations used are: G = granules, S = sprayable, L = liquid, SP = soluble powder, SC = soluble concentrate, LV = low volume, W = wettable powder, EC = emulsifiable concentrate
Numbers following liquid formulations indicate pounds active ingredient per gallon; those following solids indicate percent active ingredient.

Table. Forage, feed, and grazing restrictions for wheat insecticides.

Insecticide	Brand Name	Days From Last Application To:		Restricted Entry Interval (hr)	Maximum Amount Allowed Per Acre Per Crop	Precautions
		Harvest	Grazing			
beta-cyfluthrin	Baythroid XL (1.0EC), generics	30	7	12	4.8 fl. oz. or 2 applications	
carbaryl	Sevin	21	7	12	3 lbs. ai	Do not use within 21 days of harvest for straw.
carbofuran	Furadan 4F	Head emer-gence	No	48	2 applications	Do not apply after grain head emergence from boot. Do not feed treated forage to livestock.
dimethoate	Dimethoate, generics	35	14	48	2 applications	
imidacloprid	Gaucho	45	45	12	Seed treatment	XT formulation also contains Raxil & Apron fungicides.
lambda-cyhalothrin	Warrior 1CS, Karate Z, generics	30	7	24	0.48 pt.	Same active ingredient as gamma-cyhalothrin
gamma-cyhalothrin	Proaxis (0.5)	30	7	24	0.48 pt.	Same active ingredient as lambda-cyhalothrin
malathion	Malathion, Atrapa	7	7	12	No listed	Apply as needed.
methomyl	Lannate	7	10	48	1.8 lbs. ai	Maximum of 4 applications per crop.
methyl parathion	Methyl 4EC, Methyl parathion, Penncap-M	15	15	96	4EC: 3 pts. Penncap-M: 6 pts.	May be less effective under cool weather conditions. Use appropriate protective equipment.
spinosad	Tracer 4SC	21	14	4	9 fl. oz.	
thiamethoxam	Cruiser Wheat-pack (5FS)	-	- -	12	Seed treatment	See label for crop plant-back restrictions.
zeta-cypermethrin	Mustang MAX (0.8EC)	14	14	12	21.5 fl. oz.	Do not make applications less than 14 days apart.

DISEASE MANAGEMENT IN WHEAT

The most effective and economical method to control diseases of wheat is to plant disease resistant varieties. Resistance is the primary means to manage foliar diseases which cause the greatest yield reduction each year. However, few recommended varieties have "good" or high resistance to all the major foliar diseases. In addition, populations of fungi causing leaf rust and powdery mildew are constantly changing. There are numerous strains or races of these fungi. When a new variety is released, it is usually resistant to the most commonly occurring races of the fungi prevalent at that time. The race population can change rapidly. Certain individual races or new races may become more common. If a variety is not resistant to these races of the fungus, it can become severely diseased. This may happen as quickly as a year after the release of a new variety. Varietal recommendations are modified each year, often as a result of changes in disease susceptibility. Refer to the most recent information about the best varieties to grow in this guide and in the annual variety performance bulletin.

Weather conditions during the winter and spring can have a major effect on the severity of disease (Table 20). If the winter and spring are cool and/or dry, leaf diseases will usually be of little or no significance regardless of a variety's resistance. A warm, wet winter and spring are favorable for infection by disease-causing fungi. This results in more severe disease. New fungal races also increase more rapidly under such conditions. The combination of low resistance and warmer than normal winters and springs are favorable for severe powdery mildew, leaf rust, and Stagonospora nodorum leaf and glume blotch, the three most important fungal diseases. *Stagonospora nodorum* was formerly named *Septoria nodorum*. These conditions lead to an increased use of foliar fungicides to control diseases on susceptible varieties.

Seedborne and soilborne diseases are controlled primarily by seed treatment and crop rotation. Resistance is generally not available for these diseases. Following planting and fertility management recommendations all contribute to successful disease management for these and other diseases.

Among the diseases of wheat, viruses are often the most difficult to control. Three virus diseases occur on wheat in Georgia: soilborne mosaic, wheat spindle streak mosaic, and barley yellow dwarf. Most varieties have good tolerance to soilborne mosaic and wheat spindle streak. Tolerance or resistance to barley yellow dwarf is fair to low for most varieties.

