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Seeding Rates for Winter Wheat in Nebraska

Robert N. Klein, Western Nebraska Crops Specialist; Drew J. Lyon, Extension Dryland Crops Specialist; and Greg R. Kruger, Extension Cropping Systems Specialist

A review of winter wheat trials in Nebraska shows how widely the number of seeds per pound can vary within and among varieties. This leads specialists to recommend a change to planting by seeds per acre rather than pounds per acre.

Growers in Nebraska use seeding rates for winter wheat that vary from 30 to 180 pounds per acre. The lower rates are most common in drier areas. The higher rates are used for irrigated wheat, which often is seeded in narrower rows and later in the season since it often follows another crop rather than fallow. This later seeding date reduces tillering and requires higher seeding rates to compensate for the reduction. Also, higher yield potential requires higher seeding rates.

Winter Wheat Seed Size Varies

A change in winter wheat seeding rate recommendations should be made from using pounds per acre to seeds per acre. The number of winter wheat seeds in 1 pound can range from more than 20,000 to less than 10,000, depending on the variety and the year it was produced. *Table I* shows the number of seeds per pound per variety for the 2007 and 2010 Nebraska Winter Wheat Variety Evaluation at four Nebraska locations. Winter wheat yields ranged from a low of 25 to a high of 93 bushels per acre at these locations during the two years. Seeds per pound in these trials ranged from 10,500 to 22,300.

The variety with the greatest variance in number of seeds per pound was Antelope, a white wheat variety, which ranged from 10,500 to 20,300 seeds per pound. When weight is used for wheat seeding rates, a seed size difference of this magnitude can result in considerably more or less plants per acre.

The varieties with the largest seed size were Antelope (W), Armour, and Lyman in the 2010 crop. They had 10,500 seeds per pound. The variety with the smallest seed size was Jagalene, which had 22,300 seeds per pound in Clay County.

The Cheyenne County 2010 plot had the largest average seed size for all the varieties at 11,800 seeds per pound, while the smallest average seed size occurred in Clay County in 2007 with 18,700 seeds per pound.

All seed should be cleaned, and the small and cracked seeds eliminated. Shriveled seed can reduce yields because germination is slower and emergence is reduced.

Selecting a Seeding Rate

Winter wheat is capable of compensating among yield components, which often results in similar grain yields being produced across a fairly wide range of seeding rates. However, using seeding rates that are too low can lead to excessive tillering. It also may delay maturity, increase weed competition, and fail to make use of the plant's full yield potential. Using rates that are too high may increase costs, result in increased lodging, and possibly reduce yields.

Too much competition, even among small grain plants, may lead to fewer kernels per head and lower kernel weight. The key is an optimum plant population with uniform distribution for efficient use of available resources.

A review of seeding rates versus yield potential is helpful. On average, there are 22 seeds per head and 5 heads per plant, or 110 seeds per plant. With an average of 15,000 seeds per pound or 900,000 seeds per bushel, a pound of average-sized seed with 80 percent germination and emergence has a yield potential of approximately 1.5 bushels per acre. Seeding 40 pounds of seed at 15,000 seeds per pound has a yield potential of 60 bushels per acre.

Large, dense seeds are considered to be of better quality than low test weight seeds. Large seed tends to tiller more than small seed; however, small dense kernels are better than large, light kernels. In the seed-cleaning process, a gravity table will remove the light seed.

Another factor affecting seed quality is the seed's protein content. The amount of protein, not the protein percentage, in the seed is very important to early seedling vigor. Large seed may have a lower protein percentage than small, shriveled seed, but because it is larger, it may have more total protein per seed.

Grain test weight often is used as a measure of seed quality, but test weight is a bulk density, or a weight per volume measurement, and small seed that packs well can have a high test weight. If producers use test weight as a seed quality measurement, they should use seed with a test weight above 57 pounds per bushel. Actually, a high thousand kernel weight (TKW) is a better measurement of seed quality. A 30 gram (1.06 ounce) TKW, which translates to 15,200 seeds per pound, is an appropriate minimum TKW for a seedlot. A few varieties grown in Nebraska have small seed with a lower TKW, but their seed is still suitable for planting. With these varieties, producers should use the largest seed they can obtain.

Table I. Average number of thousand seeds per pound for varieties harvested in 2007 and 2010 winter wheat evaluation trials.

