Extension Report No. 30

1994 Sunflower Grower Survey

of Pest Problems and Pesticide Use in Kansas, Minnesota, North Dakota and South Dakota

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NDSU EXTENSION SERVICE
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AUGUST 1996

PROCEDURES

Sunflower growers in Kansas (KS), Minnesota (MN), North Dakota (ND) and South Dakota (SD) were surveyed about pest problems and pesticide use in 1994. This survey was similar to those of growers in KS, MN and ND in 1992 and 1991 and to a survey limited to ND in 1990 (1, 2, 3).

A single page survey form (Figure 1) was mailed on November 15, 1994 to 7,765 selected growers on the mailing list of the National Sunflower Association's magazine *The Sunflower*. The survey form was mailed to all 1,436 KS growers, all 1,624 MN growers, 25% of the 10,402 ND growers (2,600 contacted), and all 2,105 SD growers. Responses to the survey were confidential and a self-addressed stamped envelope was enclosed for returning the completed survey form.

Survey respondents identified the county and state where they grew sunflower; acres planted to oilseed and confection sunflower, irrigated and non-irrigated acres; planting dates; major production problems encountered; major insect, disease and weed problems encountered; percent bird damage, bird species causing damage, amount of money and time spent on attempts to control bird depredation; pesticides used; crop injury and weed control from herbicide use and other weed control practices; crop rotations; number of years since sunflower had been grown on that land; the use of soil testing and fertilizer levels used; row spacing and seeding rates used; and use of integrated pest management (IPM) and other alternative pest management practices.

Since the Clinton Administration has the stated objective that 75% of cropland will be under integrated pest management (IPM) by the year 2,000, the survey included questions about IPM. Respondents were asked if they planned to increase the use of IPM techniques within the next five years and what areas needed more research and more extension training.

RESULTS

Responses. Twenty percent, or 1,579 survey forms were returned. Of these, 1,079 (14%) had usable data, while 500 were not usable because the respondent had not grown sunflower in 1994, had retired, sold the farm, cash rented the farm, placed the entire farm in CRP or was deceased. The respondents and percent response for each state were: KS, 111 or 8%; MN, 314 or 19%; ND, 331 or 13%; and SD, 323 or 15% (Table 1). The percentage of usable responses was up from the 11% in 1992 (3).

Acres Planted By Respondents. Respondents in the four states planted 386,563 acres, or 12% of the 3,180,000 acres planted by all growers in these states (4). KS respondents planted 27,630 acres, or 11% of KS total sunflower acres of 260,000; MN respondents planted 101,867 acres, or 20% of MN 500,000 acres; ND respondents planted 105,816 acres, or 6% of ND 1,720,000 acres; and SD respondents planted 151,250 acres, or 22% of SD 700,000 acres (Table 2). The ND acreage represented in the survey is a significant number since only 25% of ND growers received the survey form. The percentage of total acres represented by respondents' acres was 12%, up from 1992 when respondents' acres represented 9% of total acres. The respondents' planted acres represented 11% of all sunflower acres planted in the United States.

Table 1. Growers contacted and reponses in 1994.

State	Total Growers	Growers Contacted	— Responses — Usable	%
Kansas	1,436	1,436	111	7.7
Minnesota	1,624	1,624	314	19.3
North Dakota	10,402	2,600	331	12.7
South Dakota	2,105	2,105	323	15.3
Total		7,765	1,079	13.9

Table 2. Total acres planted and acres planted by respondents in 1994.

State	Total Acres Planted	Respondents' Acres	Respondents Acres as % of Total
Kansas	260,000	27,630	10.6
Minnesota	500,000	101,867	20.4
North Dakota	1,720,000	105,816	6.2[a]
South Dakota	700,000	151,250	21.6
Four State Total	3,180,000	386,563	12.2
US total	3,430,000		11.3

[a] Only 25% of growers were contacted by survey.

NDSU EXTENSION SERVICE

Plant Science – Plant Pathology
North Dakota State University, Box 5012, Fargo, ND 58105-5012
(701) 231-8866

November 15, 1994

TO: Selected Sunflower Growers in Kansas, Minnesota, North Dakota and South Dakota

FROM: Art Lamey
Extension Plant Pathologist
North Dakota State University

SUBJECT: Survey of Pest Problems and Pesticide Use in 1994

Please see the reverse side for the survey of pest problems, pesticide use, and integrated pest management practices (IPM) for the 1994 growing season. This survey has been mailed to a randomly selected list of sunflower growers in Kansas, Minnesota, North Dakota and South Dakota. This is the fourth annual survey, the first having been made of selected North Dakota Growers in 1990. The second and third were mailed in 1991 and 1992 to selected growers in Kansas, Minnesota and North Dakota. A South Dakota survey for 1993 was mailed to S.D. producers in early 1994. This survey was designed by research and extension specialists from all four states with suggestions from the National Sunflower Association board of directors. It is designed to provide specific information on pest problems and pesticide use in sunflower in all four states covered by the survey.

Information from this survey will be invaluable in helping to determine the direction of research and extension programs, and in providing useful infomation on needs for retaining the use of selected pesticides.

Please take the time to complete the survey inside and return it in the enclosed evelope, which is addressed with postage paid. Your reply is important and will help guide the future of the sunflower industry. Please answer the questions as completely as possible. **Please be sure to provide information on acres treated or planted** whenever this question is asked. Accurate information will help us the most. Please feel free to add explanations or written comments that clarify your practices or express your concerns. Results will be published in future issues of The Sunflower and will also be available at the office of the National Sunflower Association.

We have deliberately kept this survey anonymous, so that you may feel free to give completely frank answers.

May we have your reply please by December 15, 1994.

This questionnaire was derived from *The Sunflower* magazine mailing list. If you no longer wish to receive the magazine or would like to notify them of address changes, please include the mailing label from this packet or include your name and your old and new address including zip code.

Please circle or fill in the requested information on pest problems and pesticide use on your 1994 sunflower crop.

Total acres planted in 1994 _____

Total acres harvested _____

Acres with frost damage _____

Acres Planted by Category

	Acres	Seedling Date
Dryland: oilseed hybrids	_____	_____
Dryland: confection hybrids	_____	_____
Irrigated: oilseed hybrids	_____	_____
Irrigated: confection hybrids	_____	_____

State and County Where Grown

(If sunflower grown in more than one county, list each county and acres)

State	County	Acres
Kansas	_____	_____
	_____	_____
Minnesota	_____	_____
	_____	_____
North Dakota	_____	_____
	_____	_____
South Dakota	_____	_____
	_____	_____

Greatest Production Problem in Sunflower in 1994

(Rank 1-3; 1 = worst)

_____ Bird Damage
_____ Diseases
_____ Emergence/Stand
_____ Harvesting
_____ Herbicide Drift
_____ Insects
_____ Weeds
_____ None

Worst Weed Problems in 1994

(Rank 1-3; 1 = worst)

_____ Canada thistle
_____ Cocklebur
_____ Common Lambsquarters
_____ Foxtail (Pigeongrass)
_____ Kochia
_____ Large crabgrass
_____ Quackgrass
_____ Redroot pigweed
_____ Russian thistle
_____ Volunteer cereals
_____ Wild buckwheat
_____ Wild Mustard
_____ Wild Oat
_____ None
_____ Other (specify) _____

Non-Chemical Weed Management

Steps used on worst weed

Practice	Acres Treated	# Cultivations
Cultivation	_____	_____
No herbicides	_____	_____
Rotary hoe	_____	_____
Other	_____	_____

Worst Insect Problems in 1994

(Rank 1-3; 1 = worst)

_____ None
_____ Seed weevil
_____ Banded sunflower moth
_____ Stem weevil
_____ Sunflower beetle
_____ Sunflower head moth
_____ Sunflower midge
_____ Grasshoppers
_____ Other (specify) _____

Non-Chemical Insect Management

Steps used on worst disease

Practice	Acres Treated
Crop Rotation	_____
Tillage	_____
Other	_____

Worst Disease Problems in 1994

(Rank 1-3; 1 = worst)

