A Survey Of Dormant-seeded Hard Red Spring Wheat Fields In Southwest North Dakota

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Summary

Six southwest North Dakota producers who dormant-seeded hard red spring wheat (Triticum aestivum L.) or durum (Triticum tugidum L. Durum Group) from November 1999 through February 2000 were interviewed and their fields surveyed during the growing season in 2000. Eighty nine percent of the acres dormant-seeded were grown to maturity and harvested. The practices common to producers on the eleven percent of the plantings that failed were seeding wheat on wheat and using a seed treatment that was not registered for the control of root and crown disease. Dormant seeded hard red spring wheat produced yields equal to or greater than spring seeded wheat over 60 percent of the time. This survey does not replace the need for research on the subject. If anything, this survey points out that research needs to be conducted to answer questions raised by producers.

Introduction

Limited information is available on dormant-seeding hard red spring wheat (HRSW) in North Dakota. Early spring-seeded HRSW produce higher yields than wheat that is sown at later dates (Briggs and Aytenfisu, 1979; Black and Siddoway, 1977). Riveland (2000) noted that hard red spring wheat planted in October at Williston, ND failed to emerge and grow in the spring. Late fall and early winter seeding at Casselton, ND failed to produce adequate stands of hard red spring wheat (Peel, 2000). At Parma, ID, Brown (1995) observed spring wheat yielded as well as or better than winter wheat planted the same day from October through March. Krall (1977) found that when barley was frost-seeded grain yield was 12 percent greater than barley seeded in early April in south central Montana. When hard red spring wheat was frost-seeded yields were at least equal to those seeded in early April.

Time constraints and inclement conditions often prevent producers in southwest North Dakota from planting crops that benefit from early seeding in a timely manner. Dormant-seeding, if successful, may provide hard red spring wheat producers an option for improving timeliness of planting operations. Some of the advantages of dormant-seeding include: 1) assures early seeding, 2) spreads workload, 3) may avoid heat, disease, insects, and weeds, and 4) HRSW is worth more per bushel than hard red winter wheat. Potential risks producers may include: 1) premature germination, 2) seeding too shallow, 3) insufficient residue to buffer seed from fluctuating temperatures during the winter and early spring, and 4) high disturbance seeding systems which bury residue, increase variability of soil temperature and increase injury.

Producers during winter meetings indicated that they had dormant-seeded or were planning to dormant-seed spring wheat in 1999-2000. Documentation of producer practices and experience can provide information which others might benefit. A survey of dormant-seeded spring wheat fields and producers was conducted during the spring and summer of 2000.

Survey Method

County agents and producers were asked for names of individuals who had planted or were planning to dormant-seed hard red spring or durum wheat in the fall and winter 1999-2000. Six producers were identified in a four county area in southwest North Dakota. Fields surveyed were located in Bowman, Golden Valley, Hettinger and Stark Counties. Growers were asked to complete a field history sheet (Appendix A) for each dormant-seeded hard red spring wheat and durum field that they planted. In addition to questions on the field history of the dormant-seeded field producers were asked to compare yield and quality of spring and dormant-seeded wheat as well as any comments they had on the dormant-seeding practice.

Soil and air temperatures were recorded at a dormant-seeded HRSW field using a Hobo H8 Pro Series (Onset Computer Corporation, Pocasset, MA) 2 channel temperature and external temperature data logger (Figure 1). The internal temperature sensor of the data logger measured the air temperature. The external temperature sensor was placed at seeding depth of 1.25 inches below the surface of the soil on the south side of the data logger shelter so the shelter would not shade the ground where the external sensor was placed. Soil and air temperatures were recorded every 15 minutes from December 5, 1999 through July 27, 2000.

Plant counts were made in April through June by conducting a random survey across the field. The surveyor stopped at six locations in each field, counted plants in a three-foot section of two adjacent rows, and recorded the results. Head counts were conducted in July surveying six sites in each dormant seeded field.

