Crop Profile for Sunflowers in Nebraska

Prepared: November, 2003

General Production Information

There are two types of sunflower production in Nebraska. There are those grown for oil production, and those grown for human food consumption referred to as confectionery seeds. A portion of the oil seed production is used in the bird seed industry.

Sunflower production in Nebraska has been increasing significantly in recent years because of the flexibility provided in the Federal farm program. Nebraska ranks 6th in the U.S. in sunflower production. Figures from 1998 indicate that Nebraska farmers raise sunflowers on approximately 68,000 acres. About 38,000 acres were oilseed production and approximately 30,000 acres are confectionary seed. Total Nebraska production was 81,020,000 pounds of sunflowers with an average yield of 1,191 pounds per acre. The total value of Nebraska sunflower production was $9,086,000. Of this total, oil sunflower production contributed $4,476,000 and confectionary seed production contributed $4,610,000. The average cost of sunflower production in Nebraska was $108 /acre on dryland. Figures from 1999 and 2000 indicate overall sunflower production in Nebraska has increased to approximately 100,000 acres.

Cultural Practices

Sunflowers are grown throughout the state of Nebraska with the greatest concentration in western Nebraska. As with any other crop, sunflowers need to be grown with good management practices that include proper placement within a rotation system. Sunflowers grow well on summer fallowed soil, but because of the deep nature of their root system, they can also do well in a rotation following shallow rooted cereal crops. The deep rooted characteristic of sunflowers can also result in significant soil water depletion. In the lower rainfall areas of western Nebraska,(ca. 14-16 in/yr), it may be necessary to summer fallow fields previously planted to sunflowers prior to planting winter wheat. Sunflowers leave minimal residue after the crop is harvested so consideration should be taken to avoid soil erosion. No-till sunflowers or sunflowers planted in strips with winter wheat or wheat stubble can help prevent serious erosion problems.

In fields where winter annual grasses such as downy brome, jointed goatgrass, or rye become a problem in winter wheat, a sunflower rotation can give a producer an opportunity to control these weeds. Sunflowers are susceptible to triazine and sulfonylurea herbicide residues in the soil. Sunflowers should not be planted where carryover from these herbicides might exist.

The Crop Profile/PMSP database, including this document, is supported by USDA NIFA.

Sunflowers grow well with a no-till seed bed preparation, but most of the soil applied herbicides labeled for sunflowers require incorporation. A seed bed suitable for corn would also be suitable for sunflowers. The seed should be placed into firm moist soil. Sunflowers do not provide fast coverage of the ground surface so a roughened soil surface should be created to prevent plant damage by windblown soil.

The sunflower crop is generally planted in late May to mid June, with some varieties being planted as late as July 15. Sunflower seeds will germinate at soil temperatures between 45 and 50 degrees F. Planting after June 5 helps avoid damage from insects. Seeding rates depend on the variety selected, but most varieties grown on dryland are planted at 14,000 to 21,000 plants per acre. Plant populations in irrigated fields range from 20,000 to 25,000 plants per acre. Seeding rates for confection sunflowers is usually lower than for oil seeds.

To determine pesticide usage and cultural practices, a survey was sent to growers to gain information about the 1999 growing season. Acres treated with pesticides and rates applied were taken from survey results.

Insect Pests

Cultivated sunflowers in the High Plains host a wide variety of insects. Not all these insects are damaging, and the problem species are not always present in densities capable of causing economic loss. When significant insect damage does occur, it may result from leaf, stem, root, or seed feeding.

Several species of native sunflower may serve as plant hosts for insects in the High Plains. Their varied flowering dates increase the chance that the presence of one or more pest species will coincide with susceptible development stages of cultivated sunflowers. Many sunflower insects overwinter in or near plant residue from the sunflower plants in which they developed. Crop rotation, modified planting dates, wild sunflower control, or deep plowing may reduce the likeli-hood of economically important insect infestations. However, deep tillage operations such as plowing may be incompatible with moisture and soil conservation practices. Experience has shown that judicious use of insecticides often is required for successful sunflower production. The use of such insecticides should be based on regular scouting and established economic thresholds when available.