	Cheyenne Co.		*Clay Co.*		*Holt Co.*		*Red Willow Co.*	
Variety	*2007*	*2010*	*2007*	*2010*	*2007*	*2010*	*2007*	*2010*
Alliance	18.9	12.7	—	—	—	—	16.3	14.6
Antelope (W)	16.8	10.5	20.3	—	11.8	10.7	15.9	13.5
Armour	—	11.0	—	10.5	—	12.6	—	13.7
Arrowsmith (W)	17.0	11.2	—	—	—	—	15.6	14.6
Art	—	—	19.5	13.1	13.7	12.8	16.6	15.2
Bond CL	17.8	12.2	—	—	14.3	12.6	18.6	15.3
Buckskin	17.3	11.6	—	—	—	—	—	—
Camelot	—	11.4	—	10.8	—	11.0	—	12.3
Expedition	—	10.9	—	11.0	—	11.2	—	13.7
Goodstreak	19.1	11.4	—	—	—	—	14.6	14.1
Harry	19.2	11.7	—	—	—	—	—	—
Hatcher	16.1	11.0	—	—	11.5	—	15.6	14.5
Hawken	18.5	14.4	18.5	12.6	13.0	—	15.9	14.4
Hitch	—	14.4	—	14.1	—	13.3	—	15.9
Infinity CL	18.6	11.0	18.4	11.0	—	—	15.7	14.1
Jagalene	16.5	—	22.3	—	13.8	—	16.4	—
Jagger	—	—	20.5	—	—	—	17.1	—
Keota	13.9	11.5	—	—	—	—	14.1	—
Lyman	—	11.3	—	10.5	—	11.2	—	13.9
Mace	—	13.1	—	12.2	—	13.7	—	17.3
Millennium	16.6	11.0	19.2	12.2	13.2	—	16.1	15.0
NW03666 (W)	—	11.3	—	12.0	—	11.4	—	13.6
Overland	14.8	10.6	18.0	11.5	12.6	11.6	15.5	14.2
Overley	—	—	13.8	11.2	—	—	13.7	13.7
PostRock	17.3	—	18.8	11.6	12.4	12.5	14.6	13.6
Pronghorn	17.6	11.5	—	—	—	—	15.7	13.5
Ripper	14.4	11.8	—	—	—	—	15.8	13.8
Santa Fe	—	—	14.5	11.3	—	11.6	—	14.4
Scout 66	16.1	10.8	15.5	10.8	—	—	15.1	13.4
Settler CL	—	10.9	—	11.0	—	11.8	—	13.7
Smoky Hill	16.7	15.0	21.7	13.9	—	11.3	21.4	17.4
TAM 111	17.2	11.5	—	—	—	—	15.8	13.3
Thunder CL	—	13.2	—	—	—	13.4	—	16.1
Trego (W)	17.6	—	—	—	—	—	16.6	—
Turkey	16.9	11.4	18.9	11.9	—	—	—	15.4
Wahoo	16.6	—	22.0	12.7	—	—	15.3	—
Wesley	14.1	11.9	17.6	12.3	11.1	12.1	15.0	13.7
Winterhawk	—	11.4	—	—	—	—	—	14.7
Average	16.9	11.8	18.7	11.8	12.7	12.0	16.0	14.4

(W) – Indicates that the variety is a white wheat.
CL – Indicates that the variety is a Clearfield® wheat.

Seed cleaning and sizing is essential to remove straw, chaff, dirt, stones, weed seeds, and broken, diseased, or small, shriveled kernels. Generally, seed cleaning will add 1 to 2 pounds to the seedlot's test weight by removing the small kernels. Taking a germination test is essential to determine seed viability. After seed germinability has been determined, the seeding rate can be determined. Seed for planting should be above 85 percent germination.

Table II. Range of optimum seeding rates by areas in Nebraska.

Panhandle	600,000 to 900,000 seeds/acre
Southwest	700,000 to 900,000 seeds/acre
Central	800,000 to 1,350,000 seeds/acre
Southeast	900,000 to 1,350,000 seeds/acre
Irrigated	1,000,000 to 2,500,000 seeds/acre

Table III. Yield potential in bushels/acre of a seeding rate of 18 seeds per foot of row with 80% germination and emergence, and seeded on the recommended seeding date for the area.

Row spacing (inches)	*Estimated yield potential (bu/ac)*
6	153
8	115
10	92
12	77
14	66

How many winter wheat seeds should be planted per acre? There are several opinions on this. Floyd E. Bolton, crop scientist at Oregon State University, says 18 seeds per foot of row seems to be the point of diminishing yield increases,

Table IV. Seeding rate for winter wheat to achieve 18 seeds per foot of row.

