Using Wild Oat Growth and Development to Develop a Predictive Model for Spring Wheat Growers and Consultants

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Introduction: Wild oat has become an invasive and economically important weedy species in most cereal growing areas of the world, including the Red River Valley of Minnesota and North Dakota. Approximately 79% of the wheat and 72% of barley acres seeded in northwestern Minnesota are infested with wild oat. In the past, wild oat has been effectively controlled with herbicides, and as a result little research has been conducted on developing data to use in a predictive model for wild oat control. However, as herbicide resistant populations of wild oat are increasing, and farmers are faced with fewer control options, the biology of wild oat is becoming increasing important. Further, the need to reduce production costs and increasing environmental concerns, has also led to an interest in reducing herbicide rates and the cost of controlling wild oats in spring wheat.

The objectives of this research are to:

1. evaluate the growth and development of wild oats.
2. determine if later emerging wild oat plants have an accelerated rate of growth compared to early emerging plants.
3. relate wild oat growth and development rates to air temperature and rainfall and determine growing degree-day accumulations.
4. develop a model to predict wild oat growth and development based on growing degree-days, rainfall and wild oat emergence.
5. determine the efficacy of reduced rates of wild oat herbicides.

Materials and Methods: Research plots were established at two locations in 2002 and 2003, at Fargo, ND and Crookston, MN. Both sites have a long history of being managed specifically for wild oat. Four emergence cohorts were selected, cohort 1 germinated in week one or the initial week of the experiment, cohort 2 in week 2, cohort 3 in week 3 and cohort 4 in week 4 of the experiment. Once the plots were established, 10 individual plants were randomly selected from the natural population for each cohort and numbered. The plot design was a randomized complete block with six replications and plot size was 2’ by 2’.

On a weekly basis, individual plants were evaluated for height, leaf number on the main culm, number of tillers and total leaves. Date flag leaf emerged and date of heading were also recorded. Two weeks after heading, individual plants were harvested and number of heads per plant was recorded. Two weeks was chosen to give plants adequate time to produce heads, but restrict shattering, a characteristics common in wild oat. Plants were dried for one week, weighted, and number of seeds per plant was counted. Number of seeds per plant was divided by number of heads per plant to establish average number of seeds per head. Number of tillers at time of harvesting was multiplied by number of seeds

per head to estimate potential total seed production per plant. It was assumed that each tiller had the possibility of producing a seed head and viable seed. Average soil temperature, maximum and minimum air temperature and rainfall were recorded on a daily basis. Growing degree-day accumulations were calculated with a base of 5 C or 41 F.

Results and Discussion:

The following four figures illustrate the type of data that was collected in 2002 and 2003. The figures are the results from 2002. The results from 2003 will be combined with the 2002 results. The combined results will be used to develop the wild oat model to predict growth and development based on growing degree-days, rainfall, and wild oat emergence. The goal is for this model is to have an accurate and simple method for predicting growth and development of wild oat. This model would facilitate control measures, make scouting more efficient and hopefully provide a more accurate time of herbicide application, and provide better evidence for cultural practices, like delayed planting and timely tillage.

Figure 1. Height of Wild Oat Plants at Crookston and Fargo – 2002.