Key Insect Pests of Sunflower

Sunflower Moth. *Homoeosoma electellum* (Hulst). Adults do not overwinter in Nebraska, but migrate from southern areas, and are attracted to sunflowers beginning to bloom. The annual northward dispersal is aided by southerly winds, and adults appear in the region in July. Earlier adult migrations utilize wild sunflowers and other host plants. Larvae begin to tunnel into seeds and other head tissue from July to

August and each larvae can destroy 4 to 6 seeds during development. Sunflowers infested with sunflower moth larvae are more susceptible to Rhizopus head rot.

Planting date studies indicate that early planted fields (fields that bloom before late July) stand the greatest chance of developing significant infestations. Therefore, delayed planting can reduce the potential for sunflower moth infestations, but this has to be weighed against yield loss and oil percentage loss associated with late planting. Scouting for sunflower moth should start when plants reach the R-3 stage of development. Moths are best scouted in the evening when they are active. Consider an insecticide treatment if scouting results average two or more sunflower moths per five plants at early bloom. Continue scouting through the R-5.9 stage for reinfestation. Another method to determine the economic action threshold utilizes pheromone traps. The traps should be monitored daily from the R-3 stage through the R-5.9 stage. Treatment should be considered if the traps in a field exceed 4 moths per trap per day during the R-3 to R-5.9 growth stage. Effective insecticide treatments currently used against sunflower moth include: Asana XL, Baythroid 2E, Furadan 4F, Lorsban 4E, and Warrior 1E.

Red Sunflower Seed Weevil. Red sunflower seed weevil, *Smicronyx fulvus* (LeConte) are reddish brown. Adults are about 1 /10 of an inch long. Females lay eggs between the pericarp and developing achene, usually 1 per seed. Larvae feed on the inner meat of seeds. When growth is completed, larvae exit the seed and drop to the ground from August to early October and overwinter in below-ground cavities. Pupation occurs in June and adults are found from June to September. There is a single generation each year.

Applications are made to prevent adults from laying their eggs. Treatments for red sunflower seed weevil should be made when about 30 percent of the plants have reached the R-5.1 stage. Confection types should be treated to avoid quality penalties if less than 10 to 15 per-cent of the plants have reached R-5.1 and one to two red sunflower seed weevils can be found per head. Oil seed thresholds are 8-12 weevils per head. Effective insecticide treatments currently used against seed weevils include: Asana XL, Baythroid 2E, Furadan 4F, Lorsban 4E, and Warrior 1E.

Sunflower Stem Weevil. *Cylindrocopturus adspersus* (LeConte). Adults are about 3 /16 of an inch long and grayish-brown with varying shaped white spots on the wing covers and thorax. Adults can be found on plants in June and July. Newly hatched larvae feed on leaf tissue, but latter stages move into the stalks. A chamber is formed by mature larvae (4th instar) near the base of the stalk where they remain all winter. The presence of high numbers of larval chambers can weaken the stalk, causing infested plants to lodge as plants dry down. Pupation occurs in May to June of the next year. Stem weevil adult emergence is highly influenced each spring by the preceding late fall, winter and early spring weather. However, once emergence occurs, 10 to 14 days are required before egg deposition begins. The female then selects plants with six or more leaves for egg laying. This means that early planted flowers are targeted for egg laying.

Stem weevil can be controlled by a preventive application of Furadan 4F at planting time or by scouting and controlling the adults and larvae (prior to the larvae entering the stem) with a foliar application after

the economic threshold is reached (one adult weevil per two plants).

Occasional Insect Pests of Sunflowers

Banded Sunflower Moth. *Cochylis hospes* (Walsingham). Adults begin to emerge in the region from June to early July. Peak egg laying coincides with the late bud crop growth stage (R-3 and R-4). Larvae feed on sunflower heads through late September to early October. Larvae overwinter in the soil and pupate in June of the following year.

