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NORTH DAKOTA
RESEARCH REPORT

Survey of Wild Oats and Other Weeds in North Dakota 1978 and 1979

Survey supported by North Central Regional and
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Introduction

This survey of wild oats and other weeds was conducted to obtain information needed in order to determine the benefits from diallate and triallate for wild oats control. Diallate is being reviewed by EPA as part of the Rebuttable Presumption Against Registration (RPAR) process and triallate is under consideration for RPAR. Pesticides are considered for RPAR review when there is information indicating possible health or environmental hazards. Reregistration of RPAR pesticides is dependent upon rebuttal of the hazards and/or a favorable benefit-risk analysis. Benefits can be actual or potential benefits so the benefits from herbicides for wild oats control is dependent upon the extent of the wild oats problem as well as present usage of herbicides for wild oats control.

This weed survey will not only provide information on infestations for present herbicide benefit analysis, but will also serve as a basis for determining weed population shifts in the future. Weed surveys give valuable information on the location and extent of infestation by various species which is important to development of weed prevention and control systems.

Methods

The weed survey was conducted during July and August of 1978 and 1979. The objective was to survey approximately 1,400 fields each year. The total crop land in North Dakota was divided by 1,400 giving the acres of crop land each sample would represent. The number of fields to be surveyed in a county was obtained by dividing the crop land acres by the acres each sample represented (11,000). A minimum was established of five samples per county in 1978 and 10 per county in 1979.

Foster and Stark counties were surveyed more intensively than the other counties in 1979. Fields were surveyed on 2 mile grids over these counties. However, a hail storm prevented completion of the survey in Foster County. The complete survey of these counties has been summarized separately (In press).

The state summaries in this report only include one sample per 11,000 acres of cropland from Foster and Stark counties even though more samples were taken. The county summaries for Foster and Stark include all samples.

The individual townships in a county were assigned numbers consecutively starting from northwest to northeast. A list of random numbers was used to select the townships to be sampled. Where the desired number of samples was greater than the number of townships or where the same township number appeared in the random numbers more than once, then more than one field was selected in a township.

Survey sites within a township were selected by beginning at Section 15 and scanning adjoining sections in a clockwise manner until the desired number of acceptable fields were located in 1978. In 1979, the first survey site was located by beginning scanning at section 8. Scanning was at section 8 and 28 for townships where more than one sample was required. An acceptable field had to be at least 40 acres, be planted to wheat, barley, oats or flax, and be accessible by road. In 1979 sunflower was added as an acceptable crop. Townships and fields which were nonrepresentative because of towns, rivers, etc., were not surveyed. The site selection method tended to concentrate the samples toward the center of the townships. The site selection procedure was used so the surveyors did not need to randomize section selection and to reduce travel. Initial field selection was from maps in the county ASC office which indicated the crops present and the farm operator. The farm operators were contacted for approval to enter their fields for the survey counts.

Weedy plants were counted in 0.25 square meter quadrats at 20 locations in the selected field. The 0.25 square meter plant count in sunflower was in a 25 cm wide band over the sunflower row. The first count was 100 steps from a field corner and 100 steps into the field. The other 19 samples were taken every 20 steps in an "M" pattern, with five samples on each line of the "M." Sheets for recording data were provided which listed the most common weeds and left blank space for other weeds. Weeds unidentifiable by the surveyor were listed as unknowns and a weed specimen was sent for identification to the NDSU diagnostic laboratory. After identification, the name of the weed was entered on the data sheet.

A maximum of 99 weeds per 0.25 square meter for an individual weed species was counted and recorded in order to save surveying time. The number of quadrats with no weeds was recorded in a separate line on the data sheets.

The field survey began July 13 in 1978 and July 5 in 1979, after the wild oats panicles had emerged, and continued until the specified number of samples were obtained for each county. The randomly selected field was not surveyable on occasion because the field had been harvested, was in fallow or inadequate in size. Then the surveyors substituted the nearest field which met the requirements of the survey. Wells County in 1978 was not surveyed because a death in the family of the assigned surveyor delayed the survey until harvest was nearly complete. No county summary is given for Wells County and the values used in the maps are estimates based upon weed counts from nearby townships in the adjacent counties.