Results and Discussion

Temperature

Warmer than normal air temperatures occurred through much of the late fall and through the winter. Very little snow covered the ground throughout the winter months and little canola residue remained after the seeding operation with a no-till drill with ¾ inch hoe openers. Air temperature fluctuated more than soil temperature. Soil temperature at the South Heart site remained below 38^{O}F from the time the sensor was placed December 5, 1999 until February 28, 2000 (Figure 2, Figure 3, and Figure 4). However, air temperature during the same 84-day period exceeded 38^{O}F for 43 days. During the December 5 through January 15 time period illustrated in Figure 2, the soil temperature never exceeded 38^{O}F though air temperature near 50oF was recorded. Also, the soil temperature never was lower than 10oF even though air temperature of -22^{O}F was recorded at this site. The air temperature on February 9 was about 60oF but soil temperature remained below 38^{O}F. Snow fell on February 11 and covered the ground for the next 10 days. The soil temperature remained nearly constant during that time period while air temperature fell below zero several days in a row. Air temperature climbed above freezing towards the end of February melting the soil. On February 28 the soil temperature warmed to 38^{O}F, the first time since November but declined after that date and did not rise above 38^{O}F again until March 3. Between March 3 and April 17 soil temperature fell below 38^{O}F several times and only after April 17 did soil temperature remain above 38^{O}F for the remainder of the growing season. Germination of seed was noted on March 5 with emergence occurring on April 1 at this site. Though soil temperatures were often below freezing between germination and emergence soil temperatures were never below 16^{O}F. Paulsen, Heyne, and Wilkins (1982) found that winter wheat between germination and emergence exhibited moderate to severe cold injury when soil temperatures fell below 16^{O}F for two hours or longer.

On April 15 an air temperature of –1.8^{O}F was recorded at the South Heart location. At Beach on that same day the North Dakota Agricultural Weather Network station recorded a low temperature of 8^{O}F. Dormant-seeded HRSW was in the one to two leaf stage at the time of this freeze and the foliage above the ground was frozen. However the crown of the plant was in soil that was at a temperature above 32^{O}F. Two weeks after the freeze injury occurred plants had recovered and had two to three leaves (Figure 5).

Survey Results

Thirty-two percent of the total acres dormant-seeded by producers surveyed were planted into fields where the previous crop was wheat (Table 1). Over 35 percent of the acres seeded into wheat stubble failed to establish an adequate stand. Producers with these poor stands indicated that even though there was some emergence in these fields, the plants that had emerged were chlorotic and appeared to have low vigor. These fields were destroyed and reseeded. Fields where an adequate stand was not established were treated with fungicides that are known to be ineffective in the control of root rotting pathogens. The remaining 68 percent of the acres dormant seeded were planted into fields where the previous crop was either chemical fallow or something other than wheat. These previous crops included canola, crambe, flax, and garbanzo beans. All dormant seeded wheat that was treated with seed treatments known to control root rots survived to establish what producers felt were sufficient plant stands.

Average plant stand numbers ranged from 8.3 to 18.1 plants/ft2. Though soil temperatures remained below 38^{O}F from late November through to the end of February, soil temperatures did exceed 32^{O}F for several days. Valovich and Grif (1974) found wheat seed will germinate in temperatures as low as 32^{O}F, the percentage varying with variety and the length of time at this low temperature. Keene HRSW was seeded by four of the producers in seven fields. Seeding dates for these fields was as early as 24 November and as late as 14 December. Plant stand for the 24 November seeding was 8.3 plants/ft2 and the 14 December seeding date was 16.3 plants/ft2. The earlier dormant-seeded Keene HRSW was exposed to a longer period of time when soil temperatures were between 32^{O}F and 38^{O}F compared to the 14 December planting. Germination may have occurred at these low temperatures and with the longer delay between germination and emergence for the November planting in comparison to the December planting, cold or a combination of cold and disease could have reduced plant population.

Head density (Table 2) was nearly always greater for dormant-seeded HRSW planted into fields where the previous crop was not wheat (Figure 6). The number of heads per plant, that is heads/ft2 divided by plants/ft2, was always higher for dormant-seeded HRSW planted into fields where the crop the previous season was not wheat.

A combination of cold-wet stress conditions and root pathogens may have damaged plant stands in dormant seeded wheat fields that were seeded into wheat stubble (Cook and Veseth, 1991). Cold soil temperatures will predispose wheat roots to Common root rot (Bipolaris sorokiniana syn. Helminthosporium sativum) (Wiese, 1987). Also with cool, moist soil conditions pathogens such as Pythium may become more of a problem in dormant seeded wheat than spring wheat planted during the traditional time of the year. Some species of Pythium will attack wheat at soil temperatures of 32^{o}F to 38^{o}F which are lower than or equal to the generally recognized minimum temperature for germination. Pythium also likes moist soil conditions, the kind of conditions that are found in early spring and in no-till seedbeds. Common root rot can still be a problem in dormant seeded hard red spring wheat, but the causal organism for Common root rot needs warmer temperatures than some species of Pythium to infect wheat roots. Freezing of plants can predispose the plant to Common root rot.

