

2006 National Sunflower Association Survey: YIELD, CULTURAL PRACTICES AND YIELD LIMITING FACTORS

Duane R. Berglund

Professor Emeritus and former Extension Agronomist, Dept. of Plant Sciences, North Dakota State University, Fargo, ND 58105

Introduction:

A field survey was conducted in September and early October over six states in the Great Plains region which was similar to a 2003 and 2005 survey in the same area (2, 3). Yield and plant population were estimated and class (oil or confection), use of certain cultural practices, weed intensity, insect damage, bird damage, lodging, and disease levels (incidence or severity) were recorded. Seeds from each field surveyed were sampled for subsequent laboratory determination of seed damage.

Materials and Methods: One field was surveyed for every 10,000 acres in each state and county, based on the planted sunflower acres in 2006 as determined by Farm Service Agency and other state estimates. Teams of two or three persons surveyed a predetermined number of fields in specific counties in each state. Training materials from the 2005 season were used as provided previously. The location of each field surveyed was determined using a hand-held GPS unit. Fields were surveyed in Colorado, Kansas, Minnesota, North Dakota, South Dakota and Texas.

Yield estimations were made by determining harvestable plant population, head diameter, seed size, percent good seed and center seed set. The estimations were made in two locations in each surveyed field, each consisting of two 25 foot measured rows, or two 5 x 25 foot measured areas in solid seeded or narrow rowed sunflower fields. The areas used for yield estimations were selected as typical of the field. Survey teams were instructed to walk at least 150 feet into a field beyond the headland rows. The following was recorded: class of sunflower, row spacing (20" or less and 21" or greater), tillage was listed as no till, minimum till or conventional till. No till was defined to have no soil disturbance, and minimum till to have only slight soil disturbance. Data on plant population and estimated yield calculations were entered on a data recording form that also listed 29 common weeds and their prevalence. The 29 common weeds evaluated were annual smartweed, biennial wormwood, Canada thistle, cocklebur, common lambsquarters, devil's claw, kochia, lanceleaf sage, marshelder, nightshade, Palmer amaranth, puncture vine, redroot pigweed, Russian thistle, common ragweed, giant ragweed, water hemp, wild buckwheat, wild mustard, wild sunflower, wollyleaf bursage, barnyard grass, downy brome, field sandbur, green foxtail, yellow foxtail, quackgrass, volunteer grain, and wild oats. In 2005, weeds were assessed as 0= none; 1= light (species found in the field) 2= moderate (1 plant per 1 ft of 30 inch row or 3 plants for grassy weeds); and 3= heavy (more than 1 plant per 1 ft of 30 inch row or over 3 for grassy weeds); Data was entered on the same data recording form used to record plant population, yield, and the major yield-limiting factor.

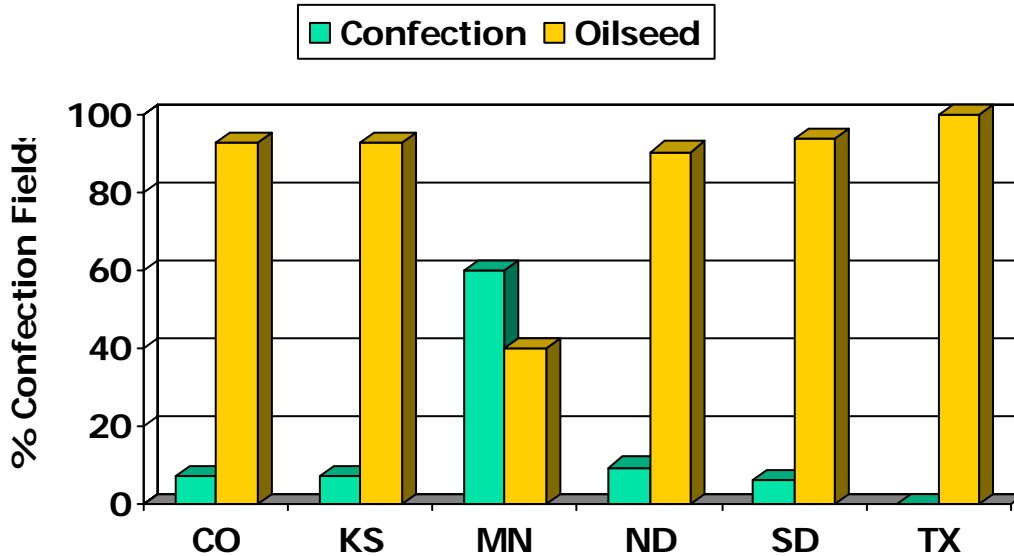
The major yield limiting factors (Number 1 and Number 2) were determined for each field. Yield-limiting factors included: no problem, birds, disease, drought, drown-outs, hail, herbicide damage, insects, lodging, plant spacing, population and weeds. The form provided space to indicate the two most yield-limiting factors.

Diseases surveyed included Sclerotinia (wilt, head rot, mid stalk rot), Phomopsis, Phoma, Rhizopus head rot, Downy mildew, charcoal rot, Verticillium wilt and red rust. Red rust was identified for severity (percent leaf area infected) using rust assessment illustrations and diseased leaf samples were sent in to the USDA-ARS lab in Fargo, ND to check for new races. All other diseases were assessed for incidence (percent infected plants). Data on lodging incidence also were assessed. Fifty plants in three groups of 17, 17 and 16 plants were examined to make disease and lodging assessments. Data were entered on a data recording form for disease and lodging. Damage assessment illustrations were used to assess midge and bird damage at both field edge and internal areas of each field. Stalks were split open and data recorded on percent of plants infested with the spotted sunflower stem weevil and the long-horned beetle. Seed samples from five consecutive heads of plants in interior of each field were taken for analysis in the USDA sunflower insect laboratory in Fargo, ND to determine damage from seed weevil, banded sunflower moth, sunflower moth, and brown spot (confection only). All field data was entered on a data recording form for bird and insect damage. One person on each team served as recorder. Data from each survey team was transmitted electronically to Duane R. Berglund, project leader for processing.

All data was also forwarded to Larry Kleingarter at the National Sunflower Association and to each state survey leader. Each state's master spreadsheet was transmitted to Janet Knodel, Extension Entomologist at North Dakota State University, who constructed maps using the GPS coordinates as reported by the various teams to identify field locations on data reported.

Results, All States: A total of 162 fields were surveyed in 2006 compared to 146 in 2005. Surveys and number of fields per state were as follows: Colorado, 13; Kansas, 15; Minnesota, 10; North Dakota, 84; South Dakota, 34; and Texas, 6. The percent of oilseed fields surveyed was as high as 100% in Texas, 94% in South Dakota, 93% in Colorado, 91% in North Dakota and 93% in Kansas. The percent of confection fields surveyed was highest in Minnesota at 60% which had 40% in oilseed sunflower.

Figure 1. Oilseed and Confection Sunflower Acres-2006



Estimated yields and plant populations: State average yield estimates in 2006 ranged from 1409 lbs/A in North Dakota, 1939 lbs/A in Minnesota, 1157 lbs/A in South Dakota, 1509 lbs/A in Colorado, 1944 lbs/A in Kansas and 1285 lbs/A in Texas. In general, 2006 yields were lower in both North Dakota and South Dakota than in 2005 and can be attributed to the drought in each state. In Colorado, yields in 2006 were down about 190 pounds per acre compared to the previous year. Yields in 2006 were almost 300 pounds higher in Minnesota compared to 2005.. Plant populations at harvest in both North Dakota and Minnesota were greater than any of the states to the south. South Dakota had the lowest populations reported which had a drier season. Plant populations in Kansas, Colorado and Texas all were at or below 15,000 plants per acre which is on the lower desired level when grown under irrigation.