The state was divided into ten areas and one surveyor assigned each area. Surveyors were given an orientation and training session which covered objectives, procedures and weed identification. The number of fields sampled for the various crops in each county is presented in tables 1 and 2 for 1978 and 1979, respectively.

In 1978 a questionnaire was sent to the operator of each surveyed field in order to determine past cropping practices and herbicide treatments. The returns of the questionnaire were only about 30%. Thus, in 1979 the surveyors interviewed the farm operators at the time of obtaining permission of entry. Further, in 1979 fields were selected randomly, located by on-site observations, and then the operator was located for the interview.

Wild buckwheat and field bindweed, and yellow foxtail and green foxtail were not counted separately in Sheridan, Wells, Eddy, Foster, Burleigh, Kidder, Stutsman, Logan, LaMoure, McIntosh and Dickey counties in 1978. Thus, the values presented for wild buckwheat include field bindweed and no values are presented for field bindweed. Also, the values for green foxtail include both green and yellow foxtail in those counties. Further, quackgrass was not included for these counties in 1978 as the assigned surveyors were not familiar with quackgrass. In 1979, all weeds were identified separately. Wild sunflower and volunteer sunflower were combined and called sunflower in both 1978 and 1979.

This survey was patterned after the ones conducted in Canada by Dr. Gordon Thomas, Agriculture Canada, Research Station, Regina, Saskatchewan.

Definition of Terms Used in Report

County — a political subdivision of the state. North Dakota has 53 counties. Wells County was not surveyed in 1978 and the information was estimates based on adjacent counties. All counties were surveyed in 1979.

Weed frequency — the percentage of the fields surveyed which contained the weed in one or more of the 20 0.25 square meter sample quadrats. "Weed free" in the Weed Species column indicates that at least one of the sample quadrats within a field had no weeds.

Field uniformity (All) — The percentage of the 0.25 square meter sample quadrats which contained the specific weed based on all sampled fields.

Field uniformity (INF) — The percentage of the 0.25 square meter sample quadrats infested with the specific weed based only on fields where the weed occurred in one or more of the 20 sample quadrats.

Weed density (All) — The average weed population or density per square meter based upon all sample quadrats in all sampled fields.

Weed density (INF) — The average weed population or density per square meter based only on infested fields, i.e., 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 the state. The maximum possible was 396 as counts were not made beyond 99 per 0.25 meter square sampling area.

Weed index — A calculated value which gives an indication of the abundance of a particular weed and can be used to make comparisons between years and among crops. The formula used was:

$$\text{weed index} = \frac{(\text{weed frequency}) + (3X\text{field uniformity-all}) + (7X\text{weed density-all})}{3}$$

Weed frequency, field uniformity, in all fields and weed density in all fields were averaged over all weeds in 1978. The ratio of weed frequency:field uniformity:weed density was 1:3:7. Thus these 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 the entire state of North Dakota as well as for individual counties. Maps of the state indicate weed frequency and weed density by county for the major weeds in 1978 and 1979.

The weeds were ranked by weed index in the various tables. The ten most important weeds in 1978 ranked by the weed index and averaged over all crops and the whole state were green foxtail, wild oats, wild buckwheat, redroot pigweed, common lambsquarters, kochia, yellow foxtail, Russian thistle, wild mustard and perennial sowthistle (Table 3). In 1979, the ranking was green foxtail, wild oats, wild buckwheat, redroot pigweed, yellow foxtail, wild mustard, common lambsquarters, Russian thistle, kochia and field bindweed (Table 4). Canada thistle was the twelfth ranked weed in 1978 and eleventh in 1979. Perennial sowthistle ranked seventeenth in 1979 and field bindweed ranked eleventh in 1978.