Row spacing (inches)	*Feet of row/acre*	*Wheat seeds/lb*						
		12,000	*13,000*	*14,000*	*15,000*	*16,000*	*17,000*	*18,000*
		lb/A of seed						
6	87,120	131	121	112	105	98	92	87
8	65,340	98	90	84	78	76	69	65
10	52,272	78	72	67	63	59	55	52
12	43,560	65	60	56	52	49	46	44
14	37,337	56	52	48	45	42	39	37

no matter what row spacing from 6 to 18 inches. This is for winter wheat seeded at an optimum planting date. Winter wheat seeded late because of weather or following harvest of another crop will require an increased seeding rate. See the section on "How to Compensate for Late Seeding Winter Wheat" for more details.

For dryland winter wheat in western Nebraska, a row spacing between 10 and 14 inches is recommended. Weed competition can be reduced by using narrower row spacings. For irrigation, and especially with late seeding dates, row spacings of 6 to 8 inches are preferred. *Table II* lists optimum seeding rates for different areas in Nebraska. *Table III* shows the yield potential of winter wheat seeded on the recommended seeding date at 18 seeds per foot of row with 80 percent germination and emergence (stand establishment). *Table IV* provides the pounds of seed needed per acre for 6- to 14-inch row spacings and seed sizes of 12,000 to 18,000 seeds per pound, based on 18 seeds per foot of row.

How to Compensate for Late Seeding of Winter Wheat

Late seeding for winter wheat is usually classified as wheat seeded at least a week after the suggested date. Usually, yields start to decline if planting is more than a week late; however, in some situations, late-planted wheat may out-yield winter wheat planted earlier, especially if wheat was planted much before the suggested dates (*Figure 1*). This can be attributed to reduced disease and insect problems and the use of extra soil water in the fall.

- **Use narrow row spacings.** When seeding after the recommended date, narrow row spacings of 6-8 inches are preferred over wider spacings of 10-15 inches. If you use a wider spacing, such as from a 15-inch seeder, consider seeding twice with the second pass at a slight angle to the first. Use one-half the seeding rate each time. These wider spacings are used when we need more weight per seeding unit and only use ½ of the units. For example, a 7 ½-inch seeder results in a 15-inch spacing. We also remove seeding units when we have problems in seeding through heavy crop residue. This works only with disc drills; hoe drills move a lot of soil and will bury much of the seed from the first pass.
- **Increase the seeding rate.** Late seeding usually results in less root and tiller development. A general recommendation is to increase the seeding rate 10 to 15 pounds (150,000-225,000 seeds) per acre per week after the suggested seeding date for your area. The maximum seeding rate for rainfed wheat is 120 pounds (1,800,000 seeds) per acre, or limit the maximum to about twice the seeding rate used for seeding at the suggested date for your area.

For irrigated wheat, the recommended seeding rate is 90 pounds (1,350,000 seeds) per acre when seeded at the optimum date. Increase the seeding rate by 30 pounds (450,000 seeds) per acre for every week after the suggested seeding date to a maximum of 180 pounds (2,700,000 seeds) per acre.

Also, when no-tilling into row crop stubble, seeding rates are usually increased by as much as 50 percent even when seeded during the suggested seeding dates. The reason for the increased seeding rates is that some drills have problems seeding in the old crop stubble row, and maintaining precise depth control can be problematic in the row crop stubble. When seeding occurs more than one week after the suggested seeding date, the seeding rate should be 90 to 120 pounds (1,350,000-1,800,000 seeds) per acre for rainfed wheat. With irrigated wheat, increase the seeding rate the same, up to the maximum listed earlier.

- **Apply phosphorus with the seed.** When seeding wheat late, phosphorus placed with the seed helps improve yield (*Figure 2*). Use 20 pounds phosphorus where none is called for by soil tests and increase other phosphorus rates that are over 20 pounds by 20 percent for late seeded winter wheat.

