Small Grains Breeding and Genetics

Virginia Tech College of Agriculture and Life Sciences

OPTIMIZING WINTER WHEAT PLANTING DATE FOR INCREASED DOUBLE CROP YIELDS IN VIRGINIA

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Introduction

- Objective: determine if planting wheat earlier will lead to increased wheat and soybean yields
- Of all the factors that can be controlled by farmers, planting date is one of the most important, due to its potential impact on productivity (Campbell, et al., 1991)
- The best way to increase winter wheat (*Triticum aestivum*, L.) yield is by increasing the number of fall tillers
- Warmer weather in the fall is the primary factor for increasing fall tiller production (Weisz, 2013)
- Winter wheat harvest occurs 1-2 days earlier for every week that it's planted earlier in the fall
- After wheat harvest, 0.5 – 1 bushel/acre of yield potential is gained for every day soybeans (*Glycine max*, L. Merr.) are planted earlier in the spring (Rowehl, 2012)
- Certain varieties are better suited for earlier planting, and identifying these varieties and how Photoperiod Sensitivity (*Ppd*) and Vernalization (*vrn*) genes impact plant development is crucial for the success of an earlier planted winter wheat crop

Materials and Methods

Test Sites and Currently Recommended Winter Wheat Planting Dates

Virginia Tech Agricultural and Extension Research Centers (AREC):
- Northern Piedmont AREC (Orange)
- Eastern Virginia AREC (Warsaw)
- Tidewater AREC (Holland)
- Davis Produce Private Research Farm (New Kent)

Virginia Cooperative Extension (VCE) Recommended Fall Planting Dates:
- Based on the expected Hessian fly free date, which is a 50% probability of a fall freeze

Planting Dates by Location and Experimental Design

Test Location	Planting Date 1	Planting Date 2	Planting Date 3
Orange	23-Sep	8-Oct	20-Oct
Warsaw	24-Sep	9-Oct	22-Oct
Holland	22-Sep	14-Oct	27-Oct
New Kent	9-Oct	18-Oct	4-Nov

Planting Dates:
- 3 dates that would be considered **VERY EARLY** (Date 1), **EARLY** (Date 2) and **ON TIME** (Date 3), based on Virginia Cooperative Extension Recommendations)
- New Kent had early, on time, and late planting dates

The 2015-2016 Design:
- 15 varieties (14 soft red winter wheat and 1 hard white winter wheat) were planted in strips by planting date in a randomized block design with 4 reps at New Kent and 3 reps at all other test sites
- Width: each plot has 7 rows on 7.5 inch spacing (5-6 feet)
- Length: harvested plot length was 17 feet at Holland and 9 feet at all other test sites
- Seeding rates were: Date 1 = 650,000 seeds/acre, Date 2 = 770,000 seeds/acre, and Date 3 = 890,000 seeds/acre (earlier planting results in more tillers, so farmers typically plant less seed)

Management

Each location was managed for optimum yield for that environment:
- Conventional tillage at all test sites except Holland* which was planted no-till into corn stubble
- Pre-plant fertilizer: 30-50 lbs of N/acre
- Fungicides and Herbicides applied as needed to control diseases and weeds
- Spring Nitrogen application at GS 30: 60-100 lbs of N/acre
- Fungicide Prosaro 6.5 oz/acre applied around flowering for prevent Fusarium Head Blight
- Growth regulator was not applied in these tests

* Holland was no-tilled behind corn, data for date 1 was omitted due to poor stands resulting from excessive volunteer corn