Green foxtail

Green foxtail was the most abundant weed throughout North Dakota in both 1978 and 1979 with 94% of the surveyed fields being infested. The average green foxtail density in infested fields was 47.5 plants per square meter in 1978 and 67.0 in 1979. The average density would have been larger but counts were limited to 99 plants per 0.25 square meter quadrat. The weed index value was 216 in 1978 and 256 in 1979 indicating that green foxtail was a more important problem in 1979 than 1978. Crop seeding was late in both years, which may have accounted for the high green foxtail infestations. Green foxtail occurred at a high frequency in the surveyed fields over North Dakota except in the southwest. The highest densities were in the east and northeast in 1978 and uniformly high throughout North Dakota with the highest densities in the east central in 1979 (Figures 1 to 4).

These results would indicate that green foxtail is a major weed problem in North Dakota. The competition from green foxtail with crops is not as intensive as from weeds like wild oats or wild mustard. However, the high green foxtail densities and frequency would indicate that green foxtail causes large losses to the state.

Waldron (9) reported in 1903 that foxtail occurred throughout North Dakota where crops were grown and that yellow foxtail was more abundant than green foxtail in North Dakota. In the present surveys, yellow foxtail occurred on 33% or less of the surveyed fields and green foxtail on 94% of the fields. Thus, a shift from yellow to green foxtail occurred over the years.

Wild oats

Wild oats occurred in 66% of the surveyed fields in 1978 and 60% in 1979, with an average density in the infested fields of 9 and 7 plants per square meter, respectively. The weed index value for wild oats was 69 in 1978 and 55 in 1979. Wild oats emergence and growth is greater with cool than warm conditions while a warm environment is more favorable for foxtail. Thus, the higher green foxtail and lower wild oats infestation in 1979 than 1978 probably was related to late crop seeding in 1979. Wild oats occurred throughout North Dakota and the wild oats frequency and density within the counties varied between 1978 and 1979 (Figures 5 to 8). The wild oats frequency was generally highest in the northern and eastern counties. However, frequency was higher in western than eastern counties in 1979. Wild oats densities did not vary greatly among counties. The generally low wild oats densities probably reflects the late crop seeding and the use of herbicides for wild oats control.

1978 and 1979 were both years with relatively late spring crop seeding which caused lower than average wild oats infestations. A weed survey of Cass County conducted in 1980 by North Dakota Department of Agriculture (7) indicated a wild oats weed frequency of 63.3%, an average infestation of 43.5 plants per square meter in the infested fields, and a wild oats weed index of 131.2. In the 1978 and 1979 surveys Cass County wild oats field frequency was 82 and 59%, plants per square meter in infested fields was 1.2 and 4.4, and weed index was 47.6 and 41.6, respectively. Thus, based on the Cass County surveys wild oats infestations vary widely with years and the results from the 1978 and 1979 surveys represent years of lower than average wild oats infestations. The wild oats density was ten or more times higher in 1980 than in 1979 or 1978.

Wild buckwheat

Wild buckwheat had a similar weed frequency to wild oats, but densities were lower for wild buckwheat than wild oats in both 1978 and 1979. Wild buckwheat occurred in 56% of the fields in 1978 and 65% in 1979 with densities of 7 and 4 plants per square meter, respectively. Wild buckwheat occurred throughout the state, with trends for more wild buckwheat in the southwest and east in 1979 and more in the central part in 1978 (Figures 9 to 12). The occurrence of wild buckwheat probably relates to the extensive usage of 2,4-D and MCPA, which do not adequately control wild buckwheat. Wild buckwheat has

been shown to be less competitive with cereal grains than wild oats (6). Thus, even though infestations were similar to those of wild oats, the economic losses from wild buckwheat would be less. Wild buckwheat, in addition to yield losses, causes harvesting difficulties as the plant vines often cause crop lodging. Further, green, moist wild buckwheat growth in grain swaths delays swath drying and may increase moisture in the harvested grain.