Figure 2. Sunflower Yields and Plant Population-2006

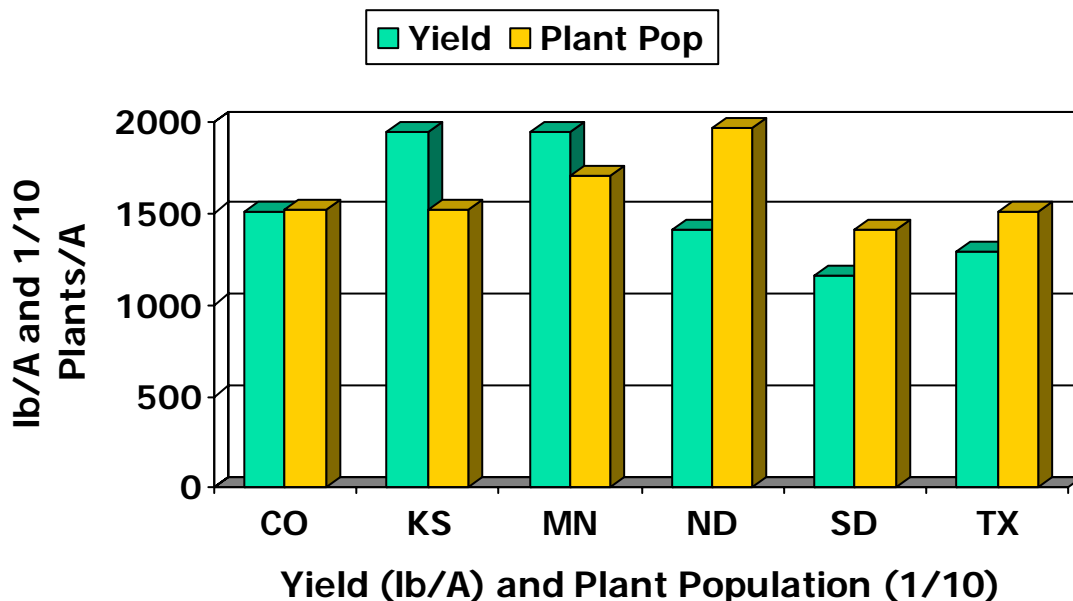
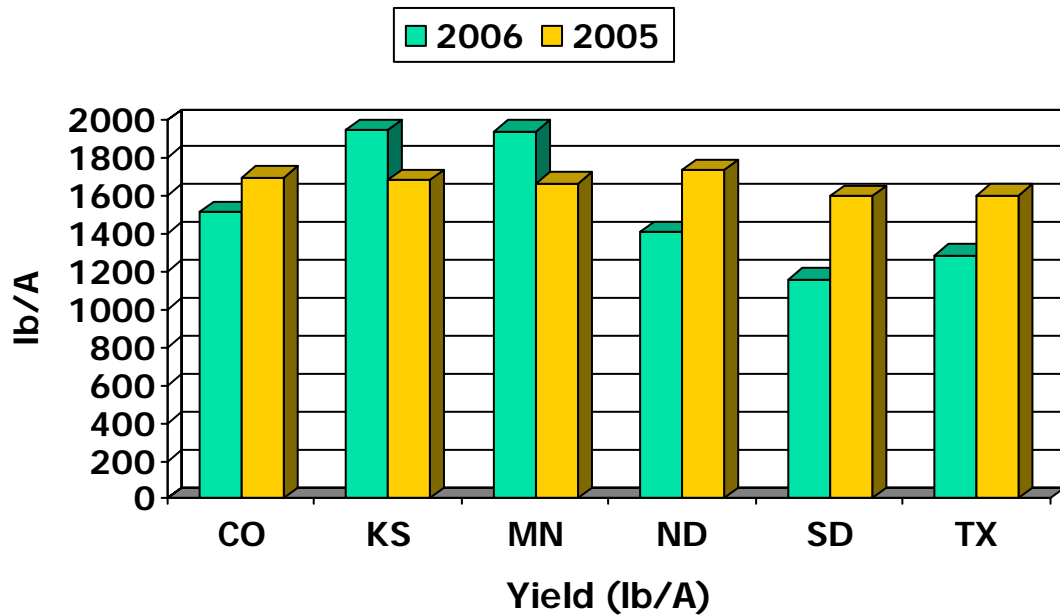
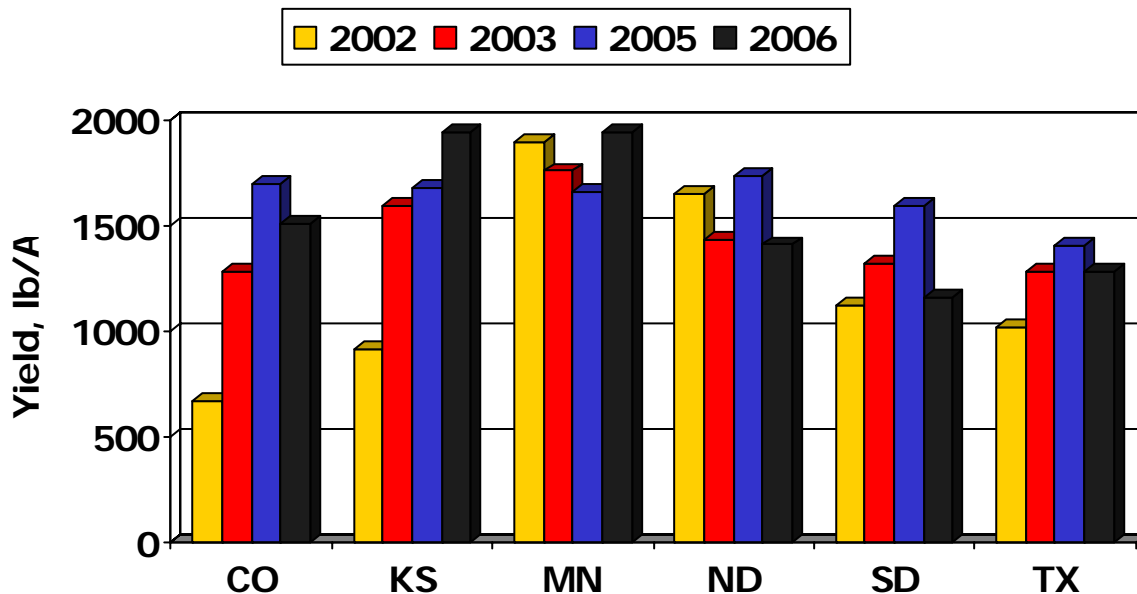


Figure 2A. Sunflower Yields in 2005 vs. 2006



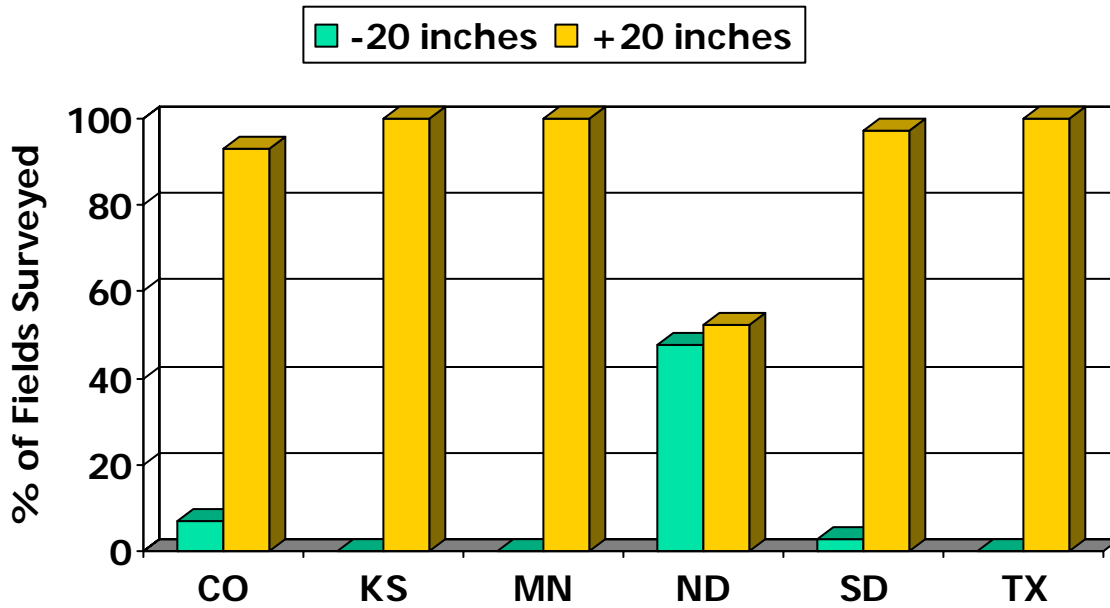
Previous Sunflower Survey Yields Reported: It can be noted in Figure 3 that sunflower yields have continued to improve in the states to the south of the Dakota's from 2002 to 2006 (Colorado, Kansas, South Dakota and Texas) since the sunflower surveys were instituted. Both South Dakota and Colorado dropped some in yields last year due primarily to drought. In North Dakota the yield drop in 2006 was caused by dry conditions and was similar to yields in 2003 which had yield reductions due to high incidences of white mold or sclerotinia head rot.

Figure 3. Sunflower Survey Yields during 4 years.



