Developing an Environmental Specific Decision Support Tool to Help Growers Determine an Optimum Seeding Rate for New Varieties

Joel Ransom, Dept. of Plant Sciences, NDSU

Research Questions

There are many new varieties of spring wheat released each year. Research has shown that the optimum seeding rate of a variety can vary significantly from the general extension recommendation. Conducting research to determine the optimum seeding rate for each new variety, however, is not practical as this type of research is expensive, time consuming, and repetitive. Furthermore, recent research has clearly demonstrated the impact that the environment (average yield, latitude, precipitation, etc) can have the seeding rate requirement to produce maximum yield. This research will attempt to develop a decision support system for growers so that they can more accurately predict the optimum seeding rate for each selected variety based on the characteristics of the variety and the environment in which it will be sown. Accordingly, the main research question is: Can environmental information together with the genetic and phenotypic factors of a variety be used to determine the optimum seeding rate for that variety for the field in which it is sown?

Results

Experiments were conducted in 6 total locations. Experimental research site locations were classified as high- or low-yielding environment, and averaged for mean comparison. Crookston and Lamberton, MN and Prosper, ND in Eastern ND comprised the high-yielding environment. Dickinson, Hettinger, and Minot located in western ND comprised the low-yielding environment. The western ND locations are funded separately by the North Dakota Wheat Commission.

Application/Use

This research has the potential of helping growers optimize the seeding rate for each variety grown. We envision that this research will enable the development of a decision tree, taking into account the various factors that are known to influence a variety's response to seeding rate. Factors that might be included in this "tree" include: the yield potential of the area, the latitude of the farm, the normal height of the variety of interest, its tillering potential and maturity length. Also to be included would be key genetic traits of the variety. The results and application of this research should allow growers to use seeding rates that optimize yield and eliminate the cost of using more seed than is needed for optimum yield.

Material and Methods

Experiments were planted in one location in North Dakota and two in Minnesota with funding from Minnesota Wheat Research and Promotion Council. The ND Wheat Commission funded three additional sites in western ND. These sites varied in their historic yield potential. Treatments consisted of a factorial combination of varieties (nine) and seed rates (four). The varieties included were: Prevail, Vit-Pro, Valda, Linkert, Lang, Surpass, Anchor, Wildfire and Shelly. These are relatively recently released varieties that vary for key genetic and phenotypic traits, specifically semi-dwarf genes Rht-B and Rht-D, photoperiod gene Ppd-D, straw strength, and tillering capacity. The seeding rates used were 0.75, 1.25, 1.75. and 2.25 million seed per acre: In addition to obtaining information on the best seeding rate for maximum yield for each variety in each environment, we collected data on the tillering capacity of each variety, measured plant height, and recorded data on lodging. The sites in western ND were included in order to obtain critical information on the effect of seeding rate on yield in lower yielding environments.

Economic Benefit to a Typical 500 Acre Wheat Enterprise

We are still in the preliminary stage of the analysis of the research results. Ultimately, we believe that there will be a twofold benefit from this research. The first will be the benefit of additional yield arising from growers using the optimum seeding rate for the variety and environment, the second is the potential saving in the cost of seed used, if the grower had been using more seed than is found to optimum.

Related Research

This research builds on previous research on the same subject conducted recently, but includes more recently released genotypes and environments that are more diverse.

Results from 2017 growing season indicate yield response differences at varying seeding rates, dependent on cultivar type and growing environment. As expected, higher yields were observed in the high-yielding environment

Location	High-yielding Environment†					Low-yielding Environment‡			
	.75§	1.25	1.75	2.25		.75	1.25	1.75	2.25
Wildfire	70.6	78.1	76.7	77.3		24.1	25.0	31.2	26.9
Shelly	79.3	81.1	82.5	77.9		24.7	28.1	31.4	32.2
Vit-Pro	70.1	68.6	66.4	66.6		24.8	26.2	27.8	25.3
Anchor	62.4	63.7	67.0	61.0		22.9	24.3	22.1	21.5
Linkert	66.9	69.7	72.4	69.7		24.8	28.7	30.1	28.4
Valda	78.8	75.9	81.6	79.3		29.7	33.6	27.6	31.1
Lang	70.3	69.9	71.2	69.7		25.3	30.2	30.1	26.9
Prevail	64.7	64.9	67.5	66.0		28.3	31.0	30.8	29.7
Surpass	64.4	72.5	70.3	72.4		26.3	29.2	29.2	25.5
Mean	**69.7**	**71.6**	**72.8**	**71.1**		**25.6**	**28.5**	**28.9**	**27.5**

† Research site locations in Minnesota (Crookston and Lamberton) and eastern North Dakota (Prosper).
‡ Research site locations in western North Dakota: Dickinson, Hettinger, and Minot.
§ Seeding rate (x millions seeds ac^{-1}).
¶ Colored cells indicate seeding rate of highest-yielding treatment for each cultivar, dependent on environment type.