ER-83

Survey of Weeds in North Dakota - 2000

WEED SCIENCE
BIOLOGICAL CULTURAL CHEMICAL
NDSU

North Dakota State University
in cooperation with
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Introduction:

Two state-wide weed surveys were conducted in 2000 to meet four main objectives:

1. Determine the population and distribution of weed species.
2. Support North Dakota state pesticide registrations.
3. Provide information for herbicide benefit analysis.
4. Evaluate weed species shifts.

The surveys were based upon surveys conducted in North Dakota during 1978 and 1979, "Survey of Wild Oats and Other Weeds in North Dakota" (Dexter et al. 1981). The 1978 and 1979 surveys were conducted in the summer of each year to obtain information needed to determine the benefits from diallate and triallate for wild oat control. The 2000 surveys were conducted in the spring before herbicides were applied and again in summer prior to harvest of each crop surveyed. Results from the summer 2000 survey would compare to the results of surveys taken in the summer of 1978 and 1979. The spring 2000 survey adds significant information by identifying natural weed populations emerging in the spring prior to herbicide application.

This 2000 surveys along with the 1978 and 1979 weed surveys provide information on weed infestations for present and future herbicide benefit analysis. Also it serves as a basis for showing weed population shifts that have occurred and those that may occur in the future, especially since glyphosate has become a major component in weed control systems. Weed surveys give valuable information on the location and extent of infestation by various species, which is important in documenting emergency conditions necessary for Section 18 herbicide registrations for minor crops. Weed surveys are also important to develop weed prevention and control systems.

Methods:

The North Dakota state weed surveys were conducted from mid May through the latter part of June (spring) in 2000 prior to herbicide application and in August through September (summer) 2000, prior to harvest of small grains, canola, soybean, dry edible beans, and sunflower. The survey followed the same procedure as the surveys conducted in 1978 and 1979 so direct comparisons could be made (Dexter et al. 1981). Over 1400 fields were surveyed in 78 and 79. North Dakota had 16,708,761 total harvested acres, excluding hay, pasture, and Conservation Reserve Program (CRP) acres, according to 1997 North Dakota Agricultural Statistics. The total number of harvested acres in North Dakota was divided by 1551 (total number of fields surveyed in the spring) and 663 (total number of fields resurveyed in the summer) , so each sample would represent 10,772 acres in spring and 25,202 acres in summer. Each field surveyed in 78/79 represented 11,000 acres. A minimum of 10 fields per county was surveyed in 1979 and 2000.

The maximum number of fields in each county to be surveyed was determined by comparing the total number of crop acres in the state to the total number of crop acres in each county. The maximum number of fields per county was reduced by 25% to establish a minimum number of fields to be surveyed, as long as the number was above the minimum of 10 fields to be surveyed per county. An acceptable field was at least 40 acres and had an annual crop planted. Fields that were not acceptable to survey were: summerfallow, pasture, alfalfa and forage land, CRP, grasslands, inaccessible by road, or a small portion of the selected field was non-croppable. If none of the fields in the section were acceptable, the next closest field that met all criteria was substituted.

A North Dakota County Atlas was used to locate the number and possible townships to sample. The map illustrated townships with little or no crop acres, such as lakes, grasslands, etc., and those townships were excluded from the survey. Townships that were acceptable were numbered consecutively starting at the northwest township, moving east, and then serpentine at county borders until all usable townships were numbered. The specific section numbers (1-36) to be surveyed within each township were randomly chosen by computer using the number of qualifying townships and the maximum number of fields per county. All surveyors used county maps with township numbers and a copy of the location and number of fields to be surveyed per county.

Weed counts were taken in 0.5 by 0.5 meter (0.25 $m^{2)}$) quadrats at 10 locations in the selected field with the quadrat centered over crop rows. The first count was 100 steps down the edge of the field, turning 90^0 and walking 100 paces into the field, turning 45^0 and walking 40 paces. The other samples were taken every 40 paces from the previous sampling location in a "M" pattern. Samples one through three were taken on the first leg, four and five on the next leg, six and seven on the next, and samples eight through ten were taken on the final leg. Sloughs, drainage ditches, and other areas of the field with irregularities were not sampled. Data collection sheets were used to record weed name and number of weeds. Data collection sheets were marked "weed free" when no weeds were present in sampling quadrats. Unidentified weed samples were identified by NDSU specialists and the correct weed name was entered on data collection sheets. A maximum density for an individual weed species of 99 plants/0.25 m^2 was recorded to save surveying time.