This insect has not caused significant damage to sunflowers in Nebraska even though it is usually present. The conditions under which this insect may cause serious damage are unknown.

Gray Sunflower Seed Weevil. Gray seed weevil, *Smicronyx sordidus* (LeConte), feeding causes the seed to enlarge during its development. The larvae consume most of the seed contents so that at harvest the seeds pass through the combine and do not contribute to dockage. Treatments for gray sunflower seed weevil should be made when 10 to 15 percent of the plants have reached the R-4 stage.

Cutworm and Armyworm. Several species may be encountered throughout this sunflower growing region: Army cutworm: *Euxoa auxilaris* (Grote), Darksided cutworm: *Euxoa messoria* (Harris) Dingy cutworm complex: *Feltia ducens* (Walker), Pale western cutworm: *Agrotis orthogonia* (Morrison), Sandhill cutworm: *Euxoa detersa* (Walker).

Check fields early and treat if there is one cutworm per square foot or if plant losses are resulting in stands near the lower limits for optimum plant populations. Effective insecticides include Asana XL, Baythroid 2E, and Warrior 1E.

Wireworm. There are many species of wireworm that attack sunflowers. These insects overwinter in larval and adult stages in the soil. In the early summer the adults (click beetles), become active. The larval stage is spent in the soil and lasts 2 to 6 years. Crop damage results from the larval feeding as the seeds germinate and plants emerge.

Wireworms are most damaging to sunflowers when the crop is planted in wheat stubble. Generally wireworms are concentrated in the highest residue areas of the field. The larvae either feed on the seed, preventing germination, or after germination they feed on the stem between the seed and the soil line. In both cases they kill the plant. There is no known rescue treatment. Seed damage can be prevented with a seed treatment utilizing Lindane. This will not prevent stem damage, however, it should reduce overall stand loss.

Sunflower Head Clipping Weevil. *Haplorhynchites aeneus* (Boheman). Adults emerge in mid July and may be found on plants for a 2- to 3-week period. The females feed on pollen and nectar of flowering heads. Damage to sunflowers occurs as the female makes a circle of feeding punctures that partially

sever the head from the stalk. An egg is then laid in the sunflower head, which subsequently falls to the ground. The larvae develop and overwinter in the fallen head. Damage is often limited to field margins.

An action threshold has not been determined for this pest. Consider insecticide treatment if more than half the plants examined have weevils present and head clipping exceeds 5 percent on average across the field.

Grasshopper. Several species of grasshopper can defoliate sunflowers and become an economic concern during years of high populations. Both damage from nymphs in the early season and adults in the late season can occur. Grasshopper outbreaks can be anticipated based on the previous years population size and the current years weather conditions. Damage can occur from early June until mid September.

Treatment is recommended when 20 or more adult grasshoppers are found per square yard in the field margins, or 8 to 14 are found in the crop, and more than 30% defoliation has occurred.

Insecticides

Insecticide	% Crop Treated 1999 Oil Conf.		Application Rate per/acre Labeled Average		Timing	Insects Controlled*
Asana XL	29.5	32.7	5.8-9.6 oz	7.2 oz	late season	bsm, sm, rsw, gsw, stw, gh
Baythroid	NA	NA	.044 lbs	NA		bsm, sm, rsw, gsw
Endosulfan	NA	NA	42 oz	NA		bsm, sm
Furadan 4F	NA	NA	4-16 oz	NA		bsm, sm, rsw, stw, gsw, gh
Lorsban 4E	NA	NA	16-24 oz	NA		bsm, sm, rsw, stw, gsw, gh
Methyl Parathion	NA	NA	32 oz	NA		rsw, gsw
Sevin	NA	NA	1-3 qt	NA		gh, stw
Supracide 2E	NA	NA	32 oz	NA		bsm,sm, rsw, gsw, stw
Warrior 1E	6.3	2.3	2.6-3.8 oz	3.3 oz	late season	bsm, sm, rsw, gsw, stw, gh