_____ Charcoal rot
_____ Downy mildew
_____ Phoma black stem
_____ Rust
_____ Sclerotinia Head Rot
_____ Sclerotinia wilt
_____ White rust
_____ Rhizopus head rot
_____ None

	Acres Affected	(%)
Lodging due to Sclerotinia	_____	_____ lodging
Lodging due to Phoma	_____	_____ lodging
Sclerotinia Head Rot	_____	_____ head rot

Hybrid affected by Sclerotinia Head Rot _____

Acres treated with Apron seed treatment _____

Non-Chemical Disease Management

Steps used on worst disease

Practice	Acres Treated
Crop Rotation	_____
Tillage	_____
Resistant hybrid	_____
Other	_____

Insecticide(s) Used on Sunflower in 1994

Insecticide	No. Acres Treated	No. of Applications	Insect Control Excell.	Good	Fair	Poor
ethyl parathion	_____	_____	1	2	3	4
methyl parathion	_____	_____	1	2	3	4
6-3 parathion	_____	_____	1	2	3	4
Asana XL	_____	_____	1	2	3	4
Lorsban	_____	_____	1	2	3	4
Furadan 4F	_____	_____	1	2	3	4
Sevin	_____	_____	1	2	3	4
Furadan 15G	_____	_____	1	2	3	4
Lindane/Maneb (seed treatment)	_____	_____	1	2	3	4
Phaser, Thiodan	_____	_____	1	2	3	4
Other (specify)_____ _____	_____	_____	1	2	3	4

Bird Problems and Losses

Mark which best fits

% Yield Loss

- ❑ 0-5 %
- ❑ 5-10%
- ❑ 10-25%
- ❑ 25-50%
- ❑ 50-100%

Species of Bird

- ❑ Blackbird
- ❑ Sparrows
- ❑ Other (specify_____ _____)

Costs for Bird Control

- $_____ Cattail control
- $_____ Exploder/alarm devices
- $_____ Gasoline
- $_____ Shells
- _____ Time (hr.)

Evaluate Weed Control Chemical and Sunflower Injury

Mark weed control used and indicate areas treated for each item. Count double application, double cultivation, etc., as double areas.

Weed Control Used	Acres Treated	Weed Control Excellent	Good	Fair	Poor	Sunflower Injury None	Slight	Moderate	Severe
Assert	_____	1	2	3	4	1	2	3	4
Eptam (fall)	_____	1	2	3	4	1	2	3	4
Eptam (spring)	_____	1	2	3	4	1	2	3	4
Poast	_____	1	2	3	4	1	2	3	4
Prowl (fall)	_____	1	2	3	4	1	2	3	4
Prowl (spring)	_____	1	2	3	4	1	2	3	4
Sonalan (fall)	_____	1	2	3	4	1	2	3	4
Sonalan (spring)	_____	1	2	3	4	1	2	3	4
Sonalan + Eptam	_____	1	2	3	4	1	2	3	4
Trifluralin (fall)	_____	1	2	3	4	1	2	3	4
Trifluralin (spring)	_____	1	2	3	4	1	2	3	4
Trifluralin + Eptam	_____	1	2	3	4	1	2	3	4
Desiccants –									
Gramoxone Extra	_____	1	2	3	4	1	2	3	4
Leafex-3 Defol	_____	1	2	3	4	1	2	3	4

Integrated Pest Management (IPM)

Compared to 1993, pesticide use in 1994 was

❑ less ❑ more ❑ same

If less or more, _____% increase or decrease

If less pesticides used in 1994, was due to:
(Please circle one or more)

a) fewer pests
b) better application techniques
c) better scouting for timely application
d) use of different chemical with lower use rates
e) not economically feasible
f) used alternative pest management practices

Please specify practices below

1. Crop rotation _____# acres.
2. Preceding crop _____.
   How long since previous sunflowers?_____
3. Preceding herbicide _____.
4. Cultivation _____# _____# acres.
5. Water management (irrigators) _____# acres.
6. Other (specify_____) _____# acres
   _____# acres _____# acres.
7. Did you soil test in 1994?
   ❑ Yes ❑ No Number of acres _____
8. Number of lbs. nitrogen per acre _____.
9. Planting practices
   No till # acres _____ Row spacing _____
   Row till # acres_____ Seeding rate _____

Do you wish to expand the use of IPM in the next five years?

❑ Yes ❑ No

If yes, circle all the techniques you plan to use for sunflower IPM

1. Increased pest monitoring.
2. Use of pest forecasting (if available).
3. Pesticide application timed by pest forecasting.
4. Use of resistant hybrids.
5. Crop rotation.
6. Tillage to bury crop refuse.
7. Other (specify)_____
   _____

In which of the above areas do you need help?

(List number from above)

Research _____

Extension (training) _____

Other Comments

_____

_____

_____

_____

_____

_____

_____

_____

Results of the survey will be published in *The Sunflower*

Please return by December 15, 1994 • Thank you

Art Lamey, Extension Plant Pathologist, NDSU

Confection sunflower planted by respondents was 22% of the total sunflower crop in KS, 20% in MN, 22% in ND, but only 4% in SD (Tables 3 and 4). The data for KS and MN are similar to data for 1992, but the percent of ND respondents' acres planted to confection sunflower increased from 13% in 1992 (3) to 22% in 1994. Between 93 and 96% of planted acres in all four states were harvested in 1994 (Table 3).

Most irrigated sunflower was grown in KS, where nearly 24% of respondents' acres were irrigated (Table 5). The amount of irrigated sunflower acres in MN, ND and SD was insignificant. In KS, 64% of the irrigated acres were planted to oilseed sunflower (Table 3).

Major Sunflower Producing Counties Represented by Survey. KS respondents planted the most acres of sunflower in Sherman, Thomas and Cheyenne counties. MN respondents planted the most acres in Polk, Wilkin, Marshall and Roseau counties. ND respondents planted the most acres in Stutsman, Barnes and Cass counties. Most of these county listings are similar to 1992 (3). SD respondents planted the most acres in Edmunds, Sully, Kingsbury and Brown counties (Table 6).

Table 3. Sunflower acres planted and harvested by respondents in 1994.

Sunflower Class	Kansas		Minnesota		North Dakota		South Dakota	
	Respondents	Acres	Respondents	Acres	Respondents	Acres	Respondents	Acres
Nonirrigated oilseed	88	17,299	263	80,872	292	82,684	317	144,884
Nonirrigated confection	19	3,844	92	20,634	75	22,742	23	5,951
Irrigated oilseed	22	4,161	3	361	2	390	3	415
Irrigated confection	15	2,326	0	0	0	0	0	0
Total planted	111	27,630	314	101,867	331	105,816	323	151,250
Total harvested		26,446		98,055		100,388		143,717
% Acres harvested		95.7		93.3		94.9		95.0

Table 4. Confection sunflower acres planted by respondents in 1994; (data derived from Table 3).

State	Respondents' Total Acres	Respondents' Confection Acres	% Confection Acres
Kansas	27,630	6,170	22.3
Minnesota	101,867	20,634	20.3
North Dakota	105,816	22,742	21.5
South Dakota	151,250	5,951	3.9

Table 5. Irrigated acres of sunflower in 1994.

State	Respondents	Acres Irrigated
	No.	%
Kansas	6,487	23.5
Minnesota	358	0.4
North Dakota	90	0.1
South Dakota	408	0.3

Table 6. Major sunflower producing counties represented by 1994 survey.[a]

State	County	Total Reported	Non-irrigated Oilseed	Non-irrigated Confection	Irrigated Oilseed	Irrigated Confection
		acres in each class				
KS	Sherman	5,789	4,185	259	1,080	265
	Thomas	5,677	2,527	1,968	940	242
	Cheyenne	4,129	3,214	340	230	345
MN	Polk	20,915	15,325	5,590	0	0
	Wilkin	11,369	10,179	947	243	0
	Marshall	10,747	10,124	620	3	0
	Roseau	8,632	6,702	1,930	0	0
ND	Stutsman	10,553	7,283	3,270	0	0
	Barnes	10,288	9,613	585	90	0
	Cass	9,507	7,559	1,948	0	0
SD	Edmunds	16,973	16,973	0	0	0
	Sully	14,457	14,457	0	0	0
	Kingsbury	13,608	13,448	160	0	0
	Brown	13,196	13,196	0	0	0

[a] Counties with over 8% of reported acres for each state, or 2,210 in Kansas, 8,149 in Minnesota, 8,465 in N. Dakota and 12,100 in S. Dakota.