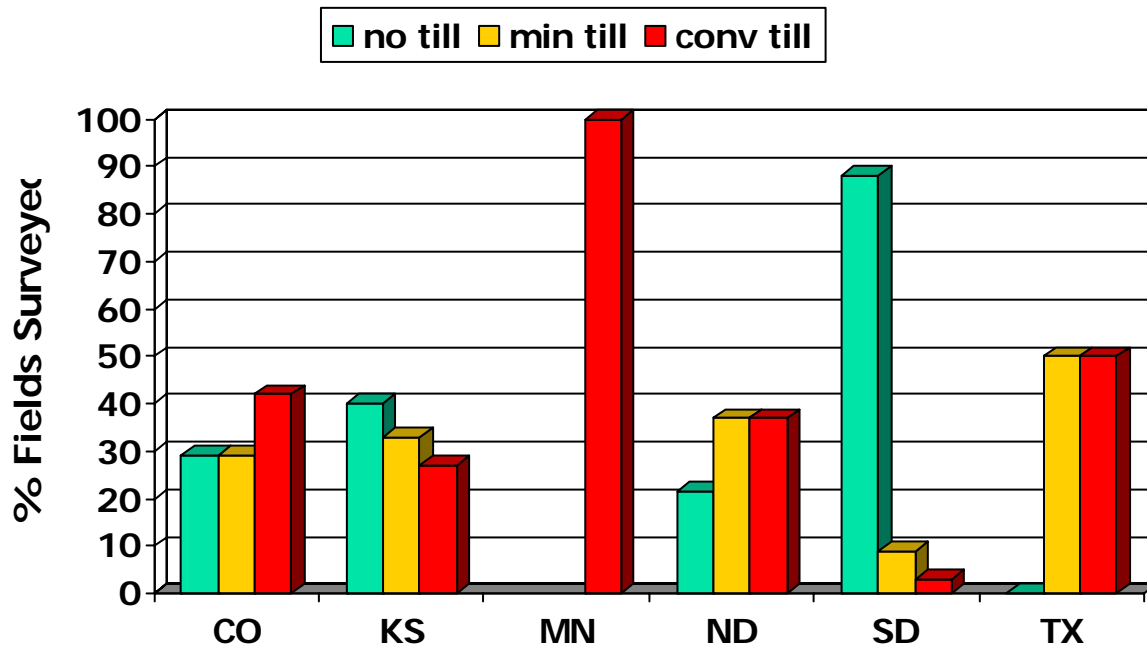
Row spacing: The majority of fields were planted with row spacing greater than 20 inches. In Colorado and South Dakota, only 8 % and 3 % respectively of fields surveyed had a row spacing of less than 20 inches. In North Dakota, 47 % of fields surveyed had narrow row spacing < 20 inches. In Minnesota, Kansas and Texas all fields sampled had wide row spacing of >20 inches.

Figure 4. Row Spacing in Sunflower-2006



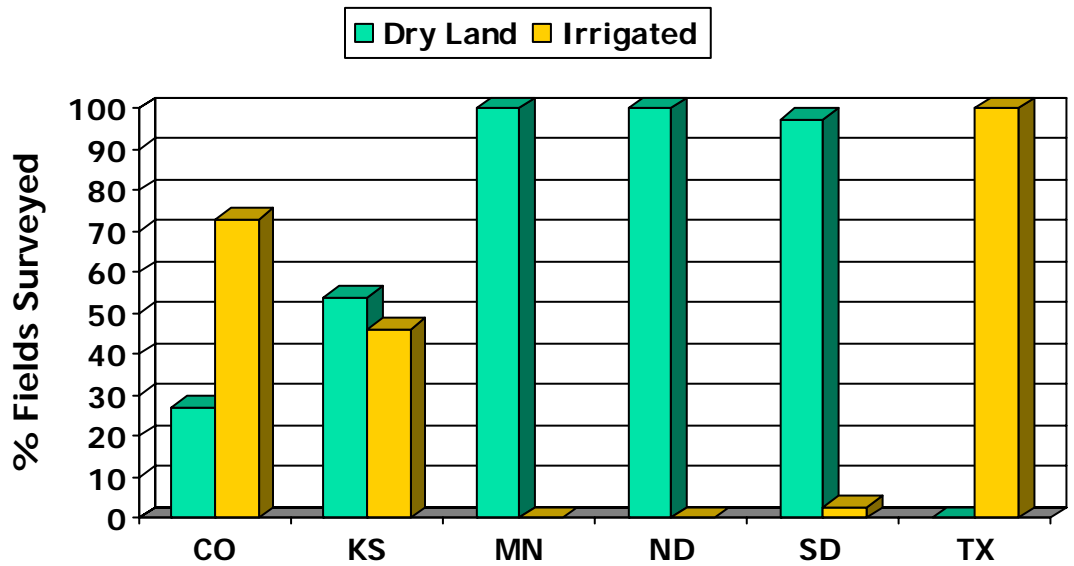
Tillage Practices: Conventional till was used in 100% of Minnesota fields surveyed, 37 % of North Dakota fields, 50 % of Texas fields, 42 % of Colorado fields, 3 % of South Dakota fields and 27 % of Kansas fields. Minimum till was reported as 33 % Kansas fields, 37 % of North Dakota fields, 50% of Texas fields and 29% of Colorado fields. No till was used on 88 % of South Dakota fields which was the highest of any state reported, followed by Kansas with 40 %, Colorado 29 % and North Dakota with 22 %. These percentages of no till acres are the highest ever reported in any and all prior sunflower surveys.

Figure 5. Tillage practices in 2006 Sunflower survey



Irrigated Sunflower Acres: North Dakota and Minnesota reported no irrigated sunflower and only one field was identified as irrigated in South Dakota. The highest reported state with irrigated sunflower production was Texas with 100 %, Kansas with 45 % and Colorado with over 70 %. These three more southern states tend to be in drier growing regions with higher evapo-transpiration demands thus respond to irrigation rather than being just rainfed.

Figure 6. Irrigated Sunflower in 2006 Survey



Yield-limiting factors: The number one yield-limiting factor had a common thread in several of the drought-stricken states. Drought was the major yield-limiting factor in 30 % of North Dakota fields, 60% of Colorado fields, and 62 % of South Dakota fields in the survey. In Minnesota, diseases in 30 % of the fields and weeds in 30% of the fields were reported as the major problems observed. In Texas, plant spacing was the primary problem followed by lodging. In Kansas the major yield reduction problems identified were weeds and drought. In South Dakota plant population problems were found to be the second most damaging to yields. Plant population, weed problems, disease and birds were also identified in North Dakota but were a problem in 10 % or less of the fields surveyed as a major problem. It should be noted that birds were only listed in North Dakota as being a yield reducing problem and not in the other states in the survey.

Figure 7. Major Yield Limiting factors in sunflower-2006

North Dakota and Minnesota

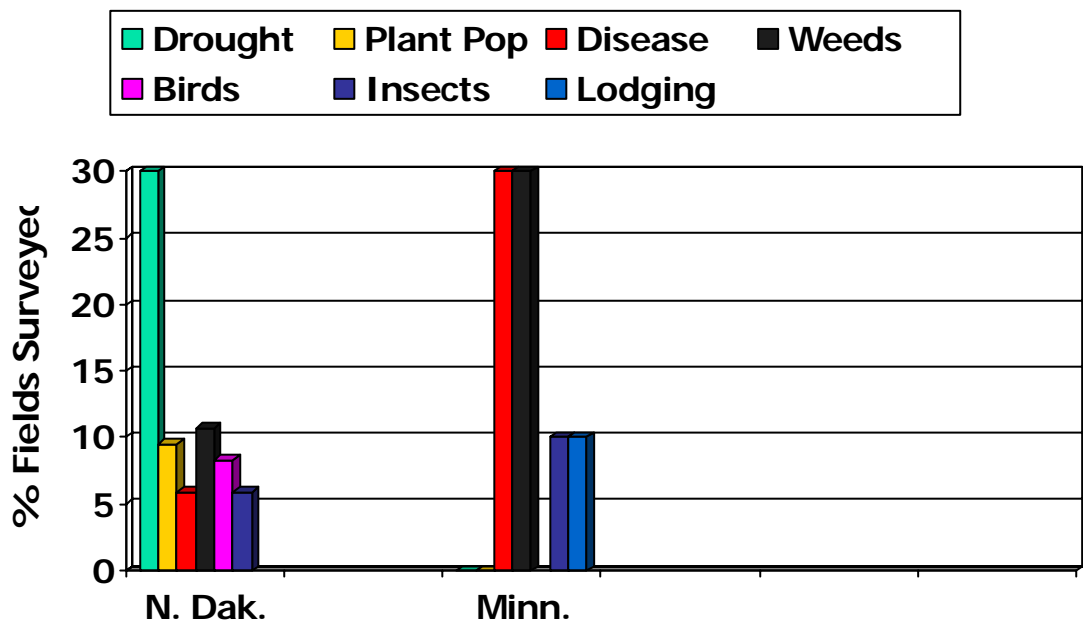
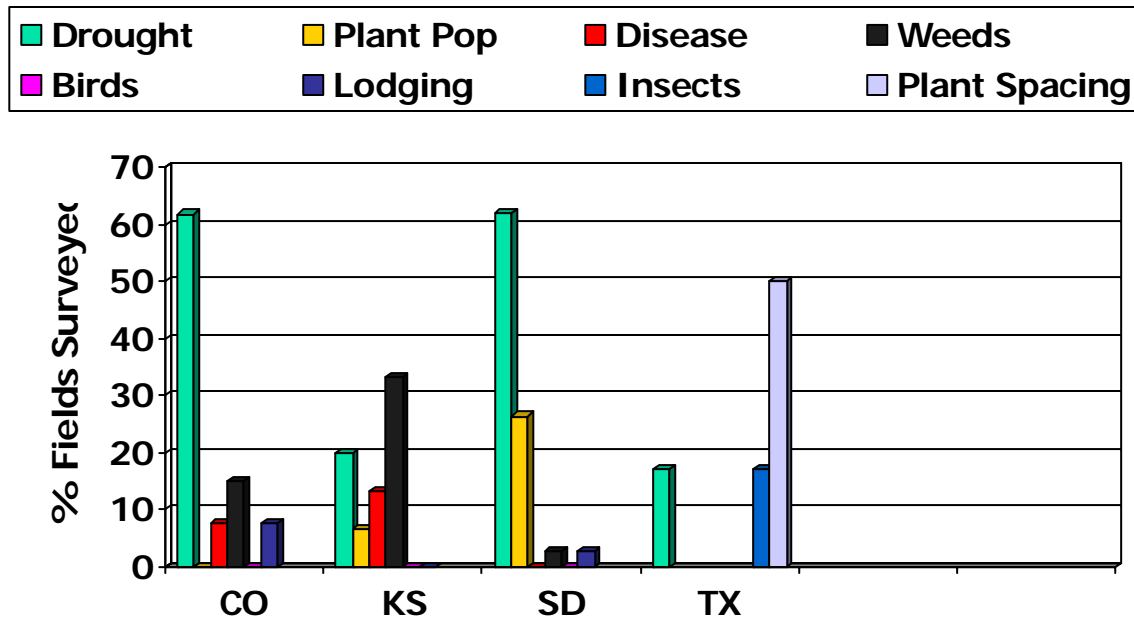