Redroot pigweed

Redroot pigweed occurred in 45% of the surveyed fields in 1978 and 63% in 1979. Density of redroot pigweed was 4.3 and 5.8 plants per square meter in 1978 and 1979, respectively. Infestations occurred throughout North Dakota, with a trend for more frequent and dense infestation in the southwest than in the rest of the state (Figures 13 to 16). However, infestations in the southeast and southwest were similar in 1979. Warm temperatures are favorable for redroot pigweed emergence and establishment so the late seeding in 1979 may help explain the high infestations of redroot pigweed. Further, the redroot pigweed may have been plants which survived MCPA or 2,4-D treatment. Redroot pigweed is moderately tolerant to MCPA and to 2,4-D at low rates. Information is not available on competition from redroot pigweed in wheat so the economic importance of redroot pigweed cannot be estimated. Redroot pigweed was reported to cause severe losses in sugarbeets in certain years (2) and smooth pigweed caused severe losses in soybeans (5).

Common lambsquarters

Common lambsquarters occurred in 26% of the fields surveyed in 1978 and 44% in 1979. Common lambsquarters ranked fifth according to the weed index in 1978, and seventh in 1979, even though the occurrence was higher in 1979 than 1978. The weed frequency of wild mustard and yellow foxtail increased more from 1978 to 1979 than common lambsquarters and this caused the change in ranking. Densities in the infested fields were 4.2 plants per square meter in 1978 and 2.8 in 1979. The highest occurrence and density of common lambsquarters in North Dakota was in the north central in 1978 and the south central in 1979 (Figures 17 to 20).

Common lambsquarters is usually controlled by 2,4-D and MCPA. The relatively high infestation of common lambsquarters may have been plants which emerged after or escaped treatment.

Kochia

Kochia was the sixth ranked weed in 1978 and ninth in 1979, with occurrence in 25% and 27% of the fields in the two years, respectively. Densities in the infested fields were 3.5 plants per square meter in 1978 and 2.3 in 1979. Kochia occurred throughout the state, with isolated counties having higher infestation, density and frequency than others (Figures 21 to 24). Kochia occurred in approximately 25% of the fields, which indicates an important loss in crop production since kochia is considered a severely competitive weed. Kochia is moderately tolerant to 2,4-D and MCPA, especially with dry conditions.

Yellow foxtail

Yellow foxtail occurred in 13% of the fields in 1978 and 33% in 1979. Green and yellow foxtail are similar and could be combined when considering competitive effects. However, the two species often have responded differently to herbicides. Distribution maps were not prepared for yellow foxtail, but the data for county infestation indicate that yellow foxtail occurred throughout the state.

Russian thistle

Russian thistle was the eighth ranked weed in both 1978 and 1979, with 22 and 31% of the surveyed fields infested, respectively. The average density on the infested field was 5.2 plants per square meter in 1978 and 4.2 in 1979. Russian thistle was not found in 14 counties in 1978 (Figure 25). However, Russian thistle was found in all counties but Barnes in 1979 (Figure 26). Russian thistle infestations are known to vary from year to year because of environmental conditions. Russian thistle emerges at various times during the growing season and is tolerant to MCPA and moderately tolerant to 2,4-D. These characteristics could account for the infestations at the time of this survey prior to harvest. The Russian thistle which emerges late in the season may cause only slight competition and crop yield losses.

Wild mustard

Wild mustard occurred in 14% of the sampled fields in 1978 and 48% in 1979. Wild mustard occurred in all counties in 1979, with the highest infestation in the southeast and south central part of North Dakota (Figures 27 to 30). Wild mustard has been reported equally as competitive as wild oats and has been a major weed for many years. Wild mustard is effectively controlled by 2,4-D and MCPA, which has reduced its importance in recent years. The higher weed frequency in 1979 than 1978 may relate to crop seeding dates, alternate crops in the rotation and environment. The wild mustard density in infested fields was 3.2 plants per square meter in 1978 and 3.5 in 1979.

Perennial sowthistle, field bindweed and Canada thistle

Perennial sowthistle occurred in 12 and 10%, field bindweed in 10 and 18%, and Canada thistle in 12 and 21% of the surveyed fields in 1978 and 1979, respectively. The density of these three perennial weeds in the infested fields varied from 1.9 to 7.3 plants per square meter. Perennial sowthistle occurred uniformly throughout the northeast three-fourths of the state (Figures 31 and 32). Field bindweed occurred throughout the state except for the northeast part and infestations were highest in the southwest and central North Dakota (Figures 33 and 34). Canada thistle occurred in the northeast three-fourths of North Dakota with highest infestations in the east and north (Figures 35 and 36).