The summer survey was conducted to determine weeds species and weed densities prior to crop harvest. The chronological order in which crops were surveyed were small grains, canola, soybean, dry edible beans, and sunflower because of relative time at which harvest occurs. The objective was to resurvey approximately half of the fields that were surveyed in the spring. Of the

1551 fields sampled in the spring survey, 663 were surveyed in the summer. Burke, Grand Forks, and Mountrail counties were not resurveyed. Each surveyor resurveyed approximately half of their fields by evenly dispersing the fields to be resurveyed throughout each county. Data collection and procedures were repeated.

Twenty seven surveyors were trained and oriented with objectives, procedures, and weed identification. Previous crop was determined by surveyors recognizing crop stubble from the previous years growth. If surveyors were not able to determine the previous crop it was listed and summarized as "unknown". Powell amaranth, redroot pigweed, and tumble pigweed were combined and called "pigweed species". Pennsylvania smartweed and ladysthumb was combined and called "annual smartweed". White and yellow whitlowwart were combined and called "whitlowwart species". Downy brome and cheat were combined and called "downy brome". Smooth brome and bromegrass were combined and called "smooth brome". Wild and volunteer sunflower were combined and called "common sunflower".

Definition of terms used in report:

County - a political subdivision of the state. North Dakota has 53 counties.

Weed Frequency - the percentage of fields surveyed that contained the weed in one or more of the 10 0.25 m^2 sample quadrats. "Weed free" in the Weed Species column of the data collection sheets indicates that at least one of the sample quadrats within the field had no weeds.

Field Uniformity (All) - The percentage of the 0.25 m^2 sample quadrats that contained the specific weed based on all sampled fields.

Field Uniformity (Infested) - The percentage of the 0.25 m^2 sample quadrats infested with the specific weed based only on fields where the weed occurred in one or more of the 10 sample quadrats.

Weed Density (All) - The average weed population or density per m^2 based upon all sample quadrats in all sampled fields.

Weed Density (Infested) - The average weed population or density per square meter based only on infested fields where the weed occurred in one or more of the sample quadrats.

Density Range - The lowest and highest density in plants per square meter recorded for a specific weed within a county or state. The highest recorded weed density was 99 plants/0.25 m^2 (equivalent to 396 plants square meter). The total number of quadrats containing more than 99 plants/0.25 m^2 meter was less than 0.4%, indicating the density range of most weeds indicated in tables are representative. Kochia, pigweed species, and green foxtail had greater than 99 plants/0.25 m^2 in 6.7%, 2.6%, and 1.7% of the total number of quadrats, respectively, so the actual mean density of the three species may be slightly higher than the mean density reported in the tables.

Weed Index - A calculated value that gives an indication of the abundance of a particular weed and can be used to determine comparisons between years and among crops. The formula used was:

$$WI = \frac{(WF) + [(3 \times FU\ (All)] + [7 \times WD\ (All)]}{3}$$

WI = Weed index
WF = Weed Frequency
FU (All) = Field uniformity for all quadrats
WD (All) = Weed density for all quadrats

The ratio of weed frequency:field uniformity:weed density was 1:3:7. These numbers were the numbers used for multiplication so that all three factors would have an approximately equal effect on weed index. Weed index does not necessarily represent the losses in crop production caused by a weed because weeds vary greatly in competitive ability.

Results and Discussion

This report contains information on the infestations of weeds in crops for both the entire state of North Dakota and individual counties. Some tables and information from the 1978 and 1979 surveys are included so comparisons can be made and changes in weed abundance can be documented over a 22 year period. Only the summer survey should be compared to the 1978/1979 surveys because the surveys were taken at similar times.

The weeds are ranked by weed index in the various tables. The 20 most important weeds in 1978, 1979 and 2000 ranked by the weed index and averaged over all crops for the entire state are given in Table 10. Green foxtail remains the most abundant weed species. The spring and summer 2000 surveys and 1978/1979 surveys are composed of mostly the same weeds but the weed rankings differ. The weed index decreased for all weeds except yellow foxtail, kochia, Canada thistle, common ragweed, quackgrass, and common cocklebur. Weeds that were in the top 10 weeds in the spring 2000 survey but not the top 10 weeds of the 1978/1979 surveys were volunteer cereals, canola, eastern black nightshade, and soybean. Weeds that were in the top 10 weeds in the summer 2000 survey but not in the top 10 weeds of the 1978/1979 survey were volunteer cereals, eastern black nightshade, perennial sowthistle, and common milkweed.