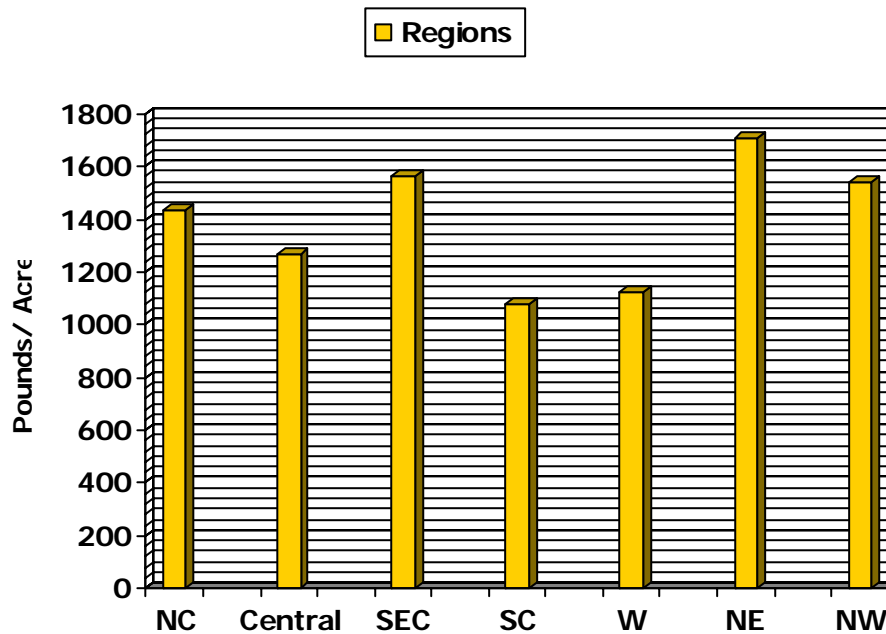
Figure 8. Major Yield Limiting factors in sunflower-2006

South Dakota, Kansas, Colorado and Texas



North Dakota Sunflower Yields by region: Sunflower yields were reported to be highest in the NE, with over 1700 lbs/A reported. The other two high yielding regions reported were the SEC and the NW regions with averages just under 1600 lbs/A. The other reported regions had some problems primarily with drought impact and poor stands. National Agricultural Statistics Service-USDA reported that 2006 that North Dakota's statewide average yield of sunflower was 1143 lb/A. This was considerably less than the survey results and can be explained by the survey not covering all the planted acres in the south central and the southwest parts of the state.

Figure 9. Sunflower Yields in 2006 by region reported by survey teams



Sclerotinia Disease: Sclerotinia (wilt, head rot and mid stalk rot) was not a serious problem in 2006 due to the dry weather and drought conditions in many sunflower production areas. Only in Colorado was the head rot of sclerotinia of any real importance this past year. Most states reported a low incidence of the wilt and mid stalk rot. However, in previous surveys as shown in Figure 11 the head rot disease was much more serious in reduction of yields and incidence. The percent of sclerotinia head rot in Minnesota went from 3% in 2003 to 12% infection reported in 2005. North Dakota had only a slight increase reported and South Dakota remained with the same incidence as 2003

Figure 10. Sclerotinia Disease in 2006 Sunflower Survey

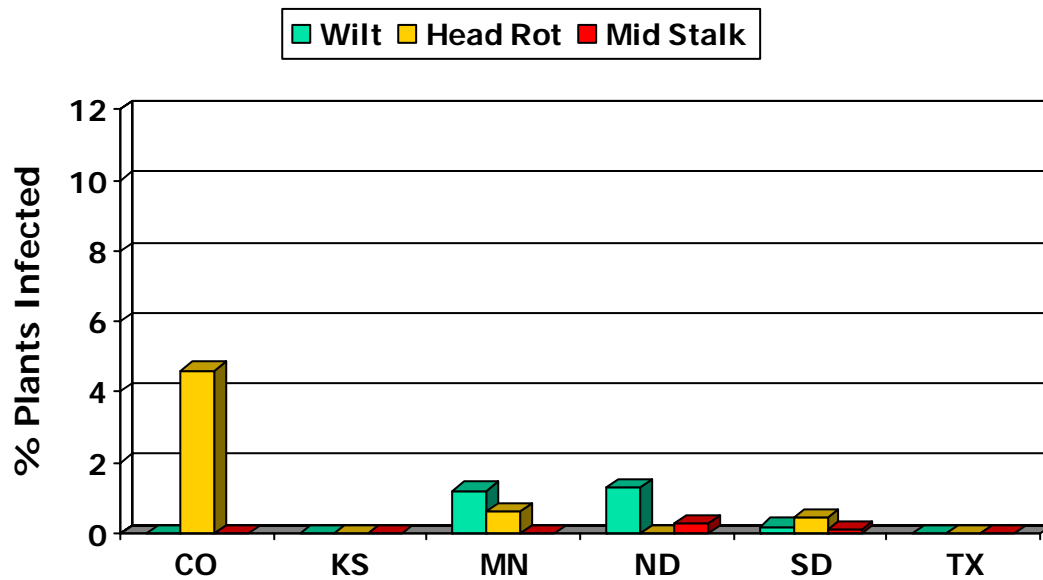
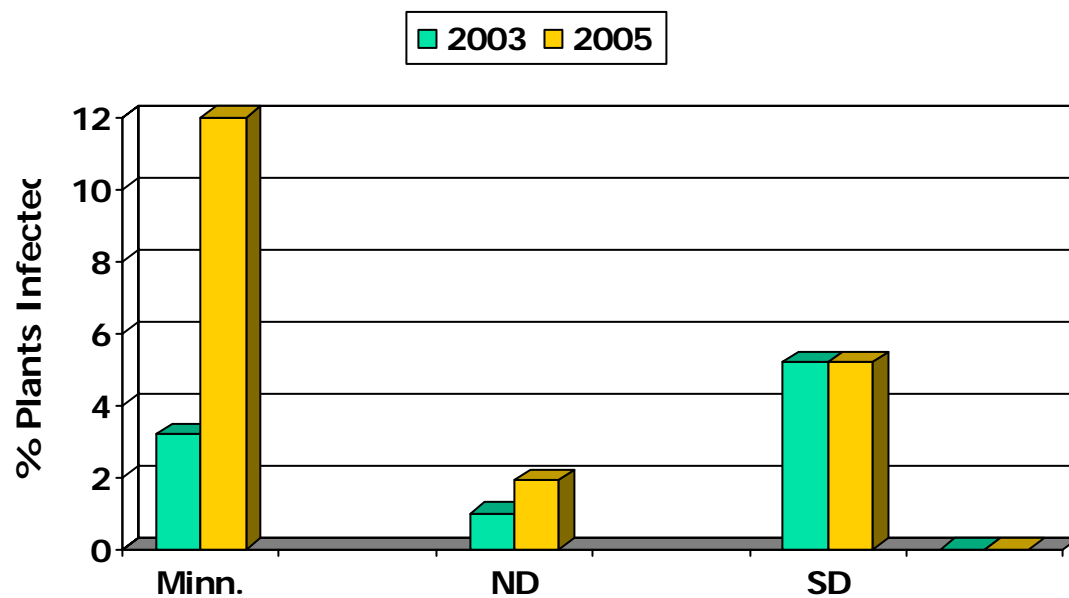
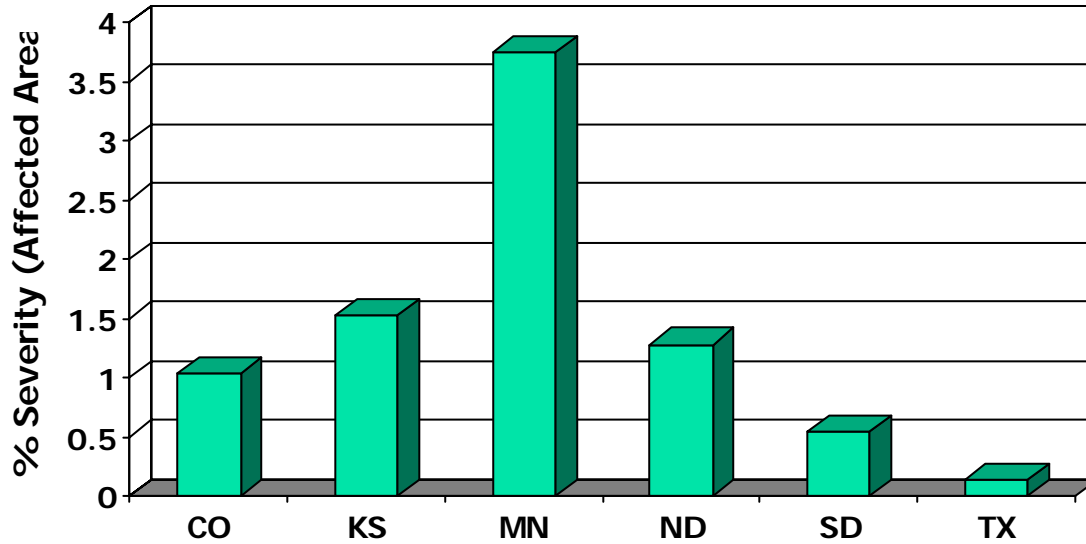