These perennial weeds are known to be very competitive with crops. The occurrence of each of these weeds on 10% or more of the sampled fields indicates an important obstacle to maximizing crop production in North Dakota. Canada thistle and perennial sowthistle usually occur in localized areas in a field. The sampling procedure could have missed detecting infestations in many fields. However, the random sampling procedure indicates an average infestation over the entire area independent of localized infestations. The potential further spread of these perennial weeds is a major concern since present herbicides and cultural control methods in crops are not completely effective.

Waldron (10) in 1904 reported that Canada thistle occurred at about 19 locations in North Dakota, mainly in the northeast. Waldron also indicated that perennial sowthistle occurred in the same area as Canada thistle. In the present surveys, Canada thistle occurred in 12 and 21% of the fields in 1978 and 1979, respectively, and perennial sowthistle occurred in 12 and 10% of the fields in 1978 and 1979, respectively, throughout most of North Dakota.

Volunteer and wild sunflower

Volunteer and wild sunflower were considered together because identification is difficult in the vegetative stage. Sunflower occurred in 12% of the fields in both 1978 and 1979. The survey included sunflower fields in 1979 and volunteer or wild sunflower were not counted in these fields. Thus, the per cent sunflower infestations averaged over all crops was biased downward in 1979 and the infestations in the cereal grains and flax were actually higher in 1979 than 1978. Sunflower acreage has been increasing and fields with volunteer sunflower also can be expected to increase. Sunflower is controlled by 2,4-D and MCPA and the infestation may represent untreated plants, stunted plants surviving treatment, or late emerging sunflower. Areas infested with sunflower varied each year with a general infestation in 1979 and localized infestation in 1978 (Figures 37 and 38).

Nightflowering Catchfly

Nightflowering catchfly was 14th ranked weed in 1978 and 19th in 1979. The weed occurred in 7% of the fields in both years. Nightflowering catchfly occurred mainly in the north, east, and far west in North Dakota (Figures 39 and 40). Nightflowering catchfly is tolerant to most presently used postemergence herbicides. Thus, even though infestations are presently limited, the potential exists for future spread of the infestations with present agronomic practices.

Other weeds

A total of 61 different weed species were detected in the crop fields surveyed in 1978 and 74 in 1979. Many of these weeds occurred only occasionally and/or under unusual situations and may not be a potential problem. Some weeds not discussed above which occurred in 2% or more of the surveyed fields in either 1978 or 1979 were prostrate pigweed, prostrate spurge, wild rose, quackgrass, field pennycress, common cocklebur, ragweed, common purslane, flixweed, dwarf mallow, common milkweed, barnyardgrass, shepherdspurse, greenflowering pepperweed, marshelder, yellow woodsorrel, smartweed, skeletonweed and prickly lettuce.

The major weeds were similar in the various crops in 1978 and 1979 (Tables 5 to 15). Thus, the data from 1978 and 1979 for the ten weeds with the highest index were combined for each crop and presented in Table 14.

The ten most abundant weeds in wheat were also most abundant in the other surveyed crops, except Canada thistle and perennial sowthistle were in the top ten for barley in place of Russian thistle and field bindweed; and sunflowers had Canada thistle in place of field bindweed. Barley and sunflowers are grown more in the eastern part of North Dakota than the west. Field bindweed was more prevalent in the west and Canada thistle more prevalent in the east. Thus, the primary location of the crop in the state helps explain the variation in ranking of weed abundance.