Agronomic Practices

Dormant-seeded HRSW planting occurred from 24 November 1999 to 7 February 2000. Soil temperature at 2 PM in the 24 November field that was seeded was 37^{o}F. Soil temperatures that were reported at seeding time for all remaining fields were less than 37^{o}F. Though soil temperature data for the two fields where stand establishment failed is not available, nearby North Dakota Agricultural Weather Network (NDAWN) soil temperature data indicates that the average soil temperature at four inches under sod was less than 38^{o}F from 5 December 1999 through to early March. Seeding rates ranged from 96 pounds per acre to 120 pounds per acre with the majority of the fields planted with 120 pounds of seed per acre (Table 3).

Some producers treated seed with the fungicides maneb or carboxin failed to establish an adequate stand (Table 1). These two fungicides have little activity against root rot pathogens. The few plants that did emerge in the spring in these fields were chlorotic and stunted.

Eight of the ten fields dormant-seeded were planted with drills that had disc openers. A drill with hoe openers was used to seed the two remaining fields. All producers reported difficulty with maintaining a constant seeding depth but the producer with the hoe drill reported that he had a great deal of difficulty maintaining planting depth. He felt that had he had installed a new set of hoe openers seeding depth would have been more uniform. Producers reported where seeding depth was less than one inch, plant stands were thinner and those plants that did emerge appeared to be more stressed than plants that were seeded at depths of one to one and a half inches deep. Also producers indicated that where water ponded, stands were thinner.

All producers applied all the phosphorous and potassium through the drill at planting time (Table 3). Anhydrous ammonia was knifed into two fields in early October. One producer applied nearly all the nitrogen needed as urea at planting time using a mid-row bander. The remaining producers top-dressed the crop in early spring with either ammonium nitrate or urea.

All producers applied herbicides to control weeds in their dormant-seeded grain. Producers reported that even though they had good control of weeds in dormant-seeded grain early in the season, thin stands in some fields allowed for weeds to germinate and compete with the crop. Two of the eight fields that survived to maturity were swathed to allow green weeds to dry down before combining. The remaining six fields were cut directly with the combine.

Harvest dates of dormant-seeded HRSW was reported to be six days earlier to two days later than spring seeded HRSW. The field that was harvested later than the spring seeded field had a low plant population, which provided an opportunity for weeds to grow. This field required swathing and time for the green weed material to dry before harvesting.

Yield and Quality

Producers were asked to compare yields of dormant-seeded hard red spring wheat to the yield of a nearby spring-seeded hard red spring wheat field with a similar cropping history. Yield, test weight, and protein of dormant seeded and spring seeded hard red spring wheat fields are listed in Table 2. Of the dormant HRSW fields that were harvested, yields reported exceeded spring planted HRSW 25 percent of the time. Dormant-seeded HRSW produced the same or nearly the same yields as spring-planted HRSW 37.5 percent of the time while dormant-seeded HRSW had lower yields 37.5 percent of the time. Protein of dormant-seeded wheat exceeded spring-seeded wheat 50 percent of the time; was the same 25 percent of the time; and was less than spring-seeded wheat 25 percent of the time. Test weight of dormant-seeded HRSW was reported to exceed the test weight of spring-seeded HRSW 50 percent of the time; was the same 37.5 percent of the time; and less than spring-seeded HRSW 12.5 percent of the time.

Planting date studies found that spring wheat test weight and protein were not affected by planting dates (Brown, 1996; Black and Siddoway, 1977). Though increased water-use efficiency has been attributed to early seeding dates (Black and Siddoway, 1977) and late fall and winter planting dates (Brown, 1996; Krall, 1977).

Additional Grower Comments

Growers made the following comments as to what they will do different the next time they tried dormant-seeding. 1) Strive to seed in fields with undisturbed crop residue on the soil surface, 2) select fields with few weed problems and control volunteer crop, 3) plant seed uniformly at a depth of 1½ to 2 inches deep, 4) wait for soil temperatures to fall into the mid-thirty degree range before planting, 5) seed into fields where the previous crop was something other than wheat, barley or durum, 6) top dress with a nitrogen source that is less likely to volatilize before rain moves it into the soil, and 7) do a better job of timing herbicide application.