Weeds that were in the 2000 survey but not in the 1978/1979 surveys were wild-proso millet, eastern black, hairy, and cutleaf nightshade, biennial wormwood, tall waterhemp, lanceleaf sage, yellow nutsedge, Venice mallow, and swamp smartweed (Table 10). Weeds that were in the 1978/1979 surveys but not in the 2000 survey were nightflowering catchfly and prairie wild rose.

The number of weed-free fields increased from 36% in 1978 and 27% in 1979 to 36% in spring 2000 spring (Table 9) and 54% in summer 2000 (Table 80). Lower weed indexes and weed frequency but higher number of weed-free fields in 2000 as compared to 1979 indicate lower weed problems even though the plant species complex across the state has remained similar.

Green foxtail

Green foxtail was the most abundant weed throughout North Dakota from 1979 to 2000 with 94%, 66%, and 56% of the surveyed fields being infested in 1978/1979, spring 2000, and summer 2000 surveys, respectively (Tables 9 and 80). The average green foxtail density in infested fields was 48 plants /m^2 in 1978, 67 in 1979, 66 in spring 2000, and 56 in summer 2000. Only 1.7% of the total number of quadrats had more than 99 plants/m^2 so the actual average density would have been slightly higher than indicated. The weed index was 236 in 1978/1979, 103 in spring 2000, and 74 in summer 2000.

These results indicate that green foxtail has become less abundant since 1979 but density has changed little in most North Dakota fields. The competition from green foxtail with crops is not as intensive as from weeds like wild oat or wild mustard. However, high green foxtail densities and frequency would indicate that green foxtail causes large losses to the state.

Wild oat

Wild oat occurred in 66% of the surveyed fields in 1978, 60% in 1979, 32% in spring 2000, and 41% in summer 2000, with an average density in infested fields of 9, 7, 19, and 11 in 1978, 1979, spring 2000, and summer 2000, respectively (Tables 9 and 80). The weed index value for wild oat was 69 in 1978, 55 in 1979, 35 in spring 2000, and 39 in summer 2000. Lower occurrence and index value may be due to several years of good control from several effective herbicides registered since 1979.

Plant density in fields were almost twice as high in spring 2000 as compared to 1978 and 1979 indicating high seed bank populations where present in fields. High densities in spring 2000 were from natural emergence but density of 11 plants/m^2 after herbicide treatment demonstrate the ability of wild oat to survive chemical control. It was thought that low densities in 1978 and 1979 were due to late crop seeding and that wild oat densities vary widely based on year, environment, and field history. For example, the wild oat density in Cass county was ten or more times higher in 1980 than in 1978 or 1979.

Yellow foxtail

Green and yellow foxtail often respond differently to herbicides. Yellow foxtail is more difficult to control, so selection pressure from several herbicides has caused a shift to yellow foxtail in many areas of the state. Yellow foxtail occurred in 13%, 33%, 20%, and 30% of the fields and at densities of 18, 20, 31, and 24 plants/m^2 in 1978, 1979, spring 2000, and summer 2000, respectively (Tables 9 and 80). This indicates the occurrence of yellow foxtail is similar but at higher densities than two decades ago.

Waldron (1904) reported in 1903 that foxtail was common throughout North Dakota and that yellow foxtail was more abundant than green foxtail, which demonstrates a shift to green foxtail from 1903 to 1979. In the 1978 and 1979 surveys, green foxtail occurred on 94% of fields and yellow foxtail occurred on 23% of fields, but in the 2000 surveys green foxtail occurred on 60% of the fields and yellow foxtail occurred on 25% of the fields. Even though green foxtail frequencies have decreased considerably, yellow foxtail occurrence have been stable over 20 years, which confirms grower observation that yellow foxtail has become more problematic.