Leaf Diseases

Powdery Mildew. This disease may occur on any above ground plant part, but it is usually most prevalent on the upper surface of the lower leaves. The conspicuous white to gray patches of fungus appear early in the season. When powdery mildew is severe, the entire leaf turns yellow and dies. Black spore producing structures develop in older lesions. Dense stands, high nitrogen fertility, and rapid growth increase susceptibility. Under such conditions a variety listed as having "good" resistance may become heavily infected. As the stem elongates and temperatures increase, conditions become less favorable for powdery mildew. This disease has the least effect on yields of any of the three diseases discussed in this guide. On all but the most susceptible varieties, powdery mildew confined to the lower leaves has little or no effect on yield. Fungicides should not be applied until flag leaf emergence unless a variety is very susceptible. If fungicide is applied too early, the plant will not be protected during the latter half of the grain-filling period.

Leaf Rust. Reddish-brown pustules develop on leaves and sheaths. These pustules are filled with spores of the fungus. Rubbing an infected leaf will leave rusty colored areas on your fingers. Rust pustules may be very tiny, barely large enough to see with the naked eye, to 1/8 inch in length. Generally, varieties with higher levels of resistance will have smaller pustules than varieties with lower levels of resistance. Varieties with poor resistance will also have larger yellow halos around the pustules. Leaf rust has the greatest effect on yield of the diseases discussed here because it develops rapidly during favorable weather.

Stripe Rust. Also known as yellow rust. Pustules coalesce to produce long yellow stripes between veins of the leaf and sheath. Small yellow, linear lesions occur on floral bracts. These pustules are filled with spores of the fungus. In Georgia, the disease appears in late February early March during cool, overcast and wet weather. Stripe rust occurs well before leaf rust. Stripe rust is an emerging disease in Georgia and has been seen for two of the last three years. Stripe rust can have a potentially devastating effect on yield. Chemical options are available to control stripe rust however selection of fungicide should be made judiciously. Genetic resistance to stripe rust should be the best way to manage the disease. According to state breeders, there are several varieties or breeding lines than have higher levels of resistance to the disease. Work is in progress to release newer varieties with resistance to stripe rust.

Leaf and Glume Blotch. Lesions (spots) are initially water-soaked and then become dry, yellow, and finally brown. Lesions are generally oblong, sometimes containing small black spore producing structures called pycnidia. The lesions are often surrounded by a yellow halo. Lower leaves are generally more heavily infected, with lesions joining together to cause entire leaves to turn brown and die. If pycnidia are present on lower leaves when the uppermost leaf and the head begins to emerge, infective spores will move to the top of the plant in splashing rain even after a brief shower. Symptoms may not appear for 10-15 days on the top leaves or glumes on the head. By the time lesions are seen on the head, it is too late for effective fungicide use. Therefore, it is important to examine the lower leaves for lesions when making decisions about fungicide application, not just the top leaves. Lesions are first tan or brown on the upper portion of the glume while the lower part remains green. As the head matures, it becomes purplish to black in appearance from glume blotch. Leaf and glume blotch can reduce yield as much as 20% and reduce test weight due to grain shriveling even when disease severity is low.

Barley Yellow Dwarf. Barley yellow dwarf virus (BYDV) is probably the most widely distributed virus in wheat. It is estimated to reduce yields by 5 to 25% each year. The symptoms are variable and resemble nutritional problems or frost damage. Usually the discoloration is characterized by various shades of yellow or reddening from the tips to the base and from the leaf margin to the midribs of the leaves. Some varieties have more yellow symptoms whereas others have more red to purple discoloration. When infection begins early in the season, after heading, the uppermost leaf is often very upright. Severe infection usually causes some stunting and reduction in numbers of seeds per head. BYDV is transmitted by several aphid species. Aphids acquire the virus by feeding on infected plants for very short periods and then move to other uninfected plants. Infection can occur any time when viruliferous aphids multiply and migrate in fields. Crop rotation is less effective for barley yellow dwarf because aphids can transmit the virus between fields, and many grasses on which the aphids feed also harbor the virus.

Barley yellow dwarf can cause severe losses in many Georgia fields, most often following a mild fall and winter which allows aphids to be active and transmit the virus early in plant development. BYDV is present in nearly all fields each year. Disease severity depends on aphid populations and the proportion of aphids that can transmit the virus. Control of volunteer wheat and grassy weeds during the summer and along the edges of fields may slow initial infection. Planting during the latter part of the recommended period can delay fall infection. Resistant varieties and insecticide application to control aphids can reduce damage from barley yellow dwarf (see Insect Management).