Figure 11. Sclerotinia Head Rot Incidence in 2003 vs. 2005.



Red Rust Severity: Red rust in sunflower was reported in all states. It was most severe in Minnesota (3.75%), Colorado, Kansas, and North Dakota between 1 to 1.5% and less than 1% in South Dakota and Texas. Rust infected leaf samples sent to the USDA-ARS laboratory were found to contain no new races of sunflower red rust, but was of a very aggressive strain. Most of the sunflower rust infestation and infection appeared late in the season and thus had no great impact on yields. If the rust infection does occur early like in mid-July to early August then economic losses can occur.

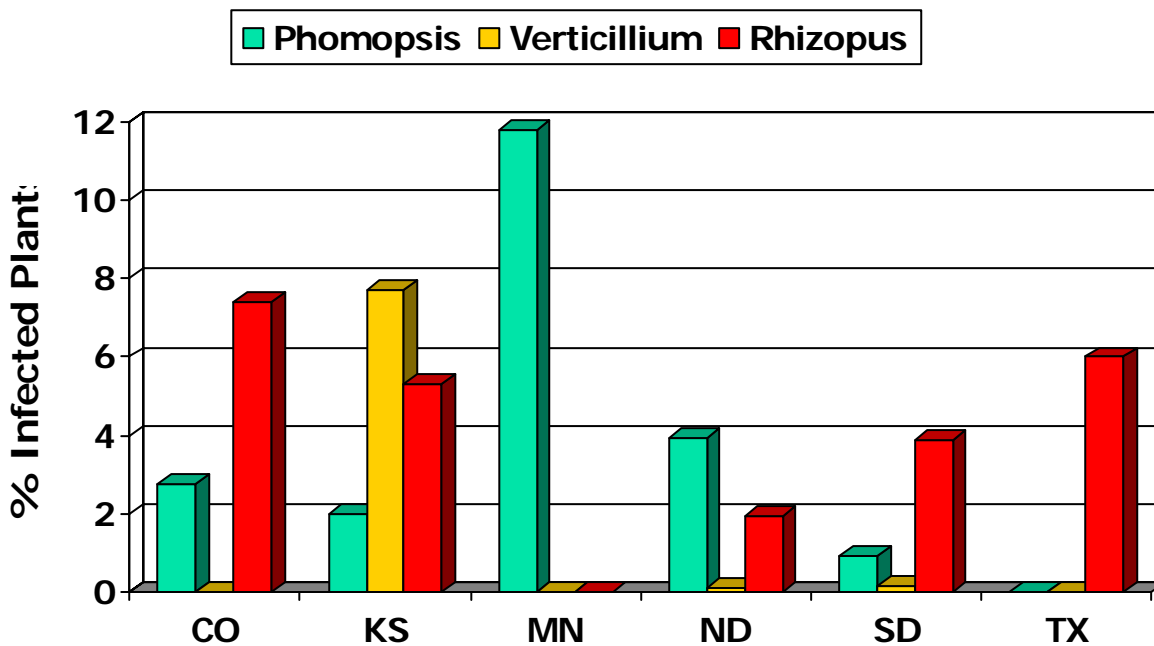
Figure 12. Sunflower Red Rust as reported in 2006 Survey



Rust Severity Estimated for Fields Where Incidence was Reported!!

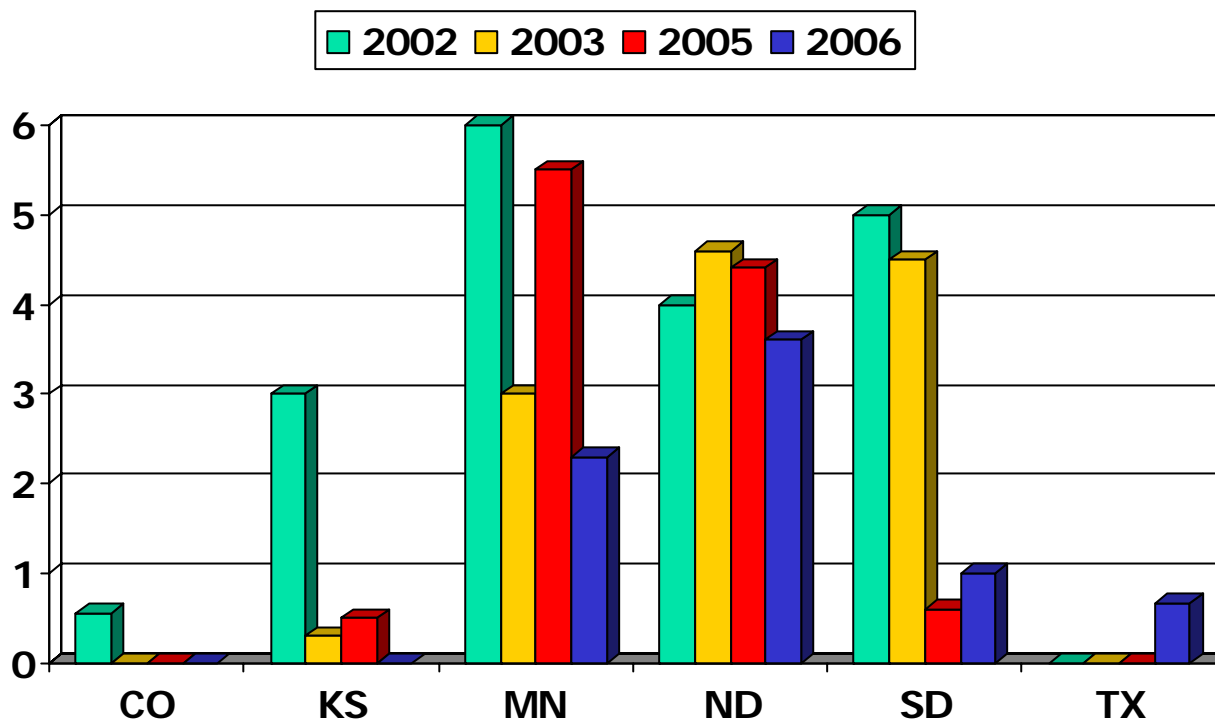
Other Sunflower Diseases: Rhizopus was reported in all states surveyed with the exception of Minnesota as being a problem disease. The incidence of Rhizopus was greatest in Colorado, followed by Texas, Kansas, South Dakota and North Dakota. Phomopsis continues to be a very serious problem with nearly 12% incidence being reported in Minnesota, followed by 4% in North Dakota and near 2% in Kansas and Colorado. Verticillium at 7.5% was only reported by Kansas survey and was not reported in other states. Downy mildew which was a problem the past few years was of very low incidence. Incidence was so low that the data is not being reported.

Figure 13. Incidence of Other Sunflower diseases in 2006.



Bird Damage: Bird damage continues to be a problem for many sunflower growers in the Great Plains. The damage from blackbirds (the primary pest species) was slightly less in North Dakota in 2006 at 3.5 % compared to 2003 and 2005. It should be noted that North Dakota had the more damage reported by birds than any of the other states in the survey. In South Dakota the damage reported from birds was under 1% in 2006 compared to over 4% damage in 2002 and 2003. In Minnesota bird damage was much lower than reported in 2002 and 2005. Minnesota had the highest reported damage due to birds in the 2005 survey. Kansas and Colorado reported no bird damage and only 0.6% in Texas which is very little damage to yield.