Data Collected

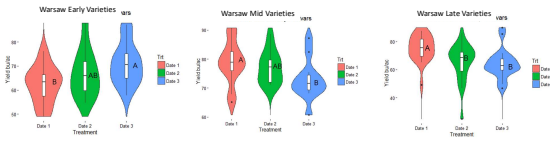
Measurement:	Time of Data Collection:	Calculation:
Plants/1 ft of row in 2 places in each plot	10-14 d after planting	% emergence
Weight of above ground plant mass in 1 ft row in 2 places in each plot	1st or 2nd week of Dec (Record GS when Biomass samples taken)	DM, kg/ha
Greenseeker readings @ GS 25 (greenup)	GS25 (greenup)	estimate of tillers/m2
Frost damage rating	GS 30 (jointing)	1-9 rating
Date when main stem of 50% of plants jointed (GS 30)	GS30 (jointing)	estimation
Normalized Difference Vegetation Index (NDVI)	Just before physiological maturity	
Date of physiological maturity	Loss of green color in peduncle	
Heading date	50% heads completely emerged from boot	
Heads/3 ft of row; in two places in each plot	At flowering stage or later	heads /m2
Grain yield	After harvest	yield, kg/ha
Test weight	After harvest	
1000 kernel weight	After harvest	
Grain Protein	After harvest	Foss NIR
	After data collection	Kernels/head; from heads, grain weight, plot weight

Variety by Maturity Group (days after Jan. 1st)

Early		Mid		Late	
VA13W-38	154.0	VA11W-106	157.3	SS 8870	160.3
Jamestown	153.7	SY 474	157.3	USG 3315	159.3
VA13W-177	153.7	Featherstone 73	156.7	USG 3251	159.3
Progeny 117	153.0	Hilliard	156.3	Pioneer 26R10	158.7
				VA11HWW-113	158.3
				Shirley	158.3
				Pioneer 25R32	158.3

Results

Warsaw: Yield (bushels/acre)



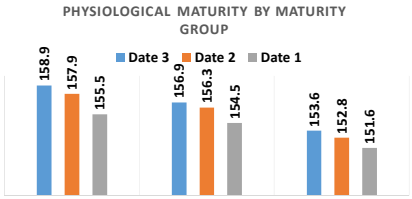
Treatment		Mean: bu/ac
Date 3	A	71.0
Date 2	A B	66.9
Date 1	B	62.3

Treatment		Mean: bu/ac
Date 1	A	78.9
Date 2	A B	77.2
Date 3	B	72.8

Treatment		Mean: bu/ac
Date 1	A	75.3
Date 2	B	65.2
Date 3	B	64.3

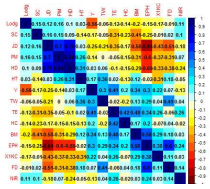
* Warsaw's Mean Yield/ Maturity Group: LATE cultivars Date 1 > Date 3 by 11 bu/ac, MID cultivars Date 1 > Date 3 by 5.2 bu/ac, EARLY cultivars Date 3 > Date 1 by 8.7 bu/ac

Warsaw: Physiological Maturity (PM) days after Jan. 1st



*Mean PM by maturity group. Plants reached PM ~1 day earlier for each week planted earlier in the fall

Pearson Correlation Coefficient of Collected Data



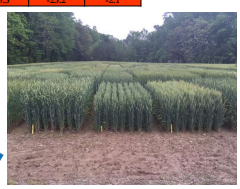
- Lodg: Lodging (0-9)
- SC: Stand Counts 1ft of row in 2 places (10-14) days after planting
- JD: Jointing Date (days after Jan. 1st)
- PM: Physiological Maturity (days after Jan. 1st)
- HD: Heading Date (days after Jan. 1st)
- HT: (Height (in.) at PM
- Y: Yield (bu/ac)
- TW: Test Weight (lbs/bu)
- TE: Tiller Estimation GS 25 (NDVI)
- HC: 3ft or row in 2 places
- BM: Biomass (g) on Dec. 15th
- EPH: Early Plant Height (GS 30)
- x1KC: 1000 Kernel Count
- FD: Frost Damage (0-9)
- NIR: % protein