Table 20. Optimum temperature and moisture for the major diseases affecting wheat grown in Georgia

DISEASE	OPTIMUM MOISTURE	OPTIMUM TEMPERATURE
Powdery Mildew[1]	High Humidity	59-72[2]
Leaf Rust	Free Moisture	59-72
Stripe Rust	Free Moisture	50-59
Leaf and Glume Blotch	Free Moisture	68-75
Take-All	Moist Soils	50-68

[1] Powdery mildew fungus does not need free moisture to develop.
[2] Temperatures above 77 F are not favorable for fungal development.

Seedborne and Soilborne Diseases

Seedling Blights. Several fungal pathogens infect the seed as it matures, particularly when rains are frequent during seed development. Seed quality is reduced significantly and germination is often problematic. Soil temperatures which are higher early in the fall also favor infection of the ungerminated seed and tissues of the germinating seedling by several species of soilborne *Pythium*. The combination of infection by both seedborne and soilborne fungi can result in severe pre- and post-emergence damping off. The result may be a substantially reduced stand that grows slowly or it may be necessary to replant. Seedling blights can be reduced by planting good quality seed and the use of seed treatment fungicides (Table 21).

Smut Diseases. There are two smut diseases that affect wheat in Georgia. They usually cause only minor problems, but they can increase rapidly and cause serious losses if not controlled. Loose smut causes the tissues in the head to be replaced by masses of powdery spores. The fungus spores invade the embryo of the developing seed and the fungus survives there until the seed germinates. Common bunt or stinking smut occurs rarely, but it can cause complete loss of a crop. The tissues of the head remain intact, but the seed is destroyed. The masses of smut spores are in 'bunt balls' which are held in the seed coat of the grain. Stinking smut gets its name from the foul odor it produces that is similar to rotting fish. The bunt balls are easily ruptured during harvest and millions of spores are deposited on the surface of healthy seeds. Spores germinate and invade the germinating seedling, then the fungus grows systemically like loose smut. Smut spores are not toxic to animals or humans. These smut pathogens are only transmitted by seed. Planting Certified seed is an effective method to control smut diseases because seed fields are carefully inspected. Seed treatment with systemic fungicides is an inexpensive way to achieve nearly complete control of loose smut and common bunt (Table 21).

Table 21. Seed Treatment Fungicides for Control of Seedborne and Soilborne Diseases of Wheat.

FUNGICIDE	CROP	RATE/100 LB SEED	REMARKS
Captan	All	See Label	Controls seedling blights. Does not control smuts.
Thiram	Barley, Rye, Wheat	See Label	Controls seedling blights. Does not control smuts. Can be used for drill-box treatment.
Carboxin-Thiram Vitavax 200 RTU-Vitavax-Thiram	 All Wheat, Oats, Barley	 2.0 oz. 2.0-4.0 oz.	Controls loose smut and stinking smut. Controls seedling blights. See label for specific rate for grains.
Triadimenol Baytan 30 RTU Baytan-Thiram	 All All	 0.75-1.5 oz. 4.5-9.0 oz	Controls loose smut and stinking smut. Controls smuts and seedling blights.
Difenoconazole Dividend	 Wheat	 0.5-1.0 oz.	Controls loose smut and stinking smut
Difenoconazole-Metalaxyl Dividend XL RTA Dividend XL Dividend Extreme	 Wheat Wheat Wheat	 5-10 oz. 1.0-2.0 oz. 0.5-1.0 oz.	Controls loose smut, stinking smut, and Pythium damping-off. Grower and Commercially applied.
Metalaxyl Apron XL Allegiance	 All All	0.32 - 0.64 oz. See label	Controls Pythium damping-off. Does not control smuts.
Tebuconazole Raxil (in various combinations with other fungicides)	Wheat, Oats, Barley	3.5 to 4.6 fl. oz.	Controls loose smut and stinking smut. Controls seedling blights. Commercially applied and drill-box formulations available.

Commercial treatment of small grain seed is preferred, but a drill box treatment can be used with many formulations. Drill-box treatment may not give control to commercial treatment.

Take-all Root and Crown Rot. The fungus responsible for this disease builds up in the soil when wheat is planted in the same field two or more years. Roots are damaged progressively during the winter and early spring. Shortly after heading infected plants wilt and die due to poor water movement from the rotted roots to the stems. The crown and lower stem turn black and plants are easily pulled from the soil. Areas of dead plants are circular or follow tillage patterns indicating movement of infested crop debris. Take-all is reduced by rotation with oats, fallow, or other non-cereal winter crops such as canola. Rotation with barley, rye, or triticale maintains the fungus in roots of these crops although they may not exhibit symptoms as severe as on wheat. Sorghum as a summer crop will reduce the disease in a subsequent wheat crop, whereas soybeans favor take-all. Other control measures include planting near the end of the recommended period to reduce fall infection and avoiding soil pH above 6.5.