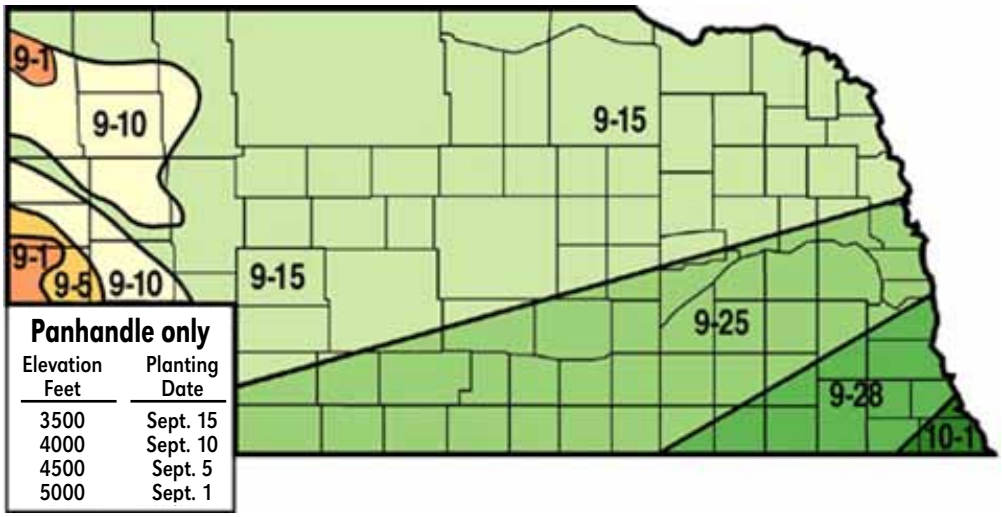

Figure 1. Recommended seeding dates.

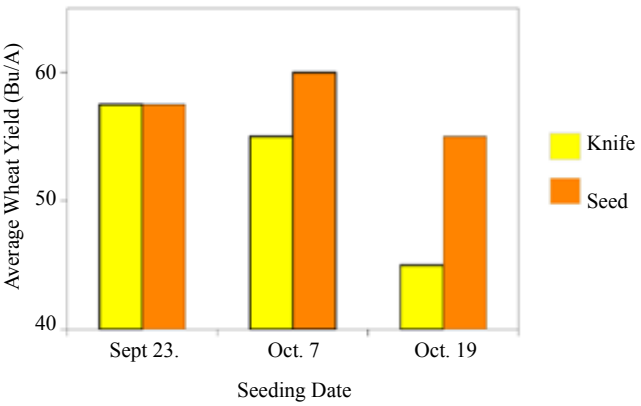

Figure 2. Effect of seedling date on performance of seed and dual placement methods of P application at three locations and seeding dates.

The normal superphosphates and ammonium phosphates generally have a negligible effect on wheat stands because of the low salt content of phosphorus fertilizers compared to nitrogen fertilizer. The low concentration associated with narrow rows (5-12 inches), and the generally high rates of seed used. The seeding mechanism for applying phosphorus fertilizer with the seed is not critical unless the producer applies additional nitrogen at the same time. Do not apply more than 15-20 pounds of nitrogen per acre with the seed. Also, do not use 12-0-0-26.

If equipment is not available to place fertilizer in the seed furrow, 11-52-0 or 18-46-0 can be mixed with the winter wheat seed. A good mix is important and fertilizer dealers can usually do this for you. The use of 11-52-0 with its lower nitrogen content is preferred. With this method, check to see if you are satisfied with the mix by test drilling on top of the ground so you can observe how well the winter wheat seed and fertilizer are mixed. Be aware that with this method, the fertilizer may cause more wear to the drill. Also, fertilizers can absorb water, so take precautions against this and limit the time that the fertilizer is in the drill.

Use certified treated seed to increase planting success. The seed treatments need to thoroughly coat the seeds to give good results and should be applied with quality seed treating equipment.

Calibrating the Drill

With seeding rate determined, how can you be sure the drill plants the desired amount? First, use the operator's manual to set the drill. Then use one of the several resources available to help calibrate the drill. For example, see NebGuide G1511, *Calibration of Sprayers (Also Seeders)*. Problem 10 from that NebGuide illustrates how to calibrate a seeder.

Example of Seeder Calibration

How many pounds of seed should you collect if you want 18 seeds/ft of row with 10-inch row spacing. Seed size is 15,000 seeds/lb and you collect seed for 500 ft.

To determine lb of seed needed/acre:

1 row/10 in x 12 in/ft = 1.2 ft of row/ft 1.2 x 43,560 ft^2/A = 52,272 ft of row/acre

52,272 ft of row/acre x 18 seeds/ft row = 940,896 seeds/acre ÷ 15,000 seeds/lb = 62.7 lb/acre

Determine area seeded with one opener on 1 acre:

10 in per row or

10 in/row x 1 ft/12 in = 0.83 ft

	Test Box 500 ft long	Acre Box
	Wt for weight of seed calibrated	62.7 lb seed/acre
	415 sq ft (500 ft x 0.83 ft)	43,560 sq ft acre

$$\frac{Wt}{415} = \frac{62.7}{43{,}560}$$

43,560 x Wt = 26,020.5 (62.7 x 415)

Wt = 0.6 lb/opener or 9.6 ounces/opener (26,020.5 ÷ 43,560)

This publication has been peer reviewed.

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