Figure 14. Bird Damage in 2002, 2003, 2005 and 2006 Sunflower Surveys



Insect Damage in Sunflower Fields- Sunflower plants including stalks were examined for damage by spotted stem weevil and longhorned beetle. It was noted that the sunflower in both Kansas (15%) and South Dakota (8.5%) had the most infestation by Spotted Stem weevils while the greatest number of longhorned beetles were reported in Colorado (14%) and South Dakota (14%). North Dakota's number of longhorned beetles at 8% incidence increased considerably from the 2003 survey. Sunflower seed weevil, banded SF moth, SF moth and Brown Spot damage were determined from seed samples taken in the fields in each state. The most serious seed damage was observed in Minnesota seed samples where banded SF moth damage was at 16.5%. The other major damage to seeds was noted in South Dakota where sunflower seed weevil damage was estimated at 10%. In North Dakota the seed damage from seed weevils and banded sunflower moths were 3% and 2% respectively. Brown spot damage in confectionary sunflower was 1.75% in North Dakota less that 0.5% in both Texas and Colorado.

Figure 15. Spotted Stem Weevil

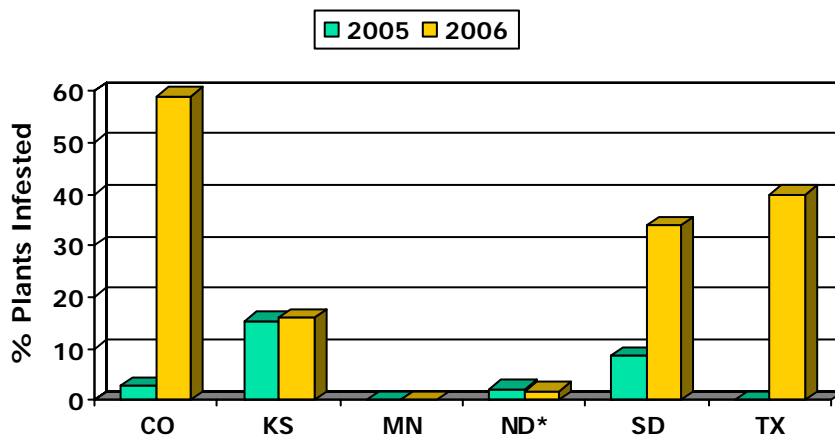


Figure 16. Spotted Stem Weevil in South Dakota
2006 Sunflower Survey
Spotted Stem Weevil

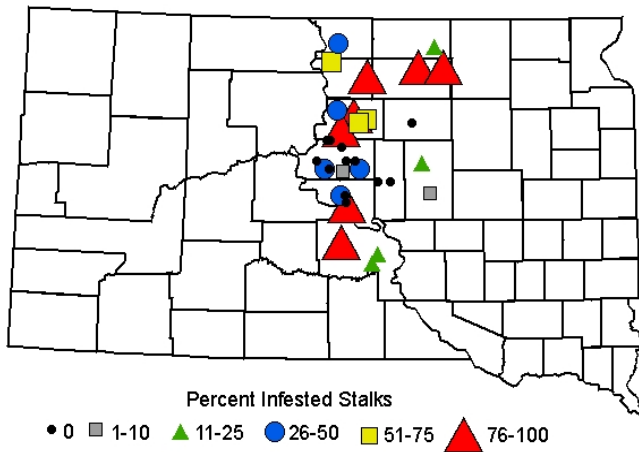


Figure 17. Red Sunflower Seed Weevil in North Dakota
2006 Sunflower Survey
Red Sunflower Seed Weevil

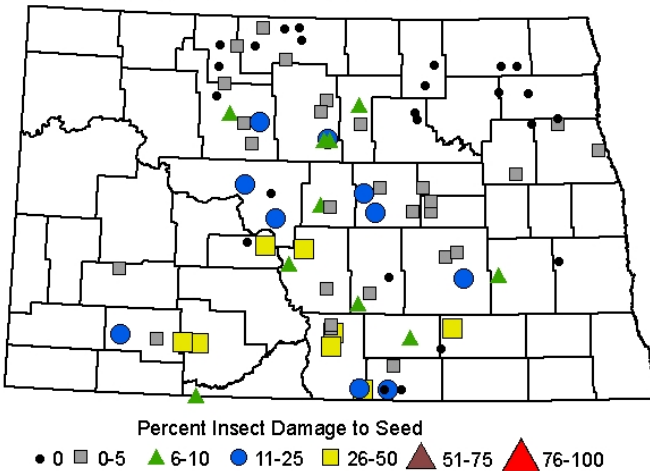
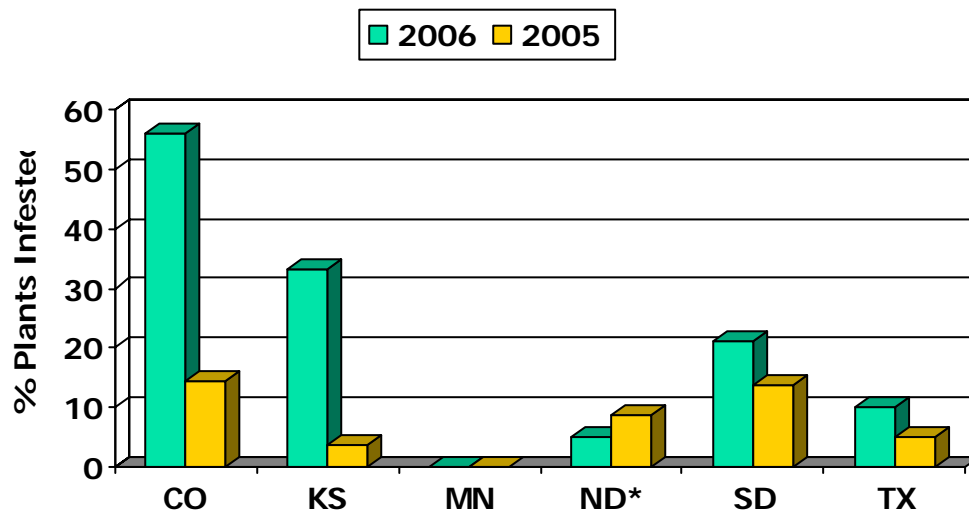


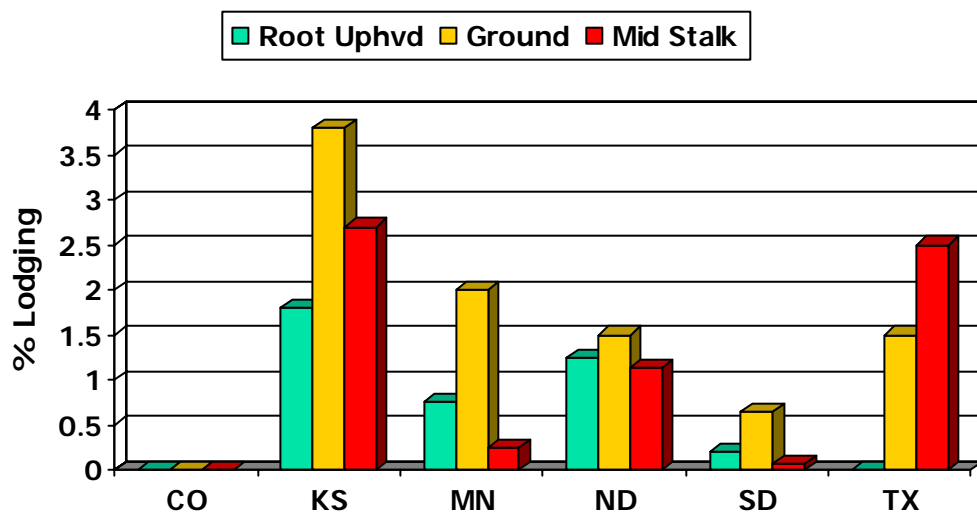
Figure 18. Incidence of Long Horned Beetle in Sunflower



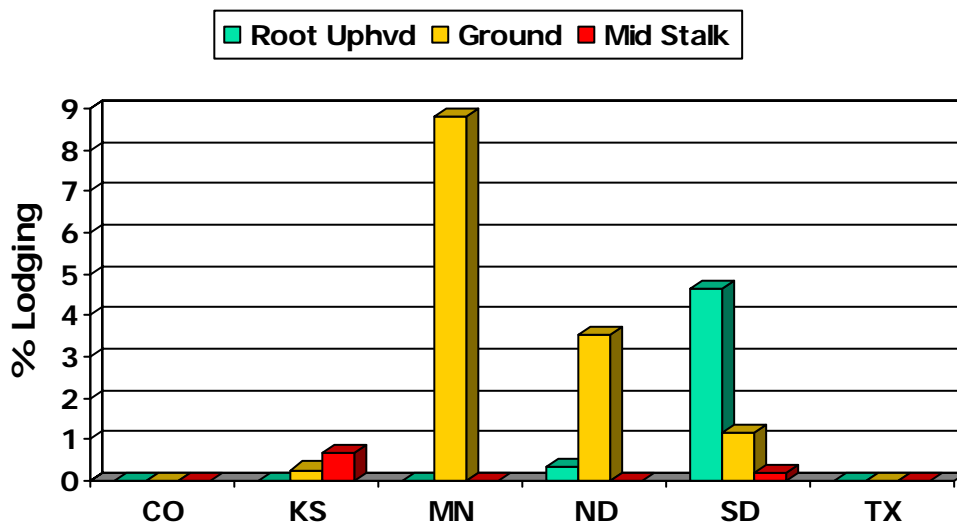
Lodging of harvest populations in 2006- Estimates of stalk and plant lodging were reported in all states in the survey. The greatest amount of lodging occurred in Minnesota where ground lodging was greater than that reported in any of the other five states in the survey. North Dakota had some incidence of ground lodging whereas South Dakota had the most root lodging reported. High winds, extremely wet soils, diseases and stem boring insects can all account for lodging problems at harvest time. The states of Kansas, Colorado and Texas reported little if any lodging. In 2005 it should be noted that lodging was reported in all states except Colorado. Kansas had more lodging problems in 2005 as did Texas.