Soilborne Mosaic and Spindle Streak Mosaic. The symptoms of soilborne mosaic range from mild green to a prominent yellow leaf mosaic. Plants may be stunted or rosette in shape. Symptoms are usually seen in late winter and early spring. New leaves may be mottled or exhibit streaks or flecking. Wheat spindle streak mosaic virus causes stunting and poor growth with yellow mottling and numerous elongated streaks on leaves. Leaf streaks are usually a light green to yellow. The discontinuous streaks run parallel to the leaf veins and taper to form a spindle shape. Both viruses are transmitted by a fungus which survives in the soil and transmits the virus into the wheat roots. These diseases are typically a problem when soils remain wet during the late fall and winter. Spindle streak mosaic and soilborne mosaic are most common in fields planted to wheat for two or more years. Both viruses may occur together and symptoms may intermingle. Crop rotation is an effective control method.

Fungicide Use

The decision about whether or not to use a fungicide needs to be made carefully. Fungicides do not increase yield. They only help preserve yield and test weight. If yield potential is low or there is no disease present at the critical time for fungicide application or conditions are not favorable for disease, there will be little benefit from fungicide application. If the price of wheat is low, there will be less profit from the use of fungicides. For these reasons, a decision guide has been developed to help you determine if fungicides will be beneficial. This guide makes no guarantee for an economic return on the fungicide investment. It will simply allow you to determine if fungicide treatment might help maintain yields.

To use this guide effectively, you must scout your wheat fields and be able to recognize the three major foliage diseases likely to reduce yields. If you have Internet access, consult the Field Crops section of the UGA Plant Pathology Extension site (http://plantpath.caes.uga.edu/extension/DiseaseLibrary.html) for information on these and other wheat diseases. Some fungicide manufacturers have a color booklet on small grain diseases which is helpful in disease identification. Begin scouting soon after the plants tiller and the stem begins to elongate. The leaves of plants should be observed at least once per week when jointing begins. Inspect plants twice each week from the time the flag (uppermost) leaf begins to emerge until flowering is complete. This is the most critical time to consider fungicide application. Inspect all the leaves, especially the lower leaves. Early in the season the lowest leaves may have symptoms while the younger upper leaves do not. Symptoms on the lower leaves are a good indication that the upper leaves will become infected, especially if rain or heavy dews occur during the next several weeks. Because disease symptoms may not appear until 7-12 days after infection begins, upper leaves that appear healthy may already be infected.

Fungicides can only be effective when you carefully select the fungicide with good activity against the disease(s) present (Table 22). They should be applied at the correct rate and time according to the label. Fungicides should be applied with enough water to get good coverage: 5-7 gal/acre for aerial and 20-30 gal/acre for ground application. Use of a spreader-sticker will help improve leaf retention and fungicide performance. When applying fungicides always read the label and comply with the instructions and restrictions listed.

Generally, the most effective time to apply fungicides is from flag leaf emergence to completion of heading but be certain to follow any label restrictions concerning time of application, the number of applications, and total amount of fungicide that can be applied per season.

Infectious fungi sometimes develop resistance to particular fungicides, especially when a product is used repeatedly without alternating with chemically unrelated fungicides. When fungicide resistance develops, there is no value in increasing rates, shortening intervals between sprays, or using other fungicides with similar modes of action. Several general strategies are recommended to minimize the risk of fungicide resistance. First, don't rely on fungicides alone for disease control. Avoid using wheat varieties that are highly susceptible to common diseases. Follow good disease management practices to reduce the possibility of fungicide resistance. Limit the number of times at-risk fungicides are used during a growing season. Alternate at-risk fungicides with different fungicide groups. These are general principles that can help to reduce but not eliminate risk. A fungicide-resistant pathogen population can still develop when these principles are practiced.

Table 22. Fungicides for Wheat Foliage Diseases.