Sunflower Planting Dates. KS respondents planted sunflower from mid-May to late July, but the majority of the acreage was planted between May 21 and June 30. The exception was irrigated confection; the majority of this acreage was planted between June 1 and July 10 (Table 7).

Sunflower was planted earlier in the northern states than in KS. MN respondents planted most of their acreage between May 1 and May 31. ND and SD respondents planted most of their acreage between May 11 and May 31, except for non-irrigated oilseed, most of which was planted between May 11 and June 10.

Production Problems. Weeds were rated the worst production problem on 37% of KS respondents' acres, followed by emergence and stand on 23%. Diseases were rated the worst production problem on 50% of MN and 25% of ND respondents' acres, followed by weather and weeds in MN (11% each) and weeds and bird damage (13% each) in ND. In SD, bird damage was rated the worst production problem on 16% of respondents' acres, followed by emergence/stand on 14% and weeds on 13% (Table 8).

Problems ranked among the three worst production problems were similar to the above except that insects were ranked second of the three worst in ND and SD and third in KS and MN.

Insect Problems. The sunflower head moth was rated the worst insect problem on 27% of KS respondents' acres, followed by the seed weevil on 16% and the stem weevil on 14%. These same insects were rated as one of the three worst insect problems in KS. The sunflower beetle was rated the worst insect problem

Table 7. Sunflower planting dates in 1994.

State	Sunflower Class	Planting Date									
		Before May 1	May 1-10	May 11-20	May 21-31	June 1-10	June 11-20	June 21-30	July 1-10	July 11-20	July 21-31
		% of acres planted for each class									
KS	Non-irrigated oilseed	0	0	7	20	28	21	11	9	2	0
	Non-irrigated conf.	7	0	13	13	40	13	7	7	0	0
	Irrigated oilseed	0	0	6	17	22	11	22	11	6	6
	Irrigated confection	0	0	0	8	31	8	23	31	0	0
MN	Non-irrigated oilseed	1	24	54	20	2	0	0	0	0	0
	Non-irrigated conf.	4	26	58	13	0	0	0	0	0	0
	Irrigated oilseed	0	33	33	33	0	0	0	0	0	0
ND	Non-irrigated oilseed	1	5	23	46	24	2	0	0	0	0
	Non-irrigated conf.	2	2	33	51	13	0	0	0	0	0
	Irrigated oilseed	0	0	50	50	0	0	0	0	0	0
SD	Non-irrigated oilseed	1	5	23	43	25	3	0	0	0	0
	Non-irrigated conf.	0	0	55	35	10	0	0	0	0	0
	Irrigated oilseed	0	0	50	50	0	0	0	0	0	0

Table 8. Worst production problems in 1994.

Production Problem	Kansas		Minnesota		North Dakota		South Dakota	
	Worst Problem	One of Three Worst Problems	Worst Problem	One of Three Worst Problems	Worst Problem	One of Three Worst Problems	Worst Problem	One of Three Worst Problems
	% of respondents' acres							
Bird damage	4.4	22.3	1.8	17.4	13.1	37.2	16.1	35.6
Diseases	5.8	16.0	50.2	67.2	24.5	43.1	10.7	29.7
Emergence/stand	23.0	42.7	4.2	12.8	4.9	16.7	13.7	22.8
Harvesting	6.0	10.7	3.1	15.9	4.4	11.4	6.2	8.3
Herbicide drift	0	0	0.3	0.7	1.8	7.0	1.2	6.9
Insects	10.4	32.0	6.5	36.1	10.3	39.1	12.9	31.5
Weather	6.0	6.4	10.8	13.3	5.9	6.5	2.8	3.3
Weeds	36.7	59.5	10.5	45.5	13.3	31.6	13.3	27.6
None	6.2	6.2	1.2	1.2	2.7	2.7	7.9	7.9

on 50% of respondents' acres in both MN and ND. It was rated one of the three worst insects on 59% of respondents' acres in MN and 58% in ND followed by the seed weevil on 28% and 37% and the stem weevil on 18% and 23%. The seed weevil was rated the worst insect problem on 25% of SD respondents' acres followed by the sunflower beetle on 16%. The seed weevil was rated one of the three worst insects on 41% of SD respondents' acres, followed by the sunflower beetle on 25% and the stem weevil on 20% (Table 9).

Insecticide Use and Other Insect Management Practices. Asana XL (esfenvalerate) was the most commonly used insecticide in MN and ND, where it was used on 33% and 43% of respondents' acres, respectively. Asana XL was the second most commonly used insecticide after all parathions in KS and SD, where it was used on 8% and 16% of respondents' acres, respectively. Use of Asana XL reflects the sunflower beetle problem reported by respondents in all four states (Table 10).

Total parathion (all types) was used on 15% of KS, 14% of ND, and 20% of SD respondents' acres; it was used on only 4% of MN respondents' acres. Ethyl parathion was the most commonly used parathion in KS and SD, where it accounted for 65% and 58% of total parathion use. In contrast, methyl parathion accounted for 67% of parathion use in ND (Table 10).

Furadan (4F and 15G) was used on 9% of respondents' acres in ND but only 4% in KS and MN and 1% in SD (Table 10).

KS respondents used insecticides more frequently on non-irrigated than irrigated sunflower and more on oilseed than confection. Insecticides were used on 21% of respondents' non-irrigated oilseed, 14% of their non-irrigated confection, 6% of their irrigated oilseed and 5% of their irrigated confection acres (Table 11). Parathion

Table 9. Worst insect problem in 1994.

Insect	Kansas		Minnesota		North Dakota		South Dakota	
	Worst Insect	One of Three Worst Insects	Worst Insect	One of Three Worst Insects	Worst Insect	One of Three Worst Insects	Worst Insect	One of Three Worst Insects
	% of respondents' acres							
Banded sunflower moth	0.9	9.0	3.1	14.2	3.5	20.1	2.4	11.8
Grasshopper	1.1	4.2	0.4	0.6	0.6	1.5	1.4	10.1
Seed weevil	15.8	21.4	7.8	27.6	7.5	36.9	24.5	40.6
Sunflower beetle	1.5	2.2	50.2	59.3	49.8	58.2	15.7	24.7
Sunflower head moth	27.0	50.1	3.6	13.5	8.4	16.4	6.0	15.7
Sunflower midge	0	0.9	4.9	9.7	2.9	5.6	2.6	3.2
Stem weevil	14.2	22.4	3.6	18.0	2.9	22.5	9.7	20.0
None	34.3	34.3	12.0	12.0	9.6	9.6	20.8	20.8

Table 10. Insecticide use on sunflower in 1994.

Insecticide	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents' acres treated			
Asana XL	8.4	32.8	42.7	16.4
Furadan 4F	2.4	2.6	7.8	0.9
Furadan 15G	1.6	1.2	1.3	0.2
Lindane/maneb	1.3	4.8	2.1	1.1
Lorsban 4E	0.4	1.2	0.9	1.9
Ethyl parathion	9.4	1.4	2.7	11.5
Methyl parathion	4.1	1.6	9.2	5.4
6-3 parathion	1.1	0.7	1.9	2.9
Sevin XLR	0.7	0.7	0.2	2.8
Other	0	0.5	1.0	1.6
Total parathion	14.6	3.7	13.8	19.9
Total treated	29.3	47.5	69.8	44.8

Table 11. Insecticide use by class of sunflower in Kansas in 1994.