Green foxtail was the most abundant weed in all crops. Wild oats ranked second for wheat and barley, third in oats, and lower in flax and sunflowers. Delayed seeding is known to reduce wild oat populations so the common practice of late seeding of flax may have caused reduced wild oat populations. The widespread use of trifluralin and cultivation probably explains the lower wild oat populations in sunflowers. Weed populations in general tended to be lower in sunflowers than in other crops except for wild mustard. Herbicide treatments most commonly used for sunflowers do not control wild mustard, which may explain the increased abundance of wild mustard in sunflowers compared to levels in other crops. Wild mustard was more abundant in oats and flax compared to wheat and barley, probably because phenoxy herbicide use is lower in oats and flax. Wild buckwheat ranked third in wheat and barley and second in oats and flax. The abundance of wild buckwheat was greatest in oats but wheat, barley and flax all had relatively high infestations.

The weeds present in the surveyed fields in each county are presented in Tables 15 through 68 for 1978 and Tables 69 through 119 for 1979. The data on weed infestations in Foster and Stark counties, which were intensively surveyed in 1979 are presented in Tables 82 and 111, respectively. The maps presented in the figures give information on the distribution of major weeds by counties. The distribution of the various minor weeds can be determined from the county tables.

Agronomic practices used and characteristics of survey

The eleven weeds with the largest weed index in semidwarf and normal height wheat fields surveyed in 1978 and 1979 are presented in Table 120. In 1979 the same eleven top weeds occurred in semidwarf and normal height wheat. In 1978 volunteer sunflower was in the top group with semidwarf wheat while wild mustard appeared only with normal height wheat. Normal height wheat was grown more in the western part of North Dakota and semidwarf more in the eastern part. Thus, differences in weed infestations in the two wheat types may be more from location than type of wheat. The green foxtail index was higher in normal height wheat than semidwarf in 1979 and higher in semidwarf wheat than normal height wheat in 1978. Wild oats had a higher index rating in semidwarf wheat than in normal height wheat in both 1979 and 1978. Unpublished research results from North Dakota State University indicate that foxtail and wild oats are similarly competitive with semidwarf and normal height wheat, but wild oats produced more seed when grown in semidwarf wheat.

The influence of the previous crop on the eight weeds with the largest weed index in wheat in 1979 is presented in Table 121. Green foxtail index was lowest in wheat which followed sugarbeets and highest when wheat followed barley or oats in the rotation. The foxtail index was similar when wheat followed fallow, wheat, sunflower, beans or potatoes in the rotation. Redroot pigweed index was the highest, 117, in wheat which followed sugarbeets in the rotation. The redroot pigweed index was less than 69 in wheat which followed any crop other than sugarbeet. The high redroot pigweed index the year following sugarbeet reflects the importance of redroot pigweed in sugarbeets. Volunteer and wild sunflower were considered together. The sunflower index was 40 in wheat following sunflower in the rotation and was 20 following beans. However, sunflower only occurred in the top eight weeds when wheat followed sunflowers or beans. The high index for sunflowers as a weed following sunflower as a crop probably was due to volunteer tame sunflowers while sunflowers following beans were wild sunflowers, which commonly infest beans. The wild oats index rating was the highest in wheat following potatoes in the rotation and lowest following sugarbeets. Wild mustard occurred with a similar index in wheat following all crops in the rotation. Even though wild mustard did not occur in the top eight weeds when wheat followed sunflower or sugarbeet in the rotation, the index was 15 and 10, respectively.

Herbicide usage was mainly at the low correct to correct rate of application. From 22 to 37% of the triallate, EPTC, triallate plus trifluralin and barban was applied at

less than the rate generally considered correct (Table 122), while less than 12% of any herbicide was used at higher than the rate considered correct. The month of herbicide application differed with the herbicide (Table 122). Most postemergence herbicide applications were in June in 1979 while much of the soil applied herbicides were applied in May.

Wild oats was listed as the worst weed problem by the survey respondents in both 1978 and 1979 and was also listed as the most important weed prior to 5 years ago by the 1978 survey respondents (Table 123). However, only 36% of the respondents listed wild oats the most important weed in 1979 compared to 53% in 1978 and 61% for prior to 5 years ago. Foxtail, field bindweed and Canada thistle all had a higher per cent of most important weed ratings in 1979 than previously.