DISEASE	CHEMICAL AND FORMULATION	RATE/A	REMARKS AND PRECAUTIONS
Stagonospora leaf and Glume Blotch, Leaf Rust, Powdery Mildew, Tan Spot, Stripe Rust	Propiconazole Tilt PropiMax	4 ozs.	Economic yield response to control wheat diseases is most likely to occur in fields with yield potentials of more than 50 bu/A and varieties with fair to poor resistance. Refer to product label for proper use and restrictions.
	Azoxystrobin Quadris	6.2-10.8 oz.	Apply after Feekes 6 but not later than Feekes 10.5. Do not harvest treated wheat for forage. Use crop oil at 1.0% v/v.
	Propiconazole-trifloxystrobin Stratego	10 oz.	Tilt can be applied until heading stage (Feekes 10.5). Do not apply Tilt after this growth stage to avoid possible illegal residues. Tank mixes of half rates of Tilt + Quadris are also effective.
	Propiconazole and Azoxystrobin Quilt	7-10 oz	Applications may be no closer than a 14 day interval. Quilt can be applied up to Feekes growth stage 9.
	Pyraclostrobin Headline	6-9 oz.	Apply no later than Feekes 10.5

Effectiveness of Foliar Fungicides for Control of Wheat Diseases

Trials were conducted at Plains and Griffin during the past 20 years to test the efficacy and timing of fungicide application on disease-susceptible wheat cultivars. During this period there has been a shift from protectant fungicides that only prevented new infections to systemic fungicides that can eliminate an existing infection and provide protection for three weeks or more. Conditions of the tests represent a range of cultivar susceptibility and yield potential, timing of fungicide application (from flag leaf emergence to full heading), and environmental conditions favoring disease. They give an accurate estimate of the full range of crop conditions that might be encountered in Georgia. All were in high yield potential management systems.

Thirty-five fungicide treatments over a span of 17 years resulted in statistically significant yield increases in response to leaf rust, and sometimes to powdery mildew and Stagonospora blotch. The average yield of controls was 67 bu/A and the average yield increase due to fungicide treatment above the controls was 9.2 bu/A or an average increase of 14.1%. In 54% of the cases, test weight was maintained at a higher level than the controls with disease. The average return was 1.5-2.5 times the cost of fungicide application.

Assuming $15.00/A cost of fungicide application:

Yield increase X	Price/bu =	Return	Profit/A
9.2	$2.50	$23.00	$ 8.00
9.2	$3.00	$27.60	$12.60
9.2	$3.50	$32.20	$17.20
9.2	$4.00	$36.80	$21.80

If yield was not increased significantly, mostly due to weather conditions unfavorable for disease after fungicide application, there was still an average 3.9 bu/A yield increase above the control for leaf rust and Stagonospora blotch. These results are based on 41 control and 168 fungicide treatments over 16 years.

Yield increase X	Price/bu =	Return	Profit/A
3.9	$2.50	$ 9.75	-$5.25
3.9	$3.00	$11.70	-$3.30
3.9	$3.50	$13.65	-$1.35
3.9	$4.00	$15.60	$0.60

Test weight was improved 11.7% of the time. Even in years when disease develops only moderately or fungicide application is less than optimal, increased yield and some protection of test weight will pay most or all the cost of fungicide application on a disease susceptible cultivar. Table 23 illustrates the impact of fungicide on different varieties in 2005-2006 production season.

MAKING SPRAY JUDGEMENTS

Scout each individual field beginning at growth stage 5 on a weekly basis. At, or just before stage 7, make a disease evaluation. Then use the point guide to determine the need to spray.

If a "zero" is indicated in any major category (I-VII), then it will probably not be profitable to spray.

Total Points		**Chances of Economic Return**
575 +	=	Good
425 - 574	=	Fair
Below 425	=	Poor

When to spray: Generally the most effective time for fungicide application is at flag leaf emergence (Feekes stage 8-9). Applications through stage 10.5 (heading complete) may be beneficial, particularly for control of Stagonospora glume blotch. Refer to the fungicide label for timing of application.

WHEAT FOLIAR FUNGICIDE POINT SYSTEM

This system should be used only as a guide to determine the need for application of foliar fungicide. It does not guarantee an economical return.