Insecticide	Non-Irrigated Oilseed	Non-Irrigated Confection	Irrigated Oilseed	Irrigated Confection
	% of respondents' acres treated			
Asana XL	5.8	3.9	0.9	2.4
Furadan 4F	0.1	0.8	2.3	0
Furadan 15G	1.6	1.3	0	0
Lindane/maneb	1.3	1.1	0	0
Lorsban 4E	0.4	0	0	0
Ethyl parathion	7.3	4.1	0	0.2
Methyl parathion	3.4	1.4	3.2	1.3
6-3 parathion	1.1	1.1	0	0
Sevin XLR	0	0	0	0.7
Other	0	0	0	0
Total parathion	11.9	6.7	3.2	1.5
Total treated	21.0	13.8	6.4	4.6

was used on 12% of respondents non-irrigated oilseed acres, 7% of their non-irrigated confection, 3% of their irrigated oilseed and 2% of their irrigated confection acres (Table 11). KS respondents used Asana XL on 6% of their non-irrigated oilseed, 4% of their non-irrigated confection, 1% of their irrigated oilseed and 2% of their irrigated confection acres (Table 11).

In the northern states, 56% of ND respondents' oilseed acres were treated with insecticides, followed by SD oilseed with 44%, MN oilseed with 37%, ND confection with 32% and MN confection with 21% of respondents' acres treated. Only 3% of SD respondents' confection acres were treated with an insecticide (Table 12).

Asana XL was the most commonly used insecticide on both oilseed and confection sunflower in MN and ND, but use on oilseed sunflower was twice as great as on confection in both states. Asana XL was the second most commonly used insecticide in SD, following parathion (Table 12).

Respondents in all four states reported using crop rotation as a means of non-chemical insect management. This was reported on 55% of KS, 70% of MN, 60% of ND and 63% of SD respondents' acres. Tillage was reported as a means of non-chemical insect management on 6% of KS, 15% of MN, 15% of ND and 12% of SD respondents' acres (Table 13).

Weed Problems. Foxtail was the worst weed problem in KS and SD, but Canada thistle was the worst weed in MN and wild mustard was the worst weed in ND (Table 14).

Table 12. Insecticide use by class of sunflower in 1994.

Insecticide	Minnesota		North Dakota		South Dakota	
	Oilseed	Confection	Oilseed	Confection	Oilseed	Confection
	% of respondents' acres treated					
AsanaXL	26.5	13.4	37.2	17.3	16.1	2.2
Furadan 4F	1.8	1.3	5.5	5.0	0.9	0
Furadan 15G	1.2	0.6	1.1	0.2	0.2	0
Lindane/maneb	3.7	2.4	2.1	0.3	1.1	0
Lorsban 4E	1.2	1.0	0.7	0.4	1.9	0.2
Ethyl parathion	0.8	0.6	1.8	2.0	11.4	0.3
Methyl parathion	0.5	1.3	5.3	5.1	5.4	0.3
6-3 parathion	0.3	0.7	0.7	1.7	2.9	0.1
Sevin XLR	0.7	0	0.2	0	2.8	0
Other	0.5	0	1.0	0	1.6	0
Total parathion	1.6	2.6	7.8	8.9	19.7	0.7
Total preated	37.2	21.3	55.6	32.2	44.3	3.1

Table 13. Non-chemical insect management in 1994.

State	Crop Rotation	Tillage
	% of respondents' acres	
Kansas	54.7	6.0
Minnesota	70.3	14.8
North Dakota	59.9	14.6
South Dakota	62.5	12.1

Table 14. Worst weed problem in 1994.

Weed	Kansas		Minnesota		North Dakota		South Dakota	
	Worst Weed	One of Three Worst Weeds	Worst Weed	One of Three Worst Weeds	Worst Weed	One of Three Worst Weeds	Worst Weed	One of Three Worst Weeds
	% of respondents' acres							
Canada thistle	5.2	8.3	13.3	35.7	10.2	26.7	17.5	36.4
Com. cocklebur	4.9	12.2	8.5	11.4	12.2	22.7	5.4	17.8
Crabgrass, large	0.8	4.3	0	0	0	0	0	0
Foxtail	29.7	45.1	10.9	26.1	11.4	21.7	22.7	46.7
Kochia	9.6	30.0	5.1	10.7	4.0	16.4	2.9	19.7
Common lambsquarters	0	6.7	1.2	4.3	0.7	1.4	4.2	5.9
Redroot pigweed	28.5	59.8	3.2	14.0	1.1	8.2	3.4	9.9
Quackgrass	0.7	3.2	8.3	20.1	4.1	16.9	1.1	5.0
Russian thistle	7.2	21.7	0.1	3.2	1.0	3.2	0.2	2.5
Volunteer cereals	3.3	3.8	7.0	11.9	13.0	24.9	2.6	5.1
Wild buckwheat	0.5	0.6	1.9	9.6	0.1	2.7	2.5	4.3
Wild mustard	0	0	12.1	33.3	15.7	28.9	0.4	1.0
Wild oats	0.6	0.6	5.2	18.2	0.3	6.8	0.5	2.5
Other	2.1	5.5	2.7	10.3	3.2	7.4	7.3	14.4
None	6.6	6.6	2.6	2.6	2.6	2.6	7.6	7.6

Foxtail was the worst weed on 30% of KS respondents' acres, followed by redroot pigweed on 29%. Redroot pigweed was one of the three worst weeds on 60% of KS respondents' acres, followed by foxtail on 45% and kochia on 30% (Table 14).

Canada thistle was the worst weed on 13% of MN respondents' acres, followed by wild mustard on 12% and foxtail on 11%. These weeds were ranked in the same order as one of the three worst weeds (Table 14).

Wild mustard was the worst weed on 16% of ND respondents' acres, followed by volunteer cereals on 13% and common cocklebur on 12%. Wild mustard was one of the three worst weeds on 29% of ND respondents' acres, followed by Canada thistle on 27% and volunteer cereals on 25% (Table 14).

Foxtail was the worst weed on 23% of SD respondents' acres, followed by Canada thistle on 18%. The same ranking held for one of the three worst weeds (Table 14).

Herbicide Use and Other Weed Management Practices. Weed control practices included use of herbicides, cultivation and use of rotary hoe. KS respondents used spring-applied Prowl on 48% of their acres, followed by spring-applied trifluralin on 17% (Table 15). Only 26% of KS respondents' acres were treated with Prowl in 1992 (3). MN respondents used spring-applied trifluralin on 40% of their acres, followed by spring-applied Sonalan on 32%, Assert on 25% and Poast on 17%. Acreage treated with Assert increased by 10% in MN from 1992 (3). ND respondents used spring-applied Sonalan on 52% of their acres, followed by spring-applied trifluralin on 36%. SD respondents used spring-applied trifluralin on 61% of their acres, followed by spring-applied Sonalan on 12% and Poast on 7%.

Desiccant use was minimal in all four states. The greatest use of desiccants was in MN, where slightly over 2% of respondents' acres were treated (Table 15).

Herbicide use was similar on different classes of sunflower in KS, with spring-applied Prowl the most commonly used herbicide on non-irrigated oilseed, non-irrigated confection, and irrigated oilseed sunflower, and the second most commonly used herbicide on irrigated confection sunflower. Spring-applied trifluralin was the most commonly used herbicide on irrigated confection sunflower and the second most commonly used on the other three classes (Table 16).

Herbicide use was similar on different classes of sunflower in MN and ND, with spring-applied trifluralin the most commonly applied herbicide in MN, followed by spring-applied Sonalan. In ND, spring-applied Sonalan was the most commonly applied herbicide, followed by spring-applied trifluralin. Herbicide use was much less on confection sunflower than on oilseed in both states. Spring-applied trifluralin, followed by spring-applied Sonalan, was the most commonly applied herbicide in SD (Table 17).

Table 15. Herbicide use on sunflower in 1994.

Herbicide	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents' acres treated			
Assert	0	25.1	4.8	0.1
Eptam (spring)	0	1.7	<0.1	0
Glyphosate (preplant)	0	0	0	0
Poast	1.8	17.4	4.0	6.5
Prowl (fall)	0	0.1	0	0.8
Prowl (spring)	48.4	8.9	1.6	7.6
Sonalan (fall)	0	3.4	0.9	0.2
Sonalan (spring)	3.8	32.3	52.3	11.8
Sonalan + Eptam	0	1.2	0.1	<0.1
Trifluralin (fall)	3.4	1.9	4.0	0.5
Trifluralin (spring)	17.2	40.1	36.3	60.5
Trifluralin + Eptam	0	1.4	0.4	0
Desiccants:				
Gramoxone	0.5	1.8	0	0.5
Leafex-3/Defol	0	0.6	0.1	0.2

Table 16. Herbicide use on different classes of sunflower in Kansas in 1994.