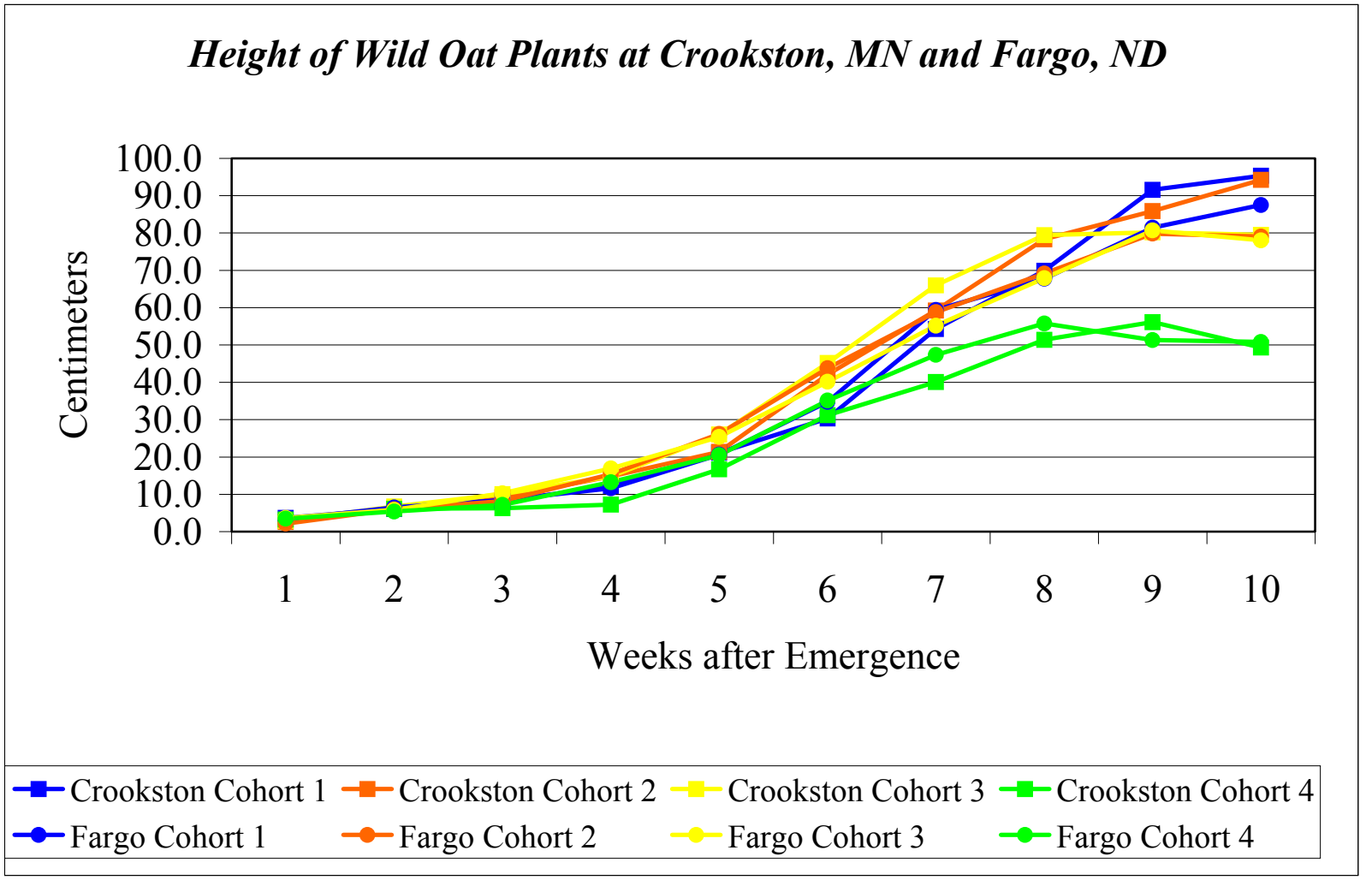


Figure 2: Number of leaves on the main culm of wild oat plants at Crookston and Fargo – 2002.