I.	**YIELD POTENTIAL**				
	1. 40 bu/A or more	= 150			
	2. 35-39 bu/A	= 50			
	3. Less than 35 bu/A	= 0		I.	________
II.	**NITROGEN FERTILIZATION**				
	1. Applied 90-120 lbs N/A	= 100			
	2. Applied 60-90 lbs N/A	= 50			
	3. Applied no nitrogen	= 0		II.	________
III.	**SEEDING RATE**				
	1. 2 or more bu/A	= 75			
	2. 1.5 - 2.0 bu/A	= 50			
	3. Less than 1.5 bu/A	= 25		III.	________
IV.	**DISEASE AT STAGE 7 (Second Node Just Visible)**				
	1. Severe (rust, powdery mildew or Stagonospora on all leaves)			=	100
	2. Moderate (bottom and middle leaves diseased)			=	75
	3. Light (disease on bottom leaves only)			=	50
	4. No visible foliage disease			=	25
	If rust, or two or more diseases are present, add			=	25
				IV.	________
V.	**SEASONAL RAINFALL PRIOR TO TODAY**				
	1. Above normal	= 100			
	2. Normal	= 75			
	3. Below normal	= 25		V.	________
VI.	**FIVE DAY RAINFALL FORECAST**				
	1. 40% probability (1 or more days)	= 100			
	2. Less than 40% probability (1 or more days)	= 50			
	3. No rainfall forecast	= 25		VI.	________
VII.	**DISEASE RESISTANCE OF VARIETY GROWN (Enter a value for each disease)**				
		Good	**Fair**	**Poor**	
	1. Leaf Rust	0	50	100	1.________
	2. Powdery Mildew	0	25	50	2.________
	3. *Stagonospora nodorum* Leaf Blotch	0	25	75	3.________
	4. Stripe Rust	0	50	100	4.________
				VII.	________
VIII.	**PRICE OF WHEAT**				
	$2.50/bu	= 25			
	$3.00/bu	= 50			
	$3.50/bu	= 75			
	$4.00/bu	=100		VIII.	________

TOTAL POINTS ________

WHEAT FOR GRAIN, CONVENTIONAL
SOUTH GEORGIA, **2008**

ESTIMATED COSTS AND RETURNS

Expected Yield **55** Bushels YIELD: YOUR FARM ________

VARIABLE COSTS	Unit	Number of Units	**$/Unit**	**Cost/Acre**	**$/Bushels**	Your F a n
Seed	Bushel	1.50	$ 14.000	$ 21.00	$ 0.38	____
Lime	Tons	0.25	$ 28.00	$ 7.00	$ 0.13	____
Fertilizer						____
Nitrogen	Lbs	80.00	$ 0.55	$ 44.00	$ 0.80	____
Phospate (P2O5)	Lbs	40.00	$ 0.31	$ 12.40	$ 0.23	____
Potash (K2O)	Lbs	40.00	$ 0.23	$ 9.20	$ 0.17	____
Weed Control	Acre	1.00	$ 6.00	$ 6.00	$ 0.11	____
Insect Control	Acre	1.00	$ -	$ -	$ -	____
Machinery: Preharvest						____
Fuel	Gallon	2.62	$ 2.25	$ 5.89	$ 0.11	____
Repairs & Maintenance	Acre	1.00	$ 4.64	$ 4.64	$ 0.08	____
Machinery: Harvest						____
Fuel	Gallon	2.00	$ 2.25	$ 4.50	$ 0.08	____
Repairs & Maintenance	Acre	1.00	$ 2.64	$ 2.64	$ 0.05	____
Labor	Hrs	0.60	$ 10.00	$ 6.02	$ 0.11	____
Crop Insurance	Acre	1.00	$ 4.75	$ 4.75	$ 0.09	____
Land Rental	Acre	1.00	$ -	$ -	$ -	____
Interest on Operating capital	Percent	$ 64.02	8.00%	$ 5.12	$ 0.09	____
Drying - 2 points	Bushel	56.65	$ 0.08	$ 4.53	$ 0.08	
Total Variable Costs				**$ 137.69**	**$ 2.50**	

Fixed Costs:						
Machinery: Depreciation, Taxes, Insurance, and Housing						
Preharvest	Acre	1.00	$ 13.15	$ 13.15	$ 0.24	____
Harvest	Acre	1.00	$ 15.50	$ 15.50	$ 0.28	____
General Overhead	% of VC	$ 137.69	5.00%	$ 6.88	$ 0.13	____
Management	% of VC	$ 137.69	5.00%	$ 6.88	$ 0.13	____
Owned Land Costs: Taxes. Cash Payment, Etc.	Acre	1.00	$ -	$ -	$ -	____
Other						
Total Fixed Costs				$ 42.42	$ **0.77**	

TOTAL COSTS AND PROFIT GOAL		
Total Costs Excluding Land	**$ 180.11**	**$ 3.27**
**** YOUR PROFIT GOAL ****	$ ________/Bu.	
$$-PRICE NEEDED FOR PROFIT-$$	$ ________/Bu.	