Figure 19. Lodging of Sunflower in 2005 and 2006

2005



2006



Weed problems in 2006 Survey in North Dakota and Minnesota- Twenty-nine common weeds were evaluated in the survey with the various infestation levels recorded. The ratings were: none, light, moderate and heavy. The data below indicates the percent of fields found with the following weed species being present. For broadleaf weeds in North Dakota and Minnesota, kochia, Canada thistle, redroot pigweed, marshelder and wild buckwheat were the most prevalent. Kochia was found in over 45 % of the fields surveyed while Canada thistle was found in over 35 % of the fields. Other weeds identified were: redroot pigweed in 33 %, biennial wormwood in 15 %, marshelder in 28 %, wild buckwheat 27 % and cocklebur 10 % of the surveyed fields. In most of the fields the infestation levels were listed as very light and only present in the field and with little if any contribution toward reduced yields. The main grassy weeds present in North Dakota and Minnesota were: green foxtail (31 %), volunteer grains(8 %). Weeds such as wild oats and yellow foxtail were in very low numbers under 5 %.

Figure 20. Percent of sunflower fields with broadleaf weed present in 2005 and 2006 in North Dakota and Minnesota.

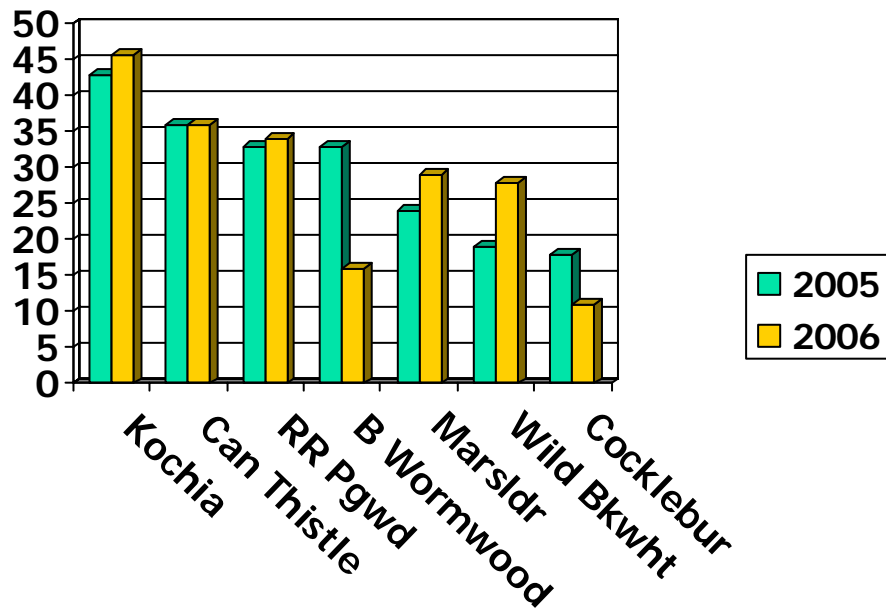
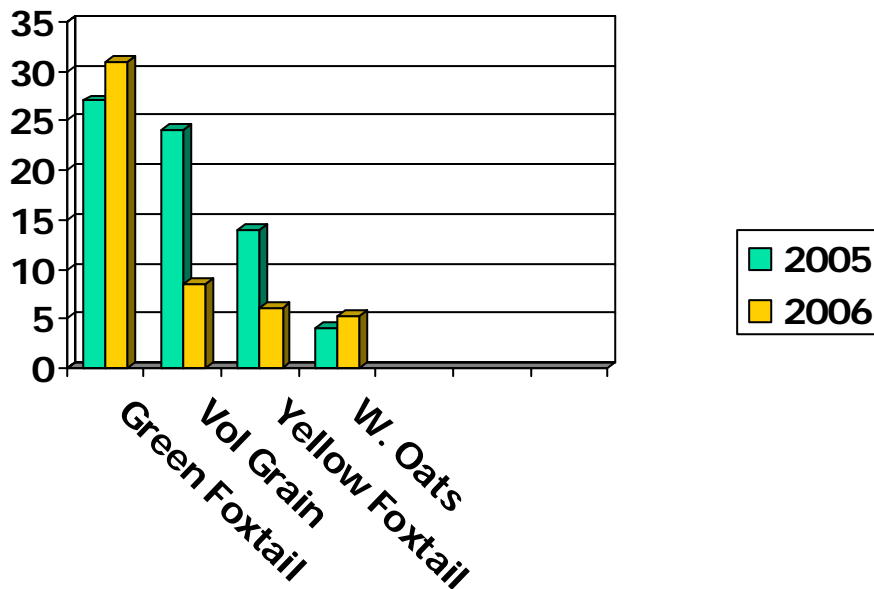


Figure 21. Percent of sunflower fields with grassy weeds present in 2005 and 2006 in North Dakota and Minnesota.



Weeds in other states: Weed species and percentage of fields these weeds were found are presented in Figures 22 through 26 as shown below. In South Dakota, kochia and redroot pigweed were found to be the most prevalent broadleaf weed. Whereas green foxtail was by far the most abundant grassy weed reported. Yellow foxtail was not found to be a problem grass weed. In Kansas, Palmer amaranth which is in the pigweed family was found to be in 65 % of the fields surveyed. It was the highest incident weed followed by volunteer grain, kochia, puncture vine, and redroot pigweed. The weed incidence reported in Colorado was much higher than reported in 2005. Primary weeds in Colorado were kochia, redroot pigweed, puncture vine and palmer amaranth. In Texas, Palmer amaranth had its presence in all fields surveyed. Other weeds were in the range of 30% incidence reported.

Figure 22. Incidence of broadleaf weeds in South Dakota 2005 and 2006.

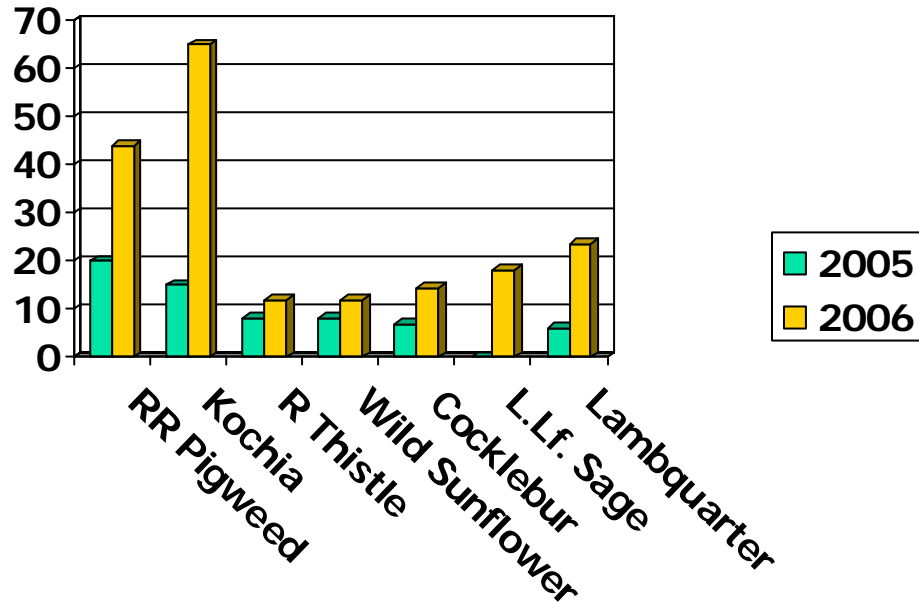


Figure 23. Incidence of grassy weeds in South Dakota in 2005 and 2006.