Kochia

Kochia was the sixth ranked weed in 1978 and spring 2000, the fourth ranked weed in summer 2000, and the ninth ranked weed in 1979 (Tables 9 and 80). Occurrences were 25%, 27%, 30%, and 40% and densities were 4, 2, 16, and 8 plants/m^2 in 1978, 1979, spring 2000, and summer 2000, respectively. In 2000, 6.7% of the total number of quadrats had more than 99 plants/m^2 so the actual average density would have been slightly higher than indicated. Kochia thrives in dry climates. Greater than normal rainfall occurred in North Dakota from 1993 through 2000, which would be expected to reduce kochia populations. However, kochia was more abundant and found at greater densities in 2000 than 1979.

Acetolactate synthase (ALS) inhibiting herbicides were introduced in the mid 1980s, and herbicides of this mode of action have been registered in most crops grown in North Dakota, including small grains, corn, soybean, dry bean, field pea and pulse crops, canola, sugarbeet, potato, and alfalfa. Kochia resistance to ALS herbicides was documented within 4 years after introduction for field use. Most fields in North Dakota contain kochia that is ALS resistant, which may explain the higher than anticipated occurrence.

Wild buckwheat

In summer 2000, wild buckwheat had a frequency and weed index similar to kochia, Canada thistle, and pigweed species, but wild buckwheat densities were higher. Frequency of wild buckwheat was 56%, 65%, 46%, and 32% in 1978, 1979, spring 2000, and summer 2000, respectively, and density was 7, 4, 13, and 10 plants/m^2 (Tables 9 and 80). Thus, wild buckwheat occurred half as frequently in 2000 as 1979 but at twice the density. Increasing broadleaf and row crop acreage and greater than normal precipitation in the 1990s may have allowed plants to emerge in high densities.

Wild buckwheat is less competitive with crops than wild oat. Thus, even though infestations were similar to wild oat, the economic losses from wild buckwheat would be less. Wild buckwheat, in addition to yield losses, causes harvesting difficulties as the plant vines cause crop lodging.

Perennial weeds: Canada thistle, field bindweed, perennial sowthistle, and common milkweed.

Canada thistle occurred in 12, 21, 39, and 34%, field bindweed in 10, 18, 13, and 12%, perennial sowthistle in 12, 10, 7, and 8%, and common milkweed in 2, 3, 7, and 9% of the surveyed fields in the 1978, 1979, spring 2000, and summer 2000 surveys, respectively (Tables 9 and 80). Density of field bindweed and perennial sowthistle doubled or nearly doubled from 1979 to 2000 and tripled for Canada thistle and common milkweed.

North Dakota state weed surveys show Canada thistle has continued to increase across the state and now surpasses leafy spurge in number of acres infested (NDDOA 2001, NDDOA 2001). Other surveys conducted in sunflower and dry bean also confirm the dramatic increase in Canada thistle populations (Lamey 2001, Lamey et al. 2001). Above average precipitation beginning in 1993, increase in number of no-till acres, high cost of control, lack of winter snow and moderate winter temperatures may be factors contributing to the increase of Canada thistle infestations.

Pigweed species

Redroot pigweed was the dominant pigweed species. Pigweed species occurred in 45% of the surveyed fields in 1978, 63% in 1979, 26% in spring 2000, and 25% in summer 2000 (Tables 9 and 80). Densities in the field were 4, 2, 15, and 8 plants/m^2 in 1978, 1979, spring and summer 2000, respectively. In 2000, 2.6% of the total number of quadrats had more than 99 plants/m^2, so the actual average density would have been slightly higher than indicated.

Redroot pigweed can produce 178,000 seeds per plant and seeds can remain viable for over five years. Despite small seed size, which normally would result in high densities, pigweed species had a lower density than weeds with larger seeds, such as yellow foxtail, kochia, and wild buckwheat. Redroot pigweed is moderately tolerant to 2,4-D and MCPA at low rates. Information on crop competition from redroot pigweed is available for soybean and sugarbeet. Lack of competition information in small grains make it difficult to estimate economic importance.

Volunteer cereals

Volunteer cereals occurred in no more than 2% of the fields in the 1978 and 1979 surveys but occurred at 15 and 12% in the spring 2000 and summer 2000 surveys, respectively (Tables 9 and 80). Volunteer cereal density was 13 plants/m^2 in the spring 2000 survey and 10 plants/m^2 in the summer 2000 survey, which was much higher than any volunteer crop in the 1978 and 1979 surveys. Volunteer cereals were ranked in the top 10 weeds by weed index for both the spring and summer 2000 surveys but did not appear in the top 20 weeds in the 1978 or 1979 surveys. Thus, volunteer cereals increased in occurrence and densities over the last 22 years.