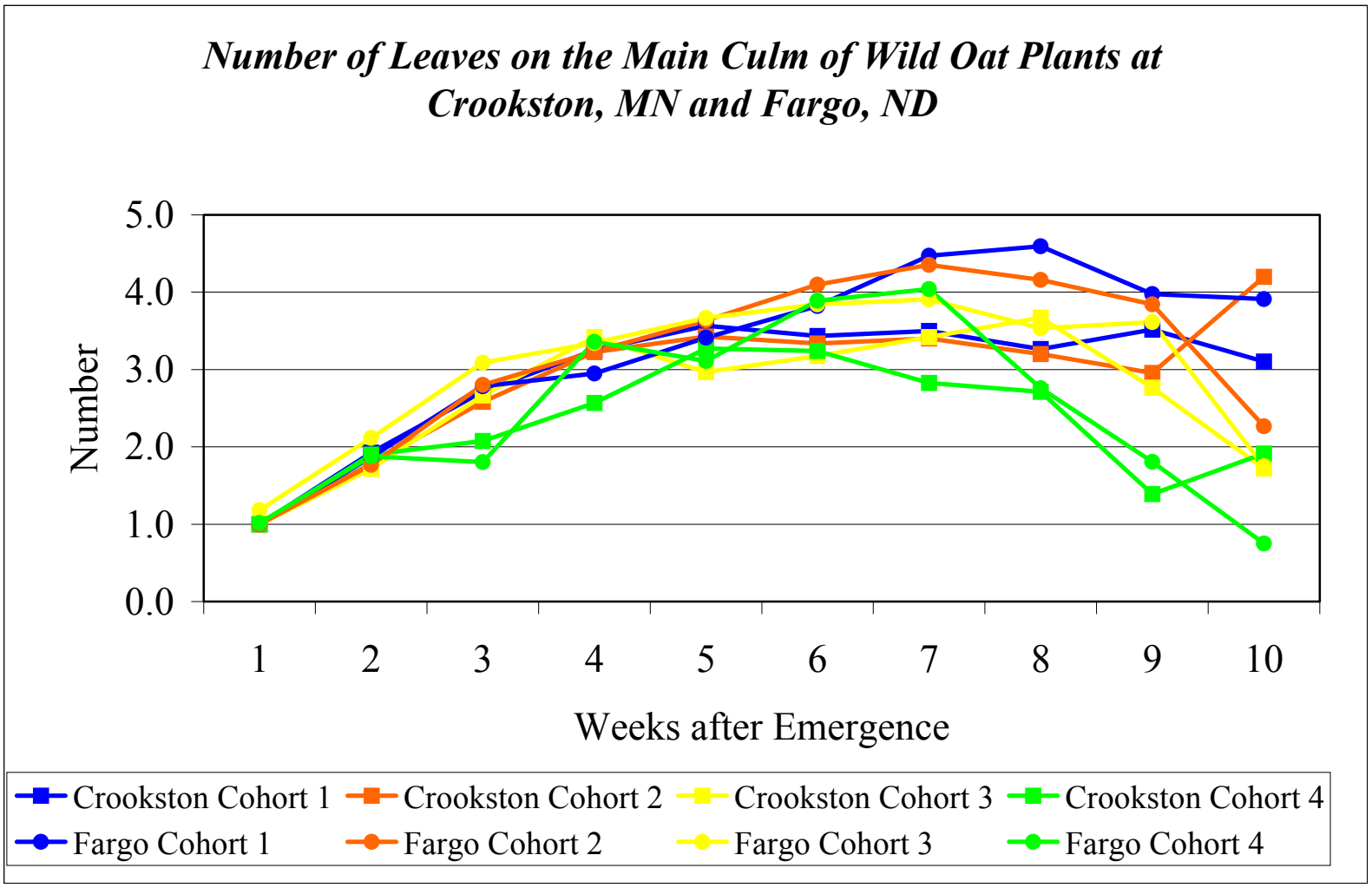


Figure 3: Biomass weight of wild oat plants for each cohort at Fargo and Crookston – 2002.