Herbicide	Non-Irrigated Oilseed	Non-Irrgated Confection	Irrigated Oilseed	Irrigated Confection
	% of respondents' acres treated			
Poast	1.8	0.9	1.4	0
Prowl (spring)	42.4	18.3	15.1	4.6
Sonalan (spring)	2.9	0.7	1.8	0.9
Trifluralin (fall)	3.4	0.4	0.4	0
Trifluralin (spring)	15.5	5.1	5.7	5.1

Cultivation was used on 39% of KS, 77% of MN, 72% of ND and 54% of SD respondents' acres. Between 76 and 83% of respondents who used cultivation in KS, ND and SD used a single cultivation. About half of MN respondents used a single cultivation and half used two cultivations. A rotary hoe was used by 5% of KS and MN, 6% of ND and 2% of SD respondents. Most respondents used a single cultivation (Table 18).

Fifteen percent of KS respondents did not use herbicides. Only 2% of MN, 4% of ND and 3% of SD respondents used no herbicide (Table 18).

Most herbicides gave good to excellent control in all four states. No herbicide was consistently rated as fair or poor (Table 19). Most herbicides caused no injury or only slight injury to the crop, as ranked by respondents in all four states. Assert appeared to produce slight injury a little more frequently than some other herbicides. In MN, Eptam and trifluralin + Eptam appeared to produce slight or moderate injury in a few cases (Table 20).

Table 17. Herbicide use on different classes of sunflower in 1994.

Herbicide	Minnesota		North Dakota		South Dakota	
	Oilseed	Confection	Oilseed	Confection	Oilseed	Confection
	% of respondents' acres treated					
Assert	22.1	8.4	3.7	2.2	0.1	0
Eptam (spring)	1.7	0.5	<0.1	0	0	0
Glyphosate (preplant)	0	0	0	0	0	0
Poast	13.7	5.8	3.5	1.5	5.0	1.5
Prowl (fall)	0.1	0.1	0	0	0.8	0
Prowl (spring)	7.9	3.2	1.6	0.2	7.3	0.7
Sonalan (fall)	3.1	1.0	0.8	0.5	0.2	0
Sonalan (spring)	28.3	10.3	45.9	19.7	11.8	0.9
Sonalan + Eptam	1.2	<0.1	0	0.1	<0.1	0
Trifluralin (fall)	1.9	0.1	3.6	1.5	0.5	0
Trifluralin (spring)	35.3	11.5	32.2	9.5	60.4	1.8
Trifluralin + Eptam	1.0	0.6	0.4	0	0	0

Table 18. Use of non-chemical weed management in 1994.

State	Cultivation					Rotary Hoe			No Herbicide
	% Respondents' Acres Cultivated	No. of Cultivations				% Respondents' Acres Cultivated	No. of Cultivations		% Respondents' Acres
		1	2	3	4		1	2	
	% responding					% responding			
Kansas	39.4	83.3	13.3	1.7	1.7	4.6	83.6	16.7	14.9
Minnesota	77.3	47.3	47.3	5.5	0	5.3	87.5	12.5	2.3
North Dakota	71.6	75.8	19.9	3.9	0.4	6.2	80.0	20.0	3.9
South Dakota	54.2	81.7	17.9	0.4	0	2.4	100.0	0	2.7

Table 19. Effectiveness of herbicides[a] on weed control in sunflower in 1994.

Herbicide	Kansas				Minnesota				North Dakota				South Dakota			
	Excel.	Good	Fair	Poor	Excel.	Good	Fair	Poor	Excel.	Good	Fair	Poor	Excel.	Good	Fair	Poor
Assert	–	–	–	–	37.5	46.2	14.4	1.9	51.4	32.4	10.8	5.4	–	–	–	–
Eptam (spring)	–	–	–	–	22.2	44.4	33.3	0	–	–	–	–	–	–	–	–
Poast	–	–	–	–	32.0	45.3	21.3	1.3	40.9	40.9	13.6	4.5	53.8	30.8	10.3	5.1
Prowl (spring)	25.5	27.7	27.7	19.1	25.7	34.3	22.9	17.1	0	20.0	20.0	60.0	8.6	40.0	31.4	20.0
Sonalan (fall)	–	–	–	–	20.0	30.0	50.0	0	42.9	28.6	28.6	0	–	–	–	–
Sonalan (spring)	0	40.0	40.0	20.0	19.5	52.8	22.0	5.7	26.4	51.6	17.0	4.9	24.4	46.7	24.4	4.4
Trifluralin (fall)	–	–	–	–	14.3	57.1	28.6	0	35.7	42.9	14.3	7.1	–	–	–	–
Trifluralin (spring)	15.4	38.5	38.5	7.7	19.2	52.0	20.0	8.8	19.2	53.1	23.1	4.6	29.6	50.3	16.8	3.4
Trifluralin + Eptam	–	–	–	–	28.6	57.1	14.3	0	–	–	–	–	–	–	–	–

[a] Includes all herbicides with 5 or more responses.

Bird Damage. Respondents in ND and SD reported the most bird damage: 23% of respondents in ND and 24% in SD reported 5-10% damage, 12% in ND and 6% in SD reported 10-25%, and 2% in each state reported 25-100% damage. Bird damage was less serious in MN and KS: 12% of KS and 16% of MN respondents reported 5-10% damage, 5% in KS and 3% in MN reported 10-25% and 1% in KS reported 25-50% damage (Table 21). These figures are similar to those for 1992 (3).

Blackbirds were the species most frequently causing damage, as reported by 80% of KS, 91% of MN, 97% of ND and 94% of SD respondents who answered this question. Sparrows were the second most frequently reported bird species, cited by 14% of KS, 8% of MN, 3% of ND and 5% of SD respondents (Table 22). Responses on bird damage are similar to those for the 1992 (3) and 1991 (2) surveys.

ND respondents spent the most on bird control: $15,575 for shotgun shells, $14,701 for exploders, $6,922 for gasoline, $635 for cattail control and 4,663 hours for bird control (Table 23). If hourly costs are calculated at $5.00/hr, the cost in time represents $23,315, and total costs for ND for respondents were $61,148 for all 331 ND respondents. However, not all respondents answered this question, so costs per respondent answering the question are shown in Table 24. Each ND respondent who answered the question spent $212 for cattail control, $272 for exploders, $113 for gasoline, $119 for shells and 41 hours ($205).

SD respondents made the next largest expenditure on bird control: $8,916 for shotgun shells, $6,992 for exploders, $2,896 for gasoline, $830 for cattail control and 2,133 hours for bird control (Table 23). Calculating $5.00 /hr for bird control, the hourly cost was $10,665 and total costs for all 323 SD respondents were $30,299 for all respondents. Costs for each SD respondent who answered the question were fairly similar to those for ND, except that fewer hours were spent (Table 24).

MN respondents had bird control expenditures of $6,125 for exploders, $5,818 for shotgun shells, $851 for cattail control, $835 for gasoline and 1,265 hours for bird control (Table 23). Total costs for all respondents, including $6,325 for hours spent, were $19,951. Costs for each MN respondent who answered the question were a bit higher than ND except that fewer hours were spent (Table 24).

Bird control expenditures in KS were minimal (Tables 23 and 24). The data reaffirm that the greatest bird problems are in the Dakotas.

Table 20. Injury from herbicides[a] on sunflower in 1994.