FOOTNOTES

Sensitivity Analysis of WHEAT FOR GRAIN, CONVENTIONAL

NET RETURNS ABOVE VARIABLE COSTS PER ACRE Varying Prices and Yield (Bushels)	-25% 41.25	-10% 49.5	Average 55	+10% 60.5	+25% 68.75
$ 3.00	$ (13.94)	$ 10.81	$ 27.31	$ 43.81	$ 68.56
$ 3.25	$ (3.63)	$ 23.18	$ 41.06	$ 58.93	$ 85.74
$ 3.50	$ 6.68	$ 35.56	$ 54.81	$ 74.06	$ 102.93
$ 3.75	$ 16.99	$ 47.93	$ 68.56	$ 89.18	$ 120.12
$ 4.00	$ 27.31	$ 60.31	$ 82.31	$ 104.31	$ 137.31

ESTIMATED LABOR AND MACHINERY COSTS PER ACRE

PREHARVEST OPERATIONS

Operation	Acres/Hour	Number Times Over	Labor Use (Hr.)	Fuel Use (Gal./Ac)	Machinery Repairs ($/Ac)	Fixed Costs ($/Ac)
Disk Harrow32' with Tractor (180-199 hp)-MFWD 190	16.291	2.00	0.12	1.20	2.16	6.28
Grain Drill15' with Tractor (180-199 hp)-MFWD 190	7.955	1.00	0.13	1.23	2.24	6.28
Spray (Broadcast)60' with Tractor (120-139 hp)-2WD 130	35.455	1.00	0.03	0.19	0.24	0.59
Total Preharvest Fuel, Repairs, Fixed Costs, & Labor			**0.277**	**$ 2.62**	**$ 4.64**	**$ 13.15**

HARVEST OPERATIONS

Operation	Acres/Hour	Number Times Over	Labor Use (Hr.)	Fuel Use (Gal./Ac)	Machinery Repairs ($/Ac)	Fixed Costs ($/Ac)
Header Wheat/Sorghum22' Rigid with Combine (200-249 hp)240hp	9.015	1.000	0.111	1.37	$ 2.08	$ 13.16
Corn Grain Cart 8R36500 bu with Tractor (120-139 hp)-2WD 130	10.642	1.000	0.094	0.63	$ 0.56	$ 2.34
Total Harvest Fuel, Repairs, Fixed Costs, and Labor			**0.205**	**$ 2.00**	**$ 2.64**	**$ 15.50**

Prepared and Reviewed By: Nathan B Smith, UGA Extension Economists, Department of Agricultural & Applied Economics, Dewey Lee, UGA Extension Agronomist, Department of Crop and Soil Sciences.

THE UNIVERSITY OF GEORGIA
COLLEGE OF AGRICULTURAL & ENVIRONMENTAL SCIENCES

WHEAT FOR GRAIN, INTENSIVE MANAGEMENT
SOUTH GEORGIA, 2008

ESTIMATED COSTS AND RETURNS

Expected Yield 75 Bushels YIELD: YOUR FARM ________

VARIABLE COSTS	Unit	Number of Units		$/Unit		Cost/Acre		$/Bushels	Your Farm
Seed	Bushel	2.25	$	14.000	$	31.50	$	0.42	
Lime	Tons	0.25	$	28.00	$	7.00	$	0.09	
Fertilizer									
Nitrogen	Lbs	120.00	$	0.55	$	66.00	$	0.88	
Phospate (P2O5)	Lbs	50.00	$	0.31	$	15.50	$	0.21	
Potash (K2O)	Lbs	60.00	$	0.23	$	13.80	$	0.18	
Weed Control	Acre	1.00	$	6.00	$	6.00	$	0.08	
Insect Control	Acre	1.00	$	-	$	-	$	-	
Disease Control	Acre	1.00	$	10.00	$	10.00	$	0.13	
Machinery: Preharvest									
Fuel	Gallon	7.41	$	2.25	$	16.67	$	0.22	
Repairs & Maintenance	Acre	1.00	$	10.53	$	10.53	$	0.14	
Machinery: Harvest									
Fuel	Gallon	2.00	$	2.25	$	4.50	$	0.06	
Repairs & Maintenance	Acre	1.00	$	2.64	$	2.64	$	0.04	
Labor	Hrs	1.23	$	10.00	$	12.25	$	0.16	
Crop Insurance	Acre	1.00	$	4.75	$	4.75	$	0.06	
Land Rental	Acre	1.00	$	-	$	-	$	-	
Interest on Operating capital	Percent	$ 100.57		8.00%	$	8.05	$	0.11	
Drying - 2 points	Bushel	77.25	$	0.08	$	6.18	$	0.08	
Total Variable Costs					$	215.37	$	2.87	
Fixed Costs:									
Machinery: Depreciation, Taxes, Insurance, and Housing									
Preharvest	Acre	1.00	$	30.73	$	30.73	$	0.41	
Harvest	Acre	1.00	$	15.50	$	15.50	$	0.21	
General Overhead	% of VC	$ 215.37		5.00%	$	10.77	$	0.14	
Management	% of VC	$ 215.37		5.00%	$	10.77	$	0.14	
Owned Land Costs; Taxes, Cash Payment, Etc.	Acre	1.00	$	-	$	-	$	-	
Other									
Total Fixed Costs					$	67.77	$	0.90	
TOTAL COSTS AND PROFIT GOAL									
Total Costs Excluding Land					$	283.14	$	3.78	
**** YOUR PROFIT GOAL ****					$	________ /Bu.			
$$-PRICE NEEDED FOR PROFIT-$$					$	________ /Bu.			