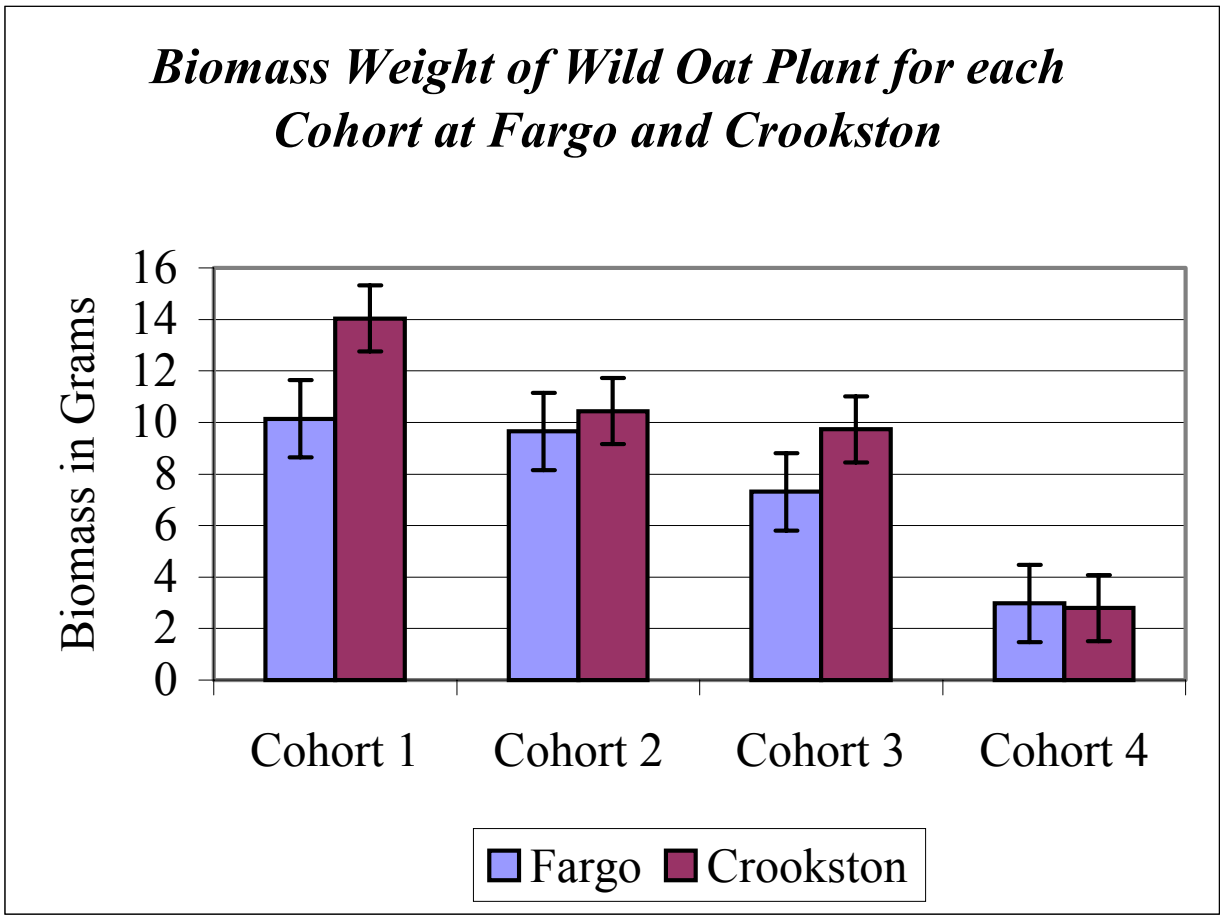
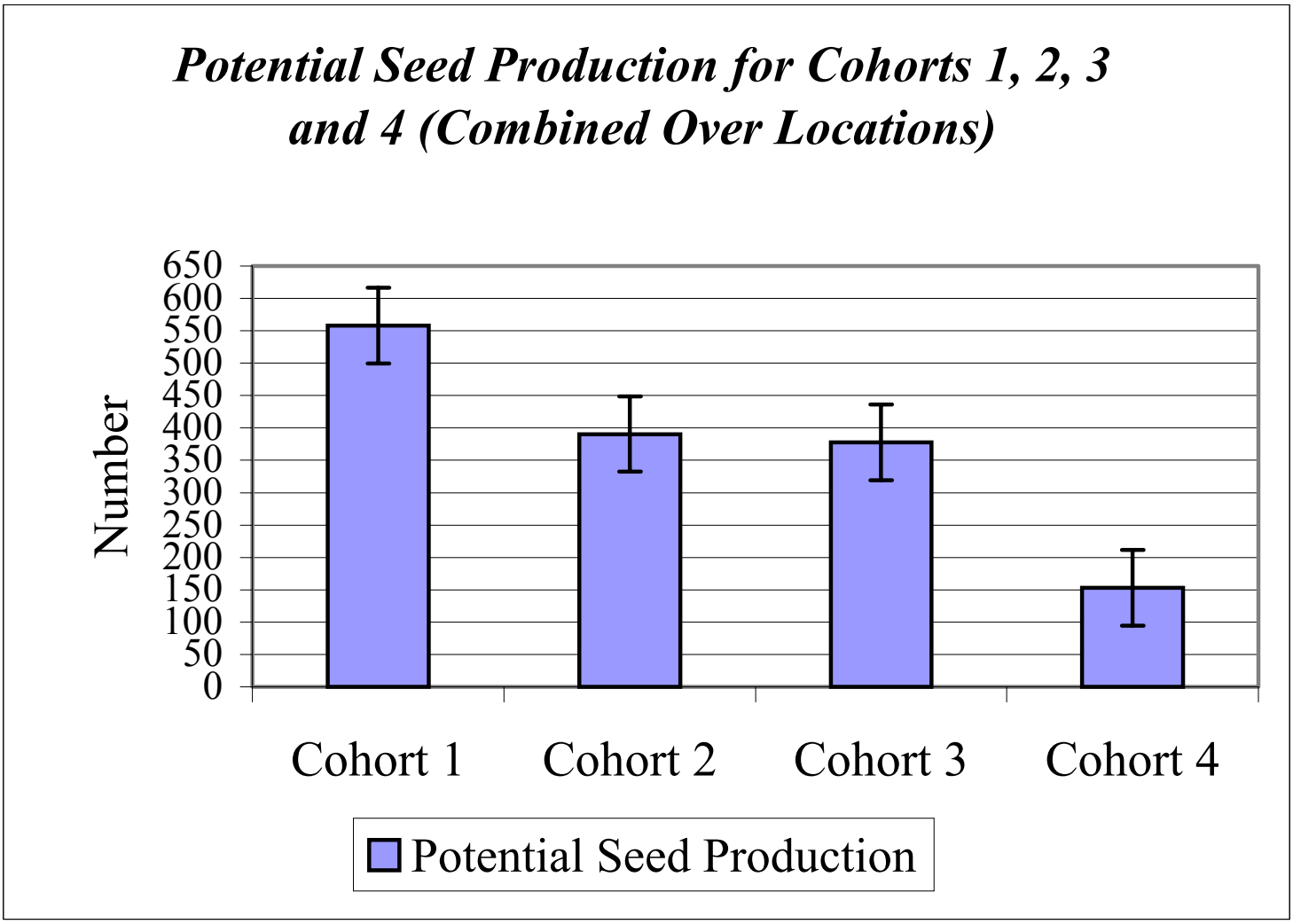


Figure 4: Potential seed production for wild oat cohorts 1, 2, 3, and 4 (combined over the Fargo and Crookston location) – 2002.