	Kansas				Minnesota				North Dakota				South Dakota			
Herbicide	None	Slight	Mod.	Severe	None	Slight	Mod.	Severe	None	Slight	Mod.	Severe	None	Slight	Mod.	Severe
Assert	—	—	—	—	60.4	36.5	2.1	1.0	55.6	41.7	0	2.8	—	—	—	—
Eptam (spring)	—	—	—	—	44.4	44.4	11.1	0	—	—	—	—	—	—	—	—
Poast	—	—	—	—	83.8	16.2	0	0	80.5	17.1	0	2.4	88.9	2.8	5.6	2.8
Prowl (spring)	87.5	7.5	0	5.0	78.1	21.9	0	0	75.0	25.0	0	0	87.5	9.4	3.1	0
Sonalan (fall)	—	—	—	—	87.5	12.5	0	0	100.0	—	—	—	—	—	—	—
Sonalan (spring)	—	—	—	—	83.2	15.0	1.8	0	81.2	17.6	1.2	0	85.4	12.2	2.4	0
Trifluralin (fall)	—	—	—	—	71.4	28.6	0	0	100.0	—	—	—	—	—	—	—
Trifluralin (spring)	78.3	21.7	0	0	81.4	16.9	1.7	0	86.8	12.4	0.8	0	87.5	12.5	0	0
Trifluralin + Eptam	—	—	—	—	28.6	42.9	28.6	0	—	—	—	—	—	—	—	—

[a] Includes all herbicides with 5 or more responses.

Table 21. Estimated sunflower yield loss due to bird damage in 1994.

Bird Damage: % Yield Loss	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents			
0-5%	82.0	81.4	63.3	67.8
5-10%	12.4	15.9	23.1	23.9
10-25%	4.5	2.7	11.5	6.2
25-50%	1.1	0	1.7	1.7
50-100%	0	0	0.3	0.3

Table 22. Bird species causing sunflower damage in 1994.

Bird Species	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents[a]			
Blackbirds	80.3	90.7	96.9	94.2
Sparrows	13.6	8.3	2.8	4.7
Others	6.1	1.0	0.4	1.2

[a] Percent of those respondents who answered this question.

Disease Problems and Disease Management. Sclerotinia head rot was reported to be the worst disease problem in all four states, as reported on 19% of KS, 62% of MN, 48% of ND and 29% of SD respondents' acres. It was one of the three worst diseases on 22% of KS, 74% of MN, 55% of ND and 34% of SD respondents' acres. Sclerotinia wilt was reported as one of the three worst disease problems on 3% of KS, 32% of MN, 28% of ND and 14% of SD respondents' acres. Thus, Sclerotinia (head rot and wilt) was one of the three worst diseases on 25% of KS, 106% of MN, 84% of ND and 48% of SD respondents' acres (Table 25).

Apron seed treatment, for control of downy mildew, was used on 13% of KS, 53% of MN, 61% of ND and 33% of SD respondents' acres (Table 26).

The most common non-chemical disease management practice was crop rotation, used on 67% of KS, 73% of MN, 65% of ND and 62% of SD respondents' acres. Tillage was used for disease management on 6% of KS, 22% of MN, 20% of ND and 14% of SD respondents' acres. Resistant hybrids were used for disease management on 3% of KS, 14% of MN, 8% of ND and 7% of SD respondents' acres (Table 27).

Table 23. Bird control costs in 1994.

Control Method	Kansas	Minnesota	North Dakota	South Dakota
	amount spent by all respondents[a]			
Cattails	0	$ 851	$ 635	$ 830
Exploder	0	$6,125	$14,701	$6,992
Gasoline	0	$ 835	$ 6,922	$2,896
Shells	$80	$5,818	$15,575	$8,916
Other	0	$ 0	$ 0	$ 0
Hours	4 hr	1,265 hr	4,663 hr	2,133 hr

[a] Respondents answering question.

Table 24. Bird control costs per respondent in 1994.

Control Method	Kansas	Minnesota	North Dakota	South Dakota
	$ spent per respondent			
Cattails	0	283.67	211.67	276.67
Exploder	0	306.25	272.24	249.71
Gasoline	0	75.91	113.48	96.53
Shells	26.67	126.48	118.89	96.91
Other	0	0	0	0
Hours	4 hrs	33 hrs	41 hrs	26 hrs

Table 25. Worst sunflower disease problem in 1994.

Disease	Kansas		Minnesota		North Dakota		South Dakota	
	Worst Disease	One of Three Worst Diseases	Worst Disease	One of Three Worst Diseases	Worst Disease	One of Three Worst Diseases	Worst Disease	One of Three Worst Diseases
	% of respondents' acres							
Charcoal rot	5.1	8.3	0	0.9	0	1.6	0.2	1.4
Downy mildew	2.7	3.3	1.6	12.4	0.9	5.3	0.4	4.6
Phoma black stem	0.1	7.6	9.5	29.8	6.5	26.8	6.4	14.6
Rhizopus head rot	6.5	18.2	2.7	16.1	2.6	8.7	1.2	6.0
Rust	2.9	5.4	1.7	5.9	0	3.8	0.2	1.0
Sclerotinia head rot	18.7	21.7	62.3	74.1	47.7	55.1	29.0	34.4
Sclerotinia wilt	2.8	2.8	2.7	32.1	5.7	28.4	8.1	13.8
White rust	0	6.3	0	2.1	0.8	2.1	0.3	0.5
None	50.6	50.6	4.6	4.6	15.4	15.4	36.8	36.8

Table 26. Use of Apron seed treatment in 1994.

State	% Respondents' Acres
Kansas	12.7
Minnesota	52.8
North Dakota	60.6
South Dakota	33.0

Table 27. Non-chemical disease management in 1994.

Practice	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents' acres			
Crop rotation	66.5	73.3	64.6	62.2
Tillage	5.7	21.9	19.5	14.3
Resistant hybrids	2.9	13.9	8.4	6.6
Other	0	0.3	0	0

Soil Testing and Nitrogen Use. Soil testing was most commonly used in MN, where 58% of respondents soil tested, followed by 50% in ND, 44% in SD and 39% in KS (Table 28). Soil testing was used more frequently on irrigated than non-irrigated sunflower in KS. It was used on non-irrigated sunflower more frequently in MN than in the other three states. Soil testing varied from a high of 74% of irrigated oilseed acres in KS to a low of 34% of non-irrigated oilseed acres in KS (Table 29).

Nitrogen amounts applied varied by state, but most respondents in all four states used 40-100 lb/A of nitrogen. Just over half of KS respondents used 40-60 lb/A; but 66% of MN, 59% of ND and 44% of SD respondents used 60-100 lb/A; 29% of SD respondents used 40-60 lb/A. About 13% of KS, 1%of MN, 9% of ND and 20% of SD respondents used 0-40 lb/A. About 3% of KS, 21% of MN, 10% of ND and 8% of SD respondents used 100-200 lb/A (Table 30).

Kansas respondents used more nitrogen on irrigated confection than on other classes, with few differences among the other three classes. No major differences in nitrogen usage were reported on confection versus oilseed sunflower in MN or ND (Table 31).

Tillage, Row Spacing and Seeding Rates. No-till was used by 21% of KS, 0% of MN, 3% of ND and 17% of SD respondents who answered the question. The other respondents used row till (Table 32).

Table 28. Percent of respondents who soil tested in 1994.

State	% of Respondents who used Soil Test
Kansas	38.7
Minnesota	58.4
North Dakota	50.0
South Dakota	44.1

Table 29. Use of soil test by class of sunflower in 1994.

State	Confection		Oilseed	
	Irrigated	Non-Irrigated	Irrigated	Non-Irrigated
	% of respondents who soil tested			
Kansas	61.5	52.6	73.7	34.1
Minnesota	—	67.0	—	57.0
North Dakota	—	47.3	—	51.8
South Dakota	—	42.9	—	44.0

Table 30. Amount of nitrogen applied by respondents in 1994.

Nitrogen applied	Kansas	Minnesota	North Dakota	South Dakota
	lb/A% of respondents			
0-20	3.6	1.1	1.2	1.9
21-40	9.5	0.4	7.8	17.6
41-60	51.2	11.7	22.5	28.6
61-80	21.4	30.1	34.5	18.6
81-100	10.7	35.7	24.4	25.7
101-120	2.4	10.9	6.6	1.0
121-140	0	2.6	1.6	3.3
141-160	0	4.5	0.8	2.9
161-180	0	1.1	0	0
181-200	1.2	0.8	0.8	0.5
Over 200	0	1.1	0	0

Table 31. Amount of nitrogen applied by class of sunflower in 1994.