Common ragweed

Common ragweed was ranked 18th in the 1978 survey, 21st in the 1979, 12th in the spring 2000, and 9th in the summer 2000 survey, which indicates an increase in occurrence (Tables 9 and 80). Broadleaf row crop acreage has increased substantially since 1979 and many herbicides used in row crops do not control common ragweed. Common ragweed is one of the most competitive weeds in soybean compared with other crops surveyed.

Other weeds

A total of 73 weed species were detected in crop fields in the spring 2000 and 71 in the summer 2000 surveys (Tables 9 and 80). This compares to 61 plants species in the 1978 survey and 74 in the 1979 survey. In the 2000 surveys, 50 of the plant species were found on less than 4% of the fields surveyed. Some species that were not discussed but occurred on 4% or more of surveyed fields in either the spring or summer survey were quackgrass, Russian thistle, wild mustard, eastern black nightshade, common sunflower, common cocklebur, field pennycress, prickly lettuce, flixweed/tansy mustard, common mallow, barnyardgrass, common purslane, horseweed (marestail), marshelder, and biennial wormwood. Other crop surveys (Lamey 2001, Lamey et al. 2001) have shown common cocklebur, marshelder, nightshades, and biennial wormwood to be important weeds infesting sunflower and dry edible beans.

The weeds present in the surveyed fields in each county are presented in Tables 14 through 74 for the spring 2000 survey and Tables 81 through 130 for the summer 2000 survey.

Agronomic practices used and characteristics of survey

The major weeds were similar in the various crops in spring and summer 2000 surveys (Tables 2-8, 10-13, and 76-79). The procedure used in the 2000 survey was slightly different than for the 1978 and 1979 surveys. The timing of the 2000 survey was in the spring prior to herbicide application and then again in the summer prior to harvest, which corresponds to the 1978 and 1979 surveys. Weeds found in fields surveyed in the spring would originate from accumulated weed seed banks and from natural emergence without influence from human activity, except for field preparation and planting. Weeds present in the summer would result from escaping herbicide or tillage treatment or germinating after the last weed control treatment.

Green foxtail was the most abundant weed in both spring and summer surveys. Weeds with higher ranking in the summer than spring surveys were wild oat, yellow foxtail, kochia, common ragweed, eastern black nightshade, field bindweed, perennial sowthistle, and common milkweed, indicating that these weeds survived control methods. Several herbicides are less effective on yellow versus green foxtail. Extensive use of ALS herbicides in almost all crops would not control ALS-resistant kochia. Only above-ground control, but not root kill, of the perennial weeds, field bindweed, perennial sowthistle, and common milkweed, results when herbicides are applied in the spring.

Generally, the most abundant weeds in small grains were also most abundant in the other crops. Volunteer cereals were present in most broadleaf crops but was not counted in small grains. In the spring survey, common sunflower in corn, and nightshade and common milkweed in sugarbeet were among the ten most abundant weeds that were not present in small grain. However, the summer survey indicated canola had several weed species that were more abundant as compared to small grain. Wild mustard, giant ragweed, perennial sowthistle, and flixweed/tansy mustard were among the most abundant weeds in canola but not in small grain even though they had similar levels of abundance as small grain. Soybean and dry bean fields had more common ragweed than small grains.

Green foxtail was the most abundant weed in the spring for all crops except sugarbeet, where it was ranked third. Yellow foxtail was ranked first in sugarbeet. In the summer survey, green foxtail was ranked first in small grain, soybean, dry bean, and sunflower but ranked seventh in canola. Wild oat was ranked first in canola.

Weed populations tended to fluctuate less in small grains than in other crops. In the spring survey, most weed populations were lower in sugarbeet than in small grain and were lower in canola than in other crops except wild oat, Canada thistle, yellow foxtail and common lambsquarters in corn, and wild mustard and Canada thistle in sunflower. Compared to small grain, the population of most weeds, including Canada thistle, was higher in flax, soybean and dry beans. Inadequate yellow foxtail control in corn is a common problem reported by growers. Increase in Canada thistle populations in most crops supports state noxious weed survey results conducted each year by the North Dakota Department of Agriculture.