Delayed crop seeding for wild oats control was practiced by 59% of the 1,023 individuals responding to the delayed seeding question in 1979 and by 71% of the 215 respondents in 1978. Delayed seeding was used for all crops to control wild oats, but flax was delayed seeded by a higher percentage of survey respondents than any other crop (Table 124). Foxtail was listed as the worst weed by 23% of the respondents practicing delayed seeding and only by 10% of those not practicing delayed seeding. Wild oats was listed as the worst weed by 54% of the respondents practicing delayed seeding and by 60% of those not practicing delayed seeding. These results indicate that foxtail becomes more important as wild oats is controlled by delayed seeding. The shift to foxtail with delayed seeding probably occurs because foxtail is a warm season weed that gains a competitive advantage with the higher temperatures at late seeding. The respondents indicated a 12% greater usage of delayed seeding for wild oats control in 1978 than in 1979. Spring warming in 1979 occurred very late, which probably prevented further seeding delays for wild oats control.

The number of tillage operations in the spring by respondents who practiced delayed seeding for wild oats control varied from one to five, with 48% indicating two tillages in 1979 (Table 125). The average number of spring tillages by respondents practicing delayed seeding was 2.1 compared to 1.9 spring tillages by all respondents including those practicing delayed seeding. The number of spring tillages was 1.7 when the responses from those practicing delayed seeding were subtracted from the total responses. Thus, 0.4 extra tillages was practiced by respondents using delayed seeding compared to those not indicating a practice of delayed seeding. The late spring in 1979 may have reduced the amount of tillage possible for delayed seeding for wild oats control in addition to reducing the practice of delayed seeding. Wheat planting was less than 2% on May 10 in 1979 compared to 25 to 36% for the average between 1970-79 (7). Summerfallow fields most frequently received four tillages, with 30% of the respondents reporting four tillage operations for fallow (Table 125). Sixty-two per cent of the respondents indicated that only one tillage was performed in the fall after harvest.

A double disk press drill was used to seed small grains and flax by 96% of the survey respondents during 1978 and 1979 (Table 126).

The field cultivator was reported used more than any other tillage implement for spring seedbed and summerfallow tillage by survey respondents in 1978 and 1979 (Table 127). Fallow fields were also tilled with a chisel plow by 37% of the respondents. Fall tillage was performed to a similar extent by moldboard plow, chisel plow and field cultivator with 31, 29, 26% usage by survey respondents, respectively.

The number and percentage of survey respondents indicating the number of times a tillage implement was used for spring and fall tillage in 1978 are presented in Table 128.

The most frequently used fallow time interval for respondents using fallow was once every fourth year (Table 129). Fifty-nine per cent of the 1978 respondents indicated fallow every fourth year, 24% every other year and 16% every third year.

The number and per cent of the 1979 surveyed fields which followed various other crops is presented in Table 130. Wheat preceded all non-wheat fields in the survey, more often than any other crop probably reflecting the large acreage of wheat in North Dakota. Wheat fields were preceded by summerfallow most often, as 50 per cent of the respondents indicated that surveyed wheat fields were on summerfallow.

In addition to information on tillage, weeds and crop rotations in the various surveyed fields, information was also obtained relative to the respondent and his farming operation in 1979. The surveyed fields had been farmed by the same operator for 1 to 10 years by 30%, for 11 to 20 years by 23% and for 21 to 30 years by 25% of the respondents. One per cent of the respondents had farmed the same field for over 50 years (Table 131). The size of the farm operation for 67% of the survey respondents was between 321 and 1,600 acres and 1% exceeded 5,501 acres (Table 132). The age distribution of the survey respondents is presented in Table 133. Seventy-one per cent of the respondents were between 31 and 60 years old. Only 14% of the respondents were less than 30 years old and 15% were over 60.

Losses in wheat and barley production based on weed survey data, 1978 and 1979

Competition data from the literature was used to determine the yield losses in wheat from the various weed infestations as determined by the 1978 and 1979 surveys. Losses from weed competition in barley were only available for wild oats and loss in barley was about 25% less than in wheat. Thus, losses in barley from all weeds were assumed 25% less than in wheat. The crop production losses were determined only from the weeds for which competition information was available. Redroot pigweed, common lambsquarters, kochia, Russian thistle and perennial sowthistle were all weeds which were important in the survey, but were not included in the wheat and barley production losses because data on competition at various infestation levels were not found in the literature.