Nitrogen Applied	Kansas				Minnesota		North Dakota		South Dakota	
	Irrigated Confection	Non-irrigated Confection	Irrigated Oilseed	Non-Irrigated Oilseed	Non-Irrigated Confection	Non-Irrigated Oilseed	Non-Irrigated Confection	Non-Irrigated Oilseed	Non-Irrigated Confection	Non-Irrigated Oilseed
lb/A	% of respondents									
0-20	0	0	0	4.3	1.3	0.9	1.7	1.3	0	1.9
21-40	0	0	15.4	10.1	1.3	0	8.5	7.9	7.1	17.3
41-60	36.4	46.2	46.2	50.7	10.4	12.4	13.6	23.7	42.9	28.4
61-80	18.2	23.1	15.4	21.7	31.2	29.8	37.3	35.1	7.1	18.7
81-100	27.3	30.8	15.4	8.7	29.9	37.8	25.4	22.8	7.1	26.0
101-120	18.2	0	7.7	2.9	14.3	10.2	6.8	7.0	0	1.0
121-140	0	0	0	0	2.6	2.2	1.7	1.3	28.6	3.4
141-160	0	0	0	0	2.6	5.3	1.7	0.9	7.1	2.9
161-180	0	0	0	0	2.6	0.4	0	0	0	0
181-200	0	0	0	1.4	1.3	0.4	3.4	0	0	0.5
Over 200	0	0	0	0	2.6	0.4	0	0	0	0

A 30-inch row spacing was most commonly used in KS, MN and ND, with 95% of KS, 78% of MN and 84% of ND respondents reporting this row spacing. Nearly 15% of MN respondents reported row spacings of 21-29 inches. In contrast, 32% of SD respondents reported 30-inch row spacing, 17% reported 31-36 inch row spacing and 50% reported 37-49 inch row spacing (Table 33).

Some minor variations in seeding rate among states occurred, with 71% of KS respondents reporting seeding rates of 16,000-22,000, 70% of MN respondents reporting seeding rates of 20,000-25,000, 76% of ND respondents reporting seeding rates of 16,000-22,000 and 83% of SD respondents reporting seeding rates of 16,000-22,000 seeds/A (Table 34).

Seeding rates tended to be lower for confection than for oilseed sunflower in KS, MN, and ND, but about the same in SD. The most common seeding rate for confection sunflower in KS and ND was 16,000-19,000 seeds/A; 20,000-22,000 seeds/A in SD; and these two rates were used equally in MN. The most common seeding rate for non-irrigated oilseed sunflower was 20,000-22,000 seeds/A in KS, ND and SD and 23,000-25,000 in MN. The most common seeding rate for irrigated oilseed in KS was 16,000-19,000 seeds/A (Table 35).

Table 32. Respondents reporting use of no-till and row-till in 1994.

State	Use of No-till	Use of Row-till
	% of respondents reporting[a]	
Kansas	20.6	79.4
Minnesota	0	100.0
North Dakota	3.1	96.9
South Dakota	16.9	83.1

[a] % responding to question

Table 33. Row spacing used on sunflower in 1994.

Row Spacing Inches	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents			
5-10	2.0	0.4	0.8	0
11-20	0	0.8	1.5	0.7
21-29	0	14.7	1.3	0.8
30	94.9	78.2	83.9	31.8
31-36	3.0	4.5	9.0	17.2
37-49	0	1.5	2.6	49.7

Table 34. Seeding rate used on sunflower in 1994

Seeding Rate	Kansas	Minnesota	North Dakota	South Dakota
Seeds/A	% of respondents			
10,000-15,000	11.7	2.7	3.1	2.6
16,000-19,000	35.9	13.8	21.3	24.1
20,000-22,000	35.9	28.0	55.0	58.4
23,000-25,000	10.6	42.3	16.3	12.8
26,000-29,000	3.2	11.1	3.4	1.5
30,000-39,000	3.2	1.9	1.2	0.8

Table 35. Seeding rates used by class of sunflower in 1994.

Seeding Rate	Kansas				Minnesota		North Dakota		South Dakota	
	Irrigated Confection	Non-Irrigated Confection	Irrigated Oilseed	Non-Irrigated Oilseed	Non-Irrigated Confection	Non-Irrigated Oilseed	Non-Irrigated Confection	Non-Irrigated Oilseed	Non-Irrigated Confection	Non-Irrigated Oilseed
Seeds/A	% of respondents									
10,000-15,000	14.3	26.7	0	10.6	6.5	1.9	8.5	1.3	10.6	2.2
16,000-19,000	57.1	40.0	40.0	33.3	33.3	6.5	53.5	14.9	31.6	23.9
20,000-22,000	21.4	26.7	25.0	42.6	34.6	27.6	29.4	60.4	57.8	58.6
23,000-25,000	0	0	15.0	10.7	23.1	49.0	8.5	18.3	0	12.9
26,000-29,000	7.1	0	10.0	1.3	1.3	13.4	0	3.8	0	1.5
30,000-39,000	0	6.7	10.0	1.3	1.3	1.8	0	1.3	0	0.8

Integrated Pest Management

Pesticide Use. From one-half to two-thirds of respondents in all four states reported that pesticide use was the same as in previous years. Nearly 26% of KS respondents reported less pesticide use, but 30% of MN, 27% of ND and 27% of SD respondents reported more pesticide use than in previous years (Table 36).

The percent decrease in pesticide use in KS was reported as 25-50% by 25% of respondents and 75-100% by 50% of respondents. Of respondents reporting an increase in pesticide use, 35% of MN, 34% of ND and 22% of SD respondents reported a 25-50% increase; 32% of MN, 35% of ND and 49% of SD respondents reported a 75-100% increase (Table 37). Differences in pesticide use between oilseed and confection sunflower were not conclusive, so data are not shown in Tables 36 and 37.

The most common reasons for less pesticide use in all four states were fewer pests, followed by not economically feasible. The third most cited reason was better scouting for timely application, cited most frequently by SD and MN respondents. Alternate pest management practices were also cited, particularly in KS (Table 38).

The reasons for increased pesticide use by 30% of MN, 27% of ND and 27% of SD respondents is not known; this question was not on the survey form.

Crop Rotation. The number of years since the previous crop in that field was sunflower was most commonly three years in KS and SD and four years in MN and ND. Over 30% of KS, 11% of SD, nearly 6% of MN and 2% of ND respondents reported they had never before planted sunflower in that field (Table 39). These data correlate inversely to the length of time that sunflower has been grown in the state.

Table 36. Pesticide use on sunflower in 1994 compared to past years.

Pesticide Use in 1994 Compared to Past Years	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents			
Less	25.6	17.8	22.7	15.7
More	7.7	30.4	27.1	26.6
Same	66.7	51.8	50.2	57.7

Table 38. Reasons for less pesticide use on sunflower, 1994.

Reason	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents			
Fewer pests	47.8	34.5	59.8	67.3
Better application techniques	0	6.9	4.6	2.0
Better scouting for timely application	0	8.6	6.9	12.2
Use of different chemicals with lower use rates	0	8.6	1.1	2.0
Not economically feasible	34.8	34.5	20.7	14.3
Used alternate pest management practices	17.4	6.9	6.9	2.0

Table 37. Percent increase or decrease in pesticide use on sunflower by respondents reporting a use change, 1994.

	Increase					Decrease			
% Increase	Kansas	Minnesota	North Dakota	South Dakota	% of Decrease	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents reporting an increase					% of respondents reporting an decrease			
1-25%	33.3	27.7	27.9	23.7	1-25%	8.3	40.7	25.5	30.8
26-50%	16.7	35.4	33.8	22.0	26-50%	25.0	37.0	48.9	15.4
51-75%	0	3.1	2.9	3.4	51-75%	16.7	0	10.6	15.4
76-100%	50.0	32.3	35.3	49.2	76-100%	50.0	22.2	14.9	38.5
Over 100%	0	1.5	0	1.7					

Wheat was the crop that most frequently preceded sunflower, as reported on 85% of KS, 72% of MN, 71% of ND and 64% of SD respondents' acres. Barley preceded sunflower on 14% of MN and 13% of ND respondents' acres. Corn preceded sunflower on 20% of SD respondents' acres (Table 40).