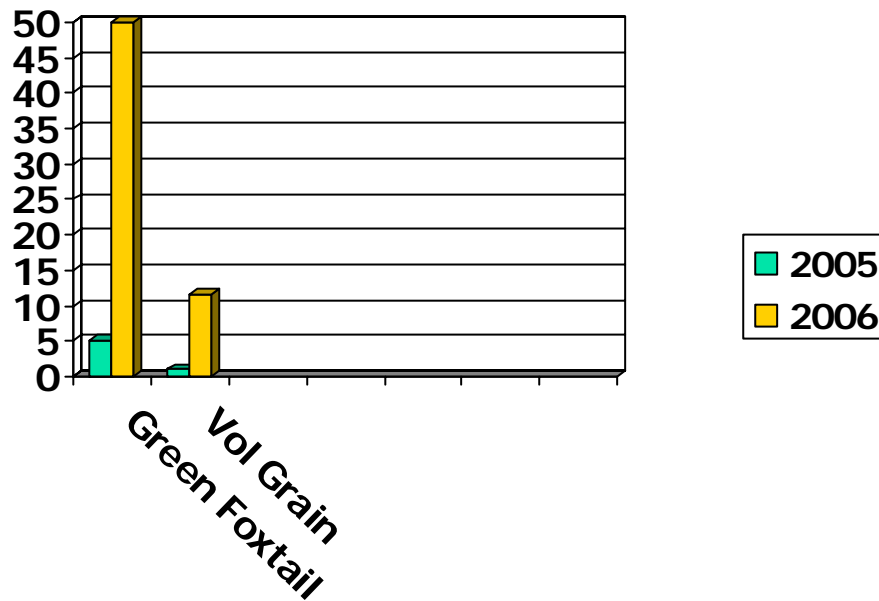


Figure 24. Incidence of weeds in Kansas in 2005 and 2006

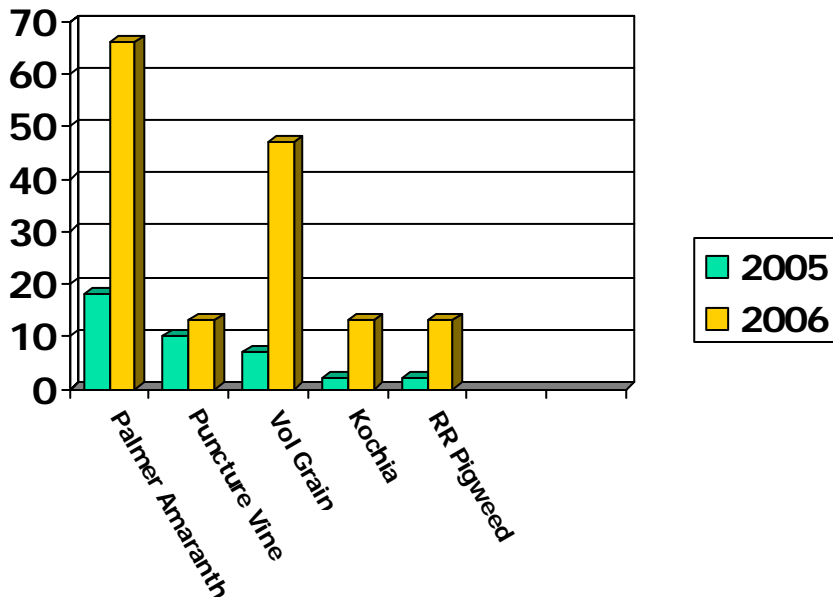


Figure 25. Incidence of weeds in Colorado in 2005 and 2006

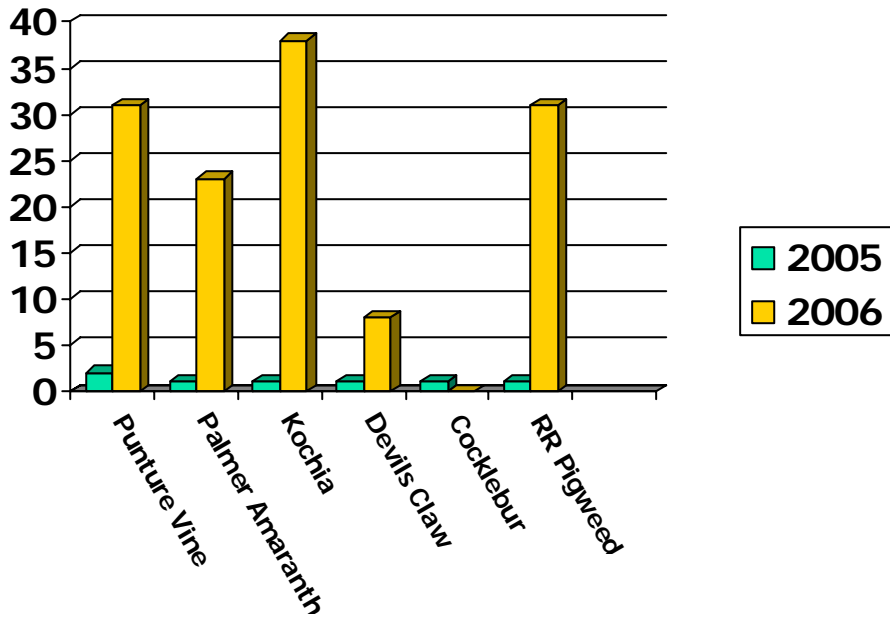
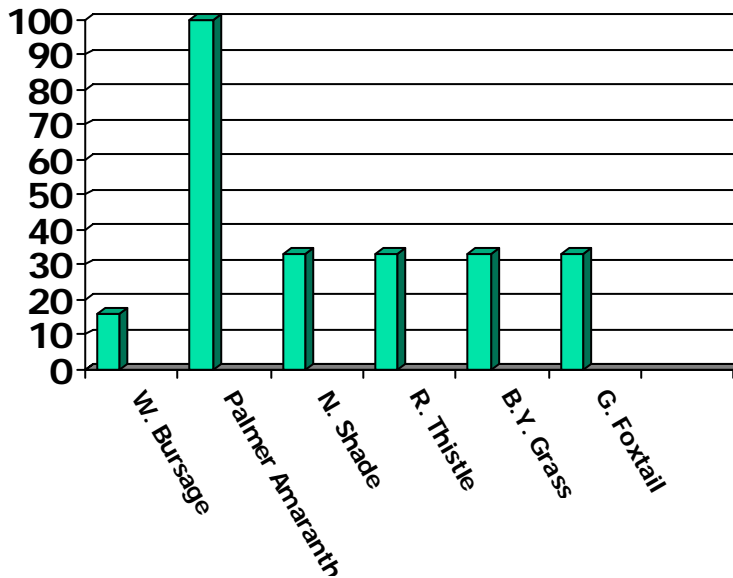


Figure 26. Incidence of weeds in Texas in 2006.



Survey Summary:

The 2006 survey was conducted in the same six states as the 2002, 2003 and 2005 sunflower surveys. More fields were surveyed in 2006 compared to 2005. Average estimated yields were lower in some states due to drought. The two exceptions were Kansas and Minnesota which both had higher yields in 2006 than in 2005. Both North Dakota and South Dakota, the highest acreage states, both had the greatest yield decrease comparing 2005 to 2006.

North Dakota has more narrow-rowed sunflower plantings with nearly 45% now in row spacing under 20 inches compared to 33% in 2005. In all other states the trend towards narrow row sunflowers is not as popular. Only Colorado and South Dakota reported some narrow row sunflower while Minnesota, Kansas and Texas reported wide row spacings.

Conventional tillage in North Dakota has been decreasing from 71% of surveyed fields in 2003, 50 % in 2005 to 38 % in 2006. Minimum tillage increased from 25% in 2003 to 38% in 2005 and 2006. No till acreage was 11% in 2002, but decreased to 4% in 2003 and increased again to 8% in 2005 and to 20 % in 2006. In South Dakota the survey shows a strong and rapid trend toward increased acres of no till. It is the leading state in that tillage category. No till acreage increased from 42% in 2003 to 91% in 2005 and 88 % in 2006. The Minnesota survey showed all acres in conventional tillage, which was also the case in 2002, 2003 and 2005. Minimum tillage and conventional tillage were 50 % and 50 %, respectively in Texas. Kansas reported 40 % in no till, 33 % minimum till and 27 % planted in conventional till. The Colorado survey showed 29% no till, 29% minimum till and 42% conventional tillage which was very similar to 2005.

The major yield limiting factor in 2002 was drought in Colorado (84% of surveyed fields), Kansas (71%), and South Dakota (60%); and plant population in Texas (42%), Minnesota (33%) and North Dakota (18%). Plant spacing was also a yield limiting factor in Texas (25%). In 2003, the major yield limiting factor was again drought in Colorado (90% of surveyed fields), South Dakota (81%), Kansas (61%), and North Dakota (22%). Plant population was again a yield limiting factor in Texas (25%), as was plant spacing (25%).

In 2005, the number one and number two major yield limiting factors by state were as follows: For North Dakota it was disease (26%) and plant population (17%), Minnesota it was birds (50%) and weeds (12%), in South Dakota the problems were low plant population (36%) and drought (34%), in Kansas it was drought (27%) and plant populations (27%), in Colorado it was drought (43%) and plant populations (14%) and in Texas it was primarily low plant populations (75%).

In 2006, the number one and number two major yield limiting factors were as follows:

In North Dakota it was drought (30 %) and weeds (11 %), Minnesota had diseases (30 %) and lodging (30 %), South Dakota had severe drought problems (62 %) and low plant populations (26 %), in Kansas it was weeds (32 %) and insects (20 %), in Colorado it was drought (62 %) followed by weeds (15 %) and in Texas it was primarily plant spacing problems (50 %) and insects (17 %).

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