Wild oats caused more wheat production losses than any other weed in both 1978 and 1979 (Table 133). However, green foxtail caused wheat yield losses nearly equal to wild oats in 1979. Wild oats caused a 17,014,000 bushel wheat loss in 1978 and a 13,130,000 loss in 1979. The weed survey of Cass County (8) conducted in 1980 indicated that the wild oats density was 10 times higher than in 1979. These results indicate that losses from wild oats could vary widely from year to year. If Cass County was representative of the state, then the percentage loss in wheat from wild oats would have been 26% in the infested field compared to 7.6% which occurred in 1979. The 1980 wheat loss for wild oats would have been 61,292,000 bushels, assuming that Cass County was representative of the state, and field infestation frequency and wheat production was as in 1979.

Green foxtail caused a 8,475,000 bushel wheat loss in 1978 and 13,018,000 loss in 1979. Green foxtail caused a 2,653,000 and wild oats a 5,537,000 bushel loss in barley in 1978. However, the barley yield loss was greater from green foxtail than from wild oats in 1979, with 3,895,000 and 2,816,000 bushel yield loss, respectively. Wild oats and green foxtail caused the highest losses of the weeds presented in Table 133, except for Canada thistle, which caused similar losses in barley in 1979.

The infestation frequency for Canada thistle and field bindweed was less than for green foxtail or wild oats. However, Canada thistle and field bindweed are highly competitive, thus causing important losses in wheat and barley production. Canada thistle caused more than a 6,000,000 bushel wheat and 3,000,000 barley loss each year. Thus, Canada thistle was the third most important weed in reducing North Dakota wheat and barley production.

Wild mustard caused less than a 3 million bushel wheat loss in either year. Wild mustard is similarly competitive to wild oats, but the wild mustard infestation frequency was less than that for wild oats. The low frequency of wild mustard probably is a result of the extensive use of 2,4-D and MCPA which effectively control wild mustard.

The total wheat loss from only green foxtail, yellow foxtail, wild oats, wild buckwheat, wild mustard, field bindweed and Canada thistle was 41,712,000 bushels in 1978 and 44,154,000 bushels in 1979 (Table 134). These weeds caused an average wheat yield loss of 14.3% in 1978 and 17.0% in 1979. The above weeds caused a barley loss of 13,446,000 bushels or 11.7% in 1978 and 11,818,000 bushels or 15.1% in 1979.

The above losses from weeds were based upon individual weed species competition. Thus, losses in wheat or barley fields which 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 probably was the only weed which occurred commonly with other weeds and the percentage losses used for foxtail competition were conservative. Thus, the competition among weeds probably did not greatly affect total crop losses. The total losses from weeds in wheat and barley would probably exceed those given in Table 134 if weeds not listed were considered. The 44,154,000 bushels of wheat and 11,818,000 bushels of barley loss from weeds in 1979 are losses which occur with present control practices. The weed surveys were taken prior to harvest and thus 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 (delayed seeding) control practices.

The results of the survey indicate that progress has occurred in reducing the importance of wild oats in North Dakota. However, wild oats, foxtail, field bindweed and Canada thistle are still major problems in wheat and barley as well as other crops in North Dakota.

Losses in sunflower production based on the weed survey data, 1979

Results from the 1979 survey of sunflowers indicated that weeds cause important production losses. The sunflower production losses in 1979 were estimated as 72.0 million pounds from wild mustard, 19.2 million from wild oats and 62.0 million pounds from foxtail. Losses were estimated only for weeds previously included in sunflower-weed competition experiments at North Dakota State University (unpublished data). Surveyed weeds were those that survived herbicide treatment. A 1978 survey indicated that 88% of the sunflower acreage was treated with herbicides. Thus, sunflower yield losses from competition from only three weeds was 153 million pounds in North Dakota in 1979.

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