In the summer survey, the population of predominant weeds in canola was greater than in small grains. Yellow foxtail, kochia and Canada thistle populations were lower in soybean than small grains but similar in sunflower compared to small grains. High adoption of Roundup Ready soybean may be responsible for low weed populations in soybean.

The influences of the previous crop on weeds in spring 2000 are presented in Tables 67 through 74. Green foxtail was the weed present in highest frequency. Species composition was similar to the 20 most abundant weeds in North Dakota (Table 10) but there were a few exceptions. Common mallow was the 15th most abundant weed following canola and tame mustard but was not in the top 20 weeds in Table 10. Roundup Ready canola composes over 70% of the total canola acreage in North Dakota. Glyphosate does not adequately control common mallow, which supports the observed and measurable infestation in mustard crops.

Nightshade, common ragweed, common cocklebur, perennial sowthistle, and common milkweed were in much higher abundance following soybean and dry beans than the state average. Most soybean grown in North Dakota are Roundup Ready. Glyphosate applied in the spring does not give season long control of most of the weeds mentioned. Yellow foxtail, common cocklebur, wild-proso millet, and nightshades occurred in higher frequency than in the state average following corn. Nicosulfuron or nicosulfuron&rimsulfuron applied with dicamba have been the most used herbicide combinations in North Dakota but does not control yellow foxtail and wild-proso millet or control multiple flushes of common cocklebur and nightshades.

The 15 most prevalent weeds following flax occurred at much higher frequency than the state average, due probably to the limited number of herbicides registered in flax and the incomplete broadleaf weed control that would result. Flax is much less competitive with weeds than most other crops, which contributes to high weed frequency. Nightshades, common milkweed, common mallow, and lanceleaf sage were more frequent following sugarbeet than the state average, which is due to lack of full spectrum herbicides.

Losses in crop production

Competition data for the 1978 and 1979 surveys are found in Table 131 and data for the summer 2000 survey are found in Table 132. The 1978 and 1979 surveys only contain yield loss data for spring wheat and barley. Similar calculations and assumptions were used to calculate acres infested, yield loss, and grain loss for all surveys. Competition data, when available, from the literature was used to determine the yield losses in hard red spring (HRS) wheat, durum wheat, and barley from the various weed infestations as determined by the 1978, 1979 and summer 2000 surveys.

Losses from weed competition in barley were available for wild oat and green foxtail. HRS wheat yield loss was about 25% for wild oat and variable for green foxtail, depending on environment, density, and emergence in relation to the small grain crop. Losses in barley were assumed to be 25% less than in HRS wheat. The yield losses were determined only from weeds where competition data were available. Competition data for spring wheat were available for only seven weeds in 1979. However, by 2000, competition data for 13 weeds were available, resulting in greater calculated yield and grain loss. HRS wheat and barley data were separated in the 1978 and 1979 surveys but were combined in the 2000 survey.

The composite totals for yield loss and grain loss were calculated using individual values for total state acres and average state yield for HRS wheat, durum wheat, and barley (NDAS 2002). Many important weeds infesting small grains are listed in Table 132, but not included in the HRS wheat, durum wheat, and barley production losses because data on competition at various infestation levels were not found in the literature.

Losses in HRS wheat, durum wheat, and barley

Wild oat caused more production losses in HRS wheat and barley than any other weed in 1978 and 1979 (Table 131). However, in 2000, Canada thistle caused more yield loss than any other weed followed by wild oat, field bindweed, common milkweed, kochia, and green and yellow foxtail combined (Table 132). Canada thistle caused 35.5 million bushel HRS wheat loss in 2000. Canada thistle frequency and density were an average of 14% and 2.9 plants/m^2 in 1978 and 1979 and 32% and 8.2 plants/m^2 in 2000, which resulted in greater small grain competition and yield loss in 2000.

Wild oat frequency was higher in HRS wheat and barley in 1978 than 2000 but density was similar; thus, there was a higher loss in grain in 1978 compared to 2000 (22,551,000 bu vs. 20,852,000 bu). The infestation frequency for Canada thistle, field bindweed, and milkweed was less than wild oat and green and yellow foxtail. However, these three perennial weeds are highly competitive, causing important losses in small grains.

Losses from wild mustard were less in 2000 than 1978 and 1979, due mostly to a significant reduction in infestation in 2000 (Table 131). ALS herbicides registered in many crops easily control wild mustard.