Reduced Herbicide Rates for Wild Oat Control:

Labeled rates of herbicides are intended to provide reliable weed control over a wide range of conditions. However, many published studies and observations of individual growers support the idea that herbicide rates lower than the labeled rate can provide adequate weed control in some situations. Caution should be exercised, though. The risk of weed control failure increases as rates are reduced, and farmers using below-label rates bear the responsibility for potential failure.

When conditions are favorable for herbicide activity, however, lower application rates (below labeled rates) will often provide good weed control at a reduced price.

The following are factors to consider when applying reduced (below labeled rates).

1. One important point to keep in mind before trying reduced herbicide rates is that when using an herbicide below the manufacturer's labeled rate, growers assume the liability for performance. Thus, it is important to apply reduced rates accurately and timely. *The risk of weed control failure increases as rates are reduced.*
2. Proper application timing is very important when applying reduced herbicide rates. Postemergence wild oat herbicides require application to wild oats and crops at precise leaf stages. Leaf number on wild oats is determined by counting the leaves on the main stem and disregarding the tillers. The youngest leaf is counted as a full leaf only when another leaf becomes visible. Lower leaves, which may have died from various stresses, such as frost or wind damage, should also be counted in the total leaf number. An accurate leaf count is important for optimum wild oat control.
3. Using reduced-rate herbicides effectively demands that growers calibrate their equipment precisely. There is less margin for application errors with reduced rates.
4. There are a number of tradeoffs for the advantages any one wild oat herbicide might offer. When using reduced herbicide rates, herbicides should be applied to the smallest labeled wild oat leaf stage. However, if the herbicide is applied too early, odds are greater that a late flush of wild oats will require a second herbicide application, or that some wild oats might escape treatment.

Most postemergence wild oat herbicides are more effective when temperatures are cool (less than 75 F) temperature and adequate soil moisture is available. The exception is Avenge – Avenge is more active under hot, dry conditions. Wild oats also grow better, and with less stress, when soil and air temperatures are cool.

Use caution when using reduced herbicide rate for wild oat control when wild oats are under stress due to high temperatures (above 75 F), drought, or frost damage. If wild oat are under environmental stress, the plants are not growing properly, and will not take up and transport the herbicide as needed for adequate control.

Research has been conducted for several years at the Northwest Research and Outreach Center in Crookston, Minnesota for several years to evaluate reduced rates of

postemergence wild oat herbicides. Herbicides were applied at the lowest labeled rate, ¾ and ½ of the labeled rate in spring wheat and barley. Herbicides evaluated included:

- Puma
- Discover
- Assert
- Achieve
- Everest

Results of this research have shown that with accurate rates and proper timing of application, wild oats can be controlled with the most effective herbicides at rates as low as one-half of the normal use rate. However, as wild oat populations increase to approximately 40 plants per square foot, the full rate or nearly full rate, was more consistent than reduced rates, but in low to moderate infestation levels below 40 plants per square foot, the reduced herbicide rates performed very well. However, wild oat control with reduced herbicide rates can vary from year to year. This is mostly due to environmental conditions and the wild oat population.

Reduced rates of ¾ of the labeled rate of Puma and Discover have provided good to excellent wild oat control in 2000, 2001, 2002, and 2003. However, Discover has given the most consistent wild oat control at the reduced rate of ¾ and ½ of the labeled rate. Wild oat control with Assert, Achieve, Everest at reduced rates has been less consistent and has varied from year to year.

Adoption of reduced herbicide rates for wild oat control in spring wheat and barley could lead to a savings of $7 to $13 per acre in chemical costs with grain yields equal to using full herbicide rates. However, reduced rates should not be used if:

1. Wild oats are under stress due to adverse environmental conditions.
2. Wild oat infestations are greater than 40 plants/ft.

A herbicide user can legally choose a rate lower than listed on the herbicide rate unless the label specifically prohibits low rates. However, the company has no obligation to support herbicides when the application rate was less than labeled rates. Thus, the user assumes all risk and liability of unacceptable weed control when less than labeled rates are used. Users should also follow practices such as rotating crops and rotating herbicides with different modes of action to minimize the potential of herbicide resistance.