Yield (bu/ac) Differences For Each Variety By Planting Date

Warsaw		d1 vs d3	d1 vs d2	d2 vs d3
USG 3315	LATE	27.3	14.0	13.4
Featherstone 73	MID	24.1	4.9	19.2
Pioneer 26R10	LATE	18.5	10.8	7.7
Shirley	LATE	12.8	10.7	2.1
Pioneer 25R32	LATE	11.3	3.6	7.7
VA11W-106	MID	11.0	8.9	2.1
USG 3251	LATE	9.3	1.2	8.1
SS 8870	LATE	5.4	11.8	-6.4
Hilliard	MID	3.6	4.1	-0.5
SY 474	MID	-0.1	-11.3	11.1
VA11HWW-113	LATE	-2.9	0.8	-3.7
VA13W-177	EARLY	-4.9	-3.6	-1.3
Jamestown	EARLY	-5.6	1.2	-6.8
VA13W-38	EARLY	-8.6	-3.9	-4.6
Progeny 117	EARLY	-15.6	2.0	-17.6

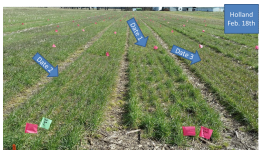
Orange		d1 vs. d3	d2 vs. d3
SS 8870	LATE	2.6	13.9
USG 3251	LATE	-13.2	21.5
VA11W-106	MID	-27.7	-18.6
Pioneer 25R32	LATE	-30	-8.5
SY 474	MID	-19.9	3.7
USG 3315	LATE	0.3	-0.4
VA11HWW-113	LATE	-18.3	-7
Pioneer 26R10	LATE	-21.5	-14.8
Featherstone 73	MID	-8	18.5
Progeny 117	EARLY	-26.9	-15.3
VA13W-38	EARLY	-28.1	-23.6
Hilliard	MID	-44.7	-15
Shirley	LATE	-60	-30.5
Jamestown	EARLY	-33.7	-25.9
VA13W-177	EARLY	-19.6	-22.4

New Kent		d1 vs d3	d1 vs d2	d2 vs d3
Pioneer 26R10	LATE	20.9	2.6	18.3
VA11HWW-113	LATE	18.9	-8.5	27.3
Shirley	LATE	1.3	-10.5	11.8
SS 8870	LATE	21.7	4.2	17.5
Featherstone 73	MID	-3.6	-17.7	14.0
Jamestown	EARLY	-25.3	-23.2	-2.1



Holland: Yield (bushels/acre)

Holland		d2 vs d3
VA13W-177	EARLY	9.2
USG 3315	LATE	7.9
Pioneer 26R10	LATE	5.9
SS 8870	LATE	4.8
VA11W-106	MID	2.5
Hilliard	MID	0.1
SY 474	MID	-1.1
VA13W-38	EARLY	-1.5
VA11HWW-113	LATE	-1.7
Featherstone 73	MID	-2.7
Pioneer 25R32	LATE	-3.4
USG 3251	LATE	-5.1
Shirley	LATE	-5.9
Progeny 117	EARLY	-7.8
Jamestown	EARLY	-7.8



*Date 1: dropped due to poor stand density a result of volunteer corn in fall

SUMMARY- based on 2015-2016 results

- Results strongly impacted by environment
- Under optimum management, **late maturing varieties** appear to perform better when planted earlier than what is recommended by Virginia Cooperative Extension
- **Early maturing varieties** should not be planted early and perform better when planted on time or even later when weather prevents planting
- Good management is key including: selecting the right variety, weed control, insecticide/fungicide seed treatments, timely fungicide sprays, split N applications, and growth regulator applications when needed

Future Directions

- Grow tests again at all locations to collect data across multiple years
- Include the full test e.g. all 15 varieties at New Kent
- Plant soybeans at Holland after each planting date to determine impact on soybean yield
- Apply growth regulator to all tests to restrict lodging
- Determine planting date recommendations for each variety/maturity group based on expected Physiological Maturity
- **Possibly will include a 5th location in Kentucky**

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