Producers felt that dormant-seeded hard red spring wheat would fit well in a no-till environment. Producers also thought the chances for succeeding with dormant-seeding HRSW were greater than their chances to succeed with dormant-seeding canola or sunflower. Many dormant-seeded canola fields failed in 2000 (Carr, 2000; McKay, et. al. 2001) and Johnson and Petersen (2001) reported lower sunflower yields from dormant-seeding compared to traditional planting dates. Though none of the producers interviewed for the 2000 growing season had dormant-seeded any hard red spring wheat at the time of publication (March 2001) five of the six producers interviewed did say that they would try dormant-seeding in late fall or early winter of 2001.

Implication of Survey

Dormant-seeding hard red spring wheat is not currently a recommended practice in North Dakota. Information presented in this report is meant to make producers aware of what others have tried and what they observed. This survey does not replace the need for research on the subject. If anything this survey points out that research needs to be conducted to answer questions raised by producers.

Producers did not feel that they had adequate information and had the following questions related to dormant-seeding HRSW:

1) Do HRSW varieties perform equally well under dormant-seeded management?
2) How many plants per square foot are required to produce maximum spring wheat yields under a dormant-seeded system?
3) Are disease problems the same as spring-seeded or are they different?
4) What rotations work best for dormant-seeded HRSW?
5) What management practices will improve the odds for a successful dormant-seeded HRSW crop?
6) When is it too late to plant winter wheat for a relatively high yielding crop compared to dormant-seeded spring wheat?
7) When is it too early to plant a dormant-seeded spring wheat crop?
8) Is there more risk in seeding a dormant-seeded HRSW crop compared to a spring-seeded crop?
9) Will dormant-seeded HRSW net more dollars than a spring-seeded HRSW crop?

Cooperating Producers

The authors wish to thank the following producers for cooperating in conducting this survey. These cooperators shared their time, and knowledge in developing this survey. Producers are Mike Zook, Beach, ND; Byron Richard, Belfield, ND; Darwyn Mayer, Mott, ND; Frank and Stuart Dilse, Scranton, ND; Bryan Krinke, Scranton, ND; and Tracy Schmacher; Scranton, ND.

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Tables & Figures

[click on table or figure number]

Table 1. Agronomic practices of selected fields dormant seeded to hard red spring wheat or durum in southwest North Dakota, 2000.

Table 2. Yield, test weight, protein and harvest dates of dormant- and spring-seeded hard red spring wheat in selected fields in southwest North Dakota, 2000.

Table 3. Agronomic practices producers used to dormant-seed wheat in southwest North Dakota, 2000.

Figure 1. Temperature logger house (top photo) and Hobo H8 Pro Series 2 channel temperature/external temperature logger used to track air and soil temperatures in dormant-seeded hard red spring wheat at the Byron Richard Farm, South Heart, ND.

Figure 2. – Soil and air temperatures for dormant-seeded hard red spring wheat at the Byron Richard Farm, South Heart, ND, December 5, 1999 – January 15, 2000.

Figure 3. Soil and air temperatures for dormant-seeded hard red spring wheat at the Byron Richard Farm, South Heart, ND, January 15 - February 26, 2000.

Figure 4. – Soil and air temperatures for dormant-seeded hard red spring wheat at the Byron Richard Farm, South Heart, ND, February 26 – May 1, 2000.

Figure 5. Dormant seeded hard red spring wheat as it appeared on April 28, 2000, on the Mike Zook Farm, Beach, ND. The previous crop was garbanzo beans. This field was seeded on December 7, 1999 and emerged on April 1. On April 15 dormant seeded hard red spring wheat was in the two-leaf stage when freezing temperatures of 8oF injured this field. Plant counts in this field average 16.9 plants/ft2.

Figure 6. Dormant seeded hard red spring wheat field as it appeared on July 11, 2000, on the Mike Zook Farm, Beach, ND. The previous crop was garbanzo beans. Head density is 36.2 heads per square foot. This field did well considering that it had received only three inches of rain between April 1 and July 1. Final yield on this crop was 48.4 bushels per acre.

Appendix. Field History Sheet (Please note: this file is in the form of a PDF. You will need Adobe Acrobat to view and print.)

[Back to 2001 Annual Report Index] [Back to Agronomy Reports]

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