Herbicide Used on Previous Crop. No herbicide was used on the previous crop on 62% of KS, 4% of MN, 16% of ND and 21% of SD respondents' acres. Assert was used on 15%, Bronate on 13% and Cheyenne on 8% of MN respondents' acres. Treflan was used on 18%, 2,4-D/Banvel on 17% and MCPA on 10% of ND respondents' acres. Treflan was used on 16%, 2,4-D on 11% and Banvel on 8% of SD respondents' acres (Table 41).

Table 39. Number of years since previous sunflower crop, 1994.

Years Since Previous Sunflower Crop	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents			
0	1.1	0	0	0
1	4.5	0	0.3	1.7
2	11.2	3.1	5.9	12.5
3	22.5	17.0	26.3	36.7
4	12.4	28.8	34.2	17.6
5	9.0	13.9	15.1	9.7
6	3.4	4.2	3.9	2.4
7	1.1	2.8	3.9	0.7
8	1.1	3.5	1.6	1.4
9	0	0.3	1.3	0.3
10	3.4	14.2	2.3	4.2
15+	0	6.6	3.3	1.7
Never before	30.3	5.6	1.6	11.1

Table 40. Crop preceding sunflower in 1994.

Preceding Crop	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents' acres			
Alfalfa	0	0.1	0	0.1
Barley	0	14.2	12.8	2.7
Corn	7.4	4.1	7.1	19.9
Dry Beans	0	0.3	0	0
Flax	0	0	0.2	0
Oats	0	0	1.0	1.0
Rye	0	0	0.5	1.0
Sorghum/millet	3.6	0	0	0.2
Soybean	0.2	2.0	2.4	1.9
Summer fallow	0	0.2	0.1	<0
Sunflower	0.7	0.7	0	0
Wheat	84.9	72.1	71.1	64.4

Cultivation. One cultivation was used by 73% of KS, 44% of MN, 63% of ND and 75% of SD respondents. Two cultivations were used by 5% of KS, 49% of MN, 26% of ND and 21% of SD respondents (Table 42).

Expanded Use of IPM. Sixty nine percent of KS, 79% of MN, 72% of ND and 67% of SD respondents responded that they wanted to increase the use of IPM in the next five years (Table 43). Respondents reported various techniques they planned to use for IPM. Crop rotation was cited by 48% of KS, 63% of MN, 53% of ND and 49% of SD respondents. Use of resistant hybrids was cited by 34% of KS, 56% of MN, 49% of ND and

Table 41. Herbicide used on crop previous to the 1994 sunflower crop in 1994.

Previous Herbicide	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents			
None	61.8	4.3	15.6	20.8
Accent	0	3.3	2.2	2.6
Ally	1.3	0	0	7.4
Assert	0	15.2	2.2	0.4
Atrazine	3.9	0	0	2.2
Avenge	0	1.1	0	0
Banvel	1.3	0	4.5	8.2
Beacon	1.3	0	0	0
Betanex/Betamix	0	1.1	0	0
Bicep	0	0.5	0	0
Bladex	2.6	1.1	1.3	0.9
Bronate	0	12.5	3.1	2.2
Buckle	0	1.1	0	0
Buctril	1.3	0.5	0.9	0
Cheyenne	0	8.2	0.9	0.4
Curtail	0	0	0	0.4
Dakota	0	0	0.9	0
Dual	2.6	0	0	4.3
Eradicane	0	2.2	2.2	3.5
Express	0	0	3.6	0.9
Fargo	0	2.7	2.7	0
Glean	3.9	0	0	0
Harmony Extra	0	5.4	5.4	6.9
Hoelon	0	7.1	0.9	0
Landmaster	2.6	0	0	0
Lasso	1.3	0.5	0.4	1.7
MCPA	0	7.6	9.8	0.9
Microtech	0	0	0	0.4
Partner	0	0.5	0	0
Poast	0	0	0	0.9
Prowl	5.3	1.6	0	2.2
Pursuit	0	0	0	0.4
Ramrod	0	0	0	0.4
Roundup	1.3	0.5	0	1.3
Sonalan	0	6.5	5.4	1.3
Surpass	0	0	0	0.4
Tiller	0	4.9	0.9	0.4
Treflan	3.9	4.3	17.9	15.6
2,4-D	2.6	6.0	17.4	10.8
2, 4-D/Banvel	2.6	1.1	1.8	2.2

40% of SD respondents. Increased pest monitoring was cited by 28% of KS, 49% of MN, 42% of ND and 33% of SD respondents. Tillage to bury crop refuse was cited by 16% of KS, 41% of MN, 31% of ND and 22% of SD respondents. Pest application timed by pest forecasting was cited by 23% of KS, 26% of MN, 27% of ND and 16% of SD respondents (Table 44).

Respondents indicated a number of areas of need for more IPM sunflower research. Resistant hybrids were cited by 16% of KS, 25% of MN, 27% of ND and 19% of SD respondents. Pesticide application timed by pest forecasting was cited by 13% of KS, 8% of MN, 8% of ND and 6% of SD respondents. Pest forecasting was cited by 9% of KS, 11% of MN, 9% of ND and 6% of SD respondents (Table 45).

Respondents most frequently cited pest monitoring as an area for more IPM extension training. Pest monitoring was cited by 11% of KS, 15% of MN, 13% of ND and 11% of SD respondents. Use of pest forecasting was cited by 4% of KS, 10% of MN, 10% of ND and 3% of SD respondents (Table 46).

Table 42. Number of cultivations used on sunflower in 1994.

Number of Cultivations	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents			
0	0	0.4	0	0.5
1	73.2	43.5	62.9	75.1
2	5.4	48.9	26.3	21.4
3	10.7	5.8	8.4	3.0
4	7.1	0.9	2.0	0
5	3.6	0.4	0.4	0

Table 43. Percent respondents who wish to expand the use of IPM in the next five years, 1994.

State	% Responding Yes
Kansas	68.9
Minnesota	79.3
North Dakota	71.8
South Dakota	67.0

Table 44. Techniques respondents plan to use for sunflower IPM, 1994.

IPM Technique	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents			
Increased pest monitoring	27.9	49.4	42.3	33.1
Use of pest forecasting	13.5	27.7	24.5	14.9
Pesticide application timed by pest forecasting	23.4	25.5	26.9	15.8
Use of resistent hybrids	34.2	55.7	48.9	40.2
Crop rotation	47.7	62.7	52.6	48.9
Tillage to bury crop refuse	16.2	40.8	31.1	22.0

Table 45. Areas indicated by respondents for more IPM sunflower research, 1994

Area for IPM Research	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents			
Pest monitoring	11.7	9.2	6.6	6.5
Pest forecasting	9.0	10.8	9.4	5.6
Pesticide application timed by pest forecasting	12.6	8.0	8.2	5.9
Resistent hybrids	16.2	25.2	26.9	18.6
Crop rotation	9.0	4.1	3.9	7.7
Tillage to bury crop refuse	4.5	5.4	2.4	3.1

Table 46. Areas indicated by respondents for more sunflower IPM extension training, 1994.

Area for IPM Extension Training	Kansas	Minnesota	North Dakota	South Dakota
	% of respondents			
Pest monitoring	10.8	15.0	13.3	10.5
Use of pest forecasting	3.6	10.2	10.3	3.1
Pesticide application timed by pest forecasting	4.5	8.6	8.5	5.3
Use of resistent hybrids	3.6	3.8	3.3	4.3
Crop rotation	4.5	2.5	2.4	2.8
Tillage to bury crop refuse	1.8	2.5	1.2	1.5

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Acknowledgements

The authors thank Rita Lattimore for manuscript preparation and Agnes Vernon for publication layout.

This study was supported by a grant from ES/USDA. The National Sunflower Association assisted with labeling and mailing of the survey forms.

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