The average total loss in HRS wheat and barley in 1978 and 1979 from the seven weeds listed in Table 131 was 55.6 million bushels. These seven weeds reduced HRS wheat and barley production in 2000 by 83.4 million bushels or 1.5 times more than in 1978 and 1979. The total average yield loss was 14.5% in 1978 and 1979 but was 20.3% in 2000.

Weed competition data generated prior to 1978 were used to calculate yield loss for 2000 even though different wheat and barley varieties were planted and yields have increased since 1979. The state yield average for HRS wheat was 30 bushels per acre in 1978 and 26 bushels per acre in 1979 compared to 37 bushels per acre in 2000. Barley yields increased from 46 bushels per acre in 1978 and 1979 to 55 bushels per acre in 2000. Higher average yield may be due to more effective weed management practices, better cultural practices and fertility management, more favorable growing environment for small grain production, and potentially higher harvest index for HRS wheat and barley varieties grown in 2000.

Less rainfall in 1978 and 1979 (state average of 17 and 14 inches, respectively) compared to 2000 (state average of 22 inches) may also explain difference in yields. Data are not available to determine if small grain varieties grown in 2000 are more competitive against weeds than those grown in 1978 and 1979 so the assumption for calculating yield loss was that varieties grown in 1978 and 1979 were similarly competitive with weeds as the varieties grown in 2000.

Total grain loss from the 13 weeds shown in Table 132 was over 115 million bushel, a two-fold increase from the 55.6 million average bushel loss from seven weeds found in the 1978 and 1979 survey. The additional six weeds increased the percent total yield loss from 14.5% in 1978 and 1979 to 28.1% in 2000.

These losses from weeds were based on individual weed species competition. Losses in HRS wheat or barley fields that were infested with more than one species may have been slightly less than a combined loss of each weed alone. The weeds would compete with each other to reduce the total loss. Green foxtail was the only weed that occurred commonly with other weeds and the percentage losses used for foxtail competition were slightly conservative. The competition among weeds probably did not greatly affect total crop losses.

Weeds present at the summer evaluation may have been injured by herbicide treatment and/or emerged late in the season. Thus, they may not have provided full-season competition as assumed in the calculation, but no research data are available to adjust for these possible variables. The total losses from weeds in small grains would probably exceed those given in Tables 131 and 132 if weeds not listed or competition data not given were considered. The loss of bushels of small grains from weeds in 1978, 1979, and 2000 were from control practices available at those times. The weed surveys were taken prior to harvest and do not indicate what losses would have been without control practices. The total cost of weeds in these crops would also need to include the cost of chemical, tillage, and cultural control practices.

The results of these surveys indicate that perennial weeds have become a greater problem and reduce small grain yields more in 2000 than 1979. The results also show that several weeds continue to infest small grains and cause major production losses.

Losses in canola

Competition information was available for wild oat, Canada thistle, quackgrass, perennial sowthistle, wild mustard, flixweed/tansy mustard (assumed same as wild mustard), and volunteer cereal (Table 132). Combining yield loss data from wild mustard and flixweed/tansy mustard showed a 124,080,000 pound loss in canola production. Canada thistle reduced canola production by 97,717,000 pounds, followed by wild oat at 83,952,000 pounds, and volunteer cereals at 29,832,000 pounds. All seven weeds reduced total canola production by 352,638,000 pounds, or a 21.4% reduction in yield.

Losses in soybean and dry bean

2000 survey results show that soybean and dry bean had a greater percentage loss in production than other crops surveyed (Table 132). Thirteen weeds listed in Table 132 reduced soybean and dry bean yield by 31,692,000 million bushels or a 41.7% reduction in yield. The most competitive weeds in soybean and dry beans were common sunflower and common cocklebur followed by pigweed. Common cocklebur caused the greatest single weed yield reduction of 5.2 million bushels, followed by pigweed at 4.9 million, sunflower at 4.2 million, and common ragweed at 3.4 million bushels.

Losses in sunflower

Seven weeds infesting sunflower caused the second highest reduction in production at 36.8% and a 642,328,000 pound total yield loss (Table 132). Green foxtail and kochia each reduced sunflower production by about 165,000,000 pounds, followed by wild oat at 94,229,000 pounds. Yellow foxtail and volunteer cereals each were similar in reducing sunflower production (about 70,000,000 pounds). Combining wild mustard and canola also reduced sunflower grain production by over 75,000,000 pounds.

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