FOOTNOTES

Sensitivity Analysis of WHEAT FOR GRAIN, INTENSIVE MANAGEMENT

NET RETURNS ABOVE VARIABLE COSTS PER ACRE Varying Prices and Yield (Bushels)	-25% 56.25	-10% 67.5	Average 75	+10% 82.5	+25% 93.75
$ 3.00	$ (46.62)	$ (12.87)	$ 9.63	$ 32.13	$ 65.88
$ 3.25	$ (32.56)	$ 4.00	$ 28.38	$ 52.75	$ 89.32
$ 3.50	$ (18.50)	$ 20.88	$ 47.13	$ 73.38	$ 112.75
$ 3.75	$ (4.43)	$ 37.75	$ 65.88	$ 94.00	$ 136.19
$ 4.00	$ 9.63	$ 54.63	$ 84.63	$ 114.63	$ 159.63

ESTIMATED LABOR AND MACHINERY COSTS PER ACRE

PREHARVEST OPERATIONS

Operation	Acres/Hour	Number Times Over	Labor Use (Hr.)	Fuel Use (Gal./Ac)	Machinery Repairs ($/Ac)	Fixed Costs ($/Ac)
Plow 4 Bottom Switch6' with Tractor (180-199 hp)-MFWD 190	2.327	1.00	0.43	4.20	5.23	15.77
Disk Harrow24' with Tractor (180-199 hp)-MFWD 190	12.218	2.00	0.16	1.60	2.58	7.50
Grain Drill15' with Tractor (180-199 hp)-MFWD 190	7.955	1.00	0.13	1.23	2.24	6.28
Spray (Broadcast)60' with Tractor (120-139 hp)-2WD 130	35.455	2.00	0.06	0.38	0.49	1.18
Total Preharvest Fuel, Repairs, Fixed Costs, & Labor			**0.776**	**$ 7.41**	**$ 10.53**	**$ 30.73**

HARVEST OPERATIONS

Operation	Acres/Hour	Number Times Over	Labor Use (Hr.)	Fuel Use (Gal./Ac)	Machinery Repairs ($/Ac)	Fixed Costs ($/Ac)
Header Wheat/Sorghum22' Rigid with Combine (200-249 hp)240hp	9.015	1.000	0.111	1.37	$ 2.08	$ 13.16
Corn Grain Cart 8R36500 bu with Tractor (120-139 hp)-2WD 130	10.642	1.000	0.094	0.63	$ 0.56	$ 2.34
Total Harvest Fuel, Repairs, Fixed Costs, and Labor			**0.205**	**$ 2.00**	**$ 2.64**	**$ 15.50**

Prepared and Reviewed By: Nathan B Smith, UGA Extension Economists, Department of Agricultural 8 Applied Economics, Dewey Lee, UGA Extension Agronomist, Department of Crop and Soil Sciences.

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ATTENTION!

Pesticide Precautions

1. Observe all directions, restrictions and precautions on pesticide labels. It is dangerous, wasteful and illegal to do otherwise.

2. Store all pesticides in original containers with labels intact and behind locked doors. "KEEP PESTICIDES OUT OF THE REACH OF CHILDREN."

   Use pesticides at correct label dosage and intervals to avoid illegal residues or injury to plants and animals.

4. Apply pesticides carefully to avoid drift or contamination of non-target areas.

5. Surplus pesticides and containers should be disposed of in accordance with label instructions so that contamination of water and other hazards will not result.

   Follow directions on the pesticide label regarding restrictions as required by State and Federal Laws and Regulations.

   Avoid any action that may threaten an endangered species or its habitat. Your County Extension Agent can inform you of endangered species in your area, help you identify them, and through the Fish and Wildlife Service Field Office, identify actions that may threaten endangered species or their habitat.

Authors: Dewey Lee, Extension Agronomist-Feed Grains
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CSS-07-10 September 2007

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