* bsm = banded sunflower moth, gh = grasshopper, gsw = gray sunflower weevil, hcw = head-clipper weevil, rsw = red sunflower weevil, sm = sunflower moth, stw = sunflower stem weevil

Weeds

Managing weeds is important to successful sunflower production. Sunflowers in the High Plains are usually grown in rotation with other crops. There are weed control benefits associated with crop rotation but these can only be realized if good weed management is practiced in each rotation crop. Sunflowers are usually planted at low densities and growth is slow during the first few weeks. Weeds emerging during this time can be very competitive and reduce sunflower yields significantly. Sunflowers become strongly competitive with weeds after the third week, therefore maintaining the crop weed free for the first 3 to 4 weeks after planting will minimize yield losses from weeds.

Preplant Weed Control

It is critical that sunflowers be planted into a weed free seedbed. Early season weed control can be accomplished with tillage, herbicides, or a combination of both. If sunflowers are planted in rotation with small grains, they should not be planted in wheat stubble if Glean, Ally, Peak, Amber, Finesse, Canvas, Maverick, or Tordon herbicides were applied for weed control in the growing wheat because of potential damage from herbicide carryover.

Nonselective herbicides such as glyphosate (Roundup Ultra or Roundup RT) or paraquat (Gramoxone Extra) are an alternative to preplant tillage to control most grasses and broadleaf weeds.

Few weeds germinate following use of preplant burndown herbicides, because there is no tillage to bring new weed seed near the soil surface to germinate, and weed seeds lying on the surface are not buried into moist soil. Glyphosate mixtures containing 2,4-D (Landmaster BW) or dicamba (Fallow Master) have a serious potential for causing crop injury and should not be used within 3 months of planting sunflowers.

Delayed planting of the sunflower crop is sometimes used to allow more weeds and volunteer wheat to germinate. By doing this a greater proportion of the early weeds can be killed before planting the sunflower crop.

Weed Control in the Crop

A number of preplant incorporated herbicides are currently available for weed control. These include EPTC (Eptam), ethalfluralin (Sonalan), pendimethalin (Prowl), and trifluralin (Treflan). These herbicides are for control of grassy weeds such as barnyardgrass , foxtail, fall panicum, field sandbur, witchgrass, and crabgrass. The best and most economical grass control is often provided by Treflan, followed by Prowl, and Sonalan, in that order. These herbicides usually control light to moderate infestations of pigweed and lambsquarter, and at higher rates will provide some control of kochia and Russian thistle. Prowl is a product that may be surface applied without incorporation and is used in no-

till and conservation-till sunflower production.

Sonalan or Treflan in granular formulation can be incorporated with a sweep plow to provide weed control in a reduced tillage system. Sonalan or Treflan granules applied and incorporated 1 to 2 weeks before planting, or in a split application with half of the herbicide applied and incorporated the previous October, provided greater than 85 percent weed control for 7 to 9 weeks after planting. Because winters in the High Plains are warmer than in the Northern Plains and snow seldom covers the ground all winter, fall and surface applications of granular herbicides break down more rapidly and do not work as well in the High Plains.

Volunteer wheat can be a major problem in wheat-sunflower rotations, especially where wheat has been shattered by hail or wheat stubble has been disked. Treflan can provide some wheat control, but generally is not satisfactory. Volunteer wheat and other grassy weeds can be controlled postemergence with sethoxydim (Poast or Poast Plus). Poast is most effective for control of wheat that is less than 4 inches tall and is actively growing.

Herbicide options for weed control in sunflowers are limited, especially for control of many broadleaf weed species. To reduce costs and provide broad spectrum weed control, mechanical weed control in the crop also should be considered. A shallow tillage pass with a spring-tooth, or flexible harrow pulled diagonally to the planting direction can remove many seedling weeds. The rotary hoe is another option used before and just after sunflower emergence. Increased planting rates are recommended if using a rotary hoe to compensate for stand reductions due to tillage.

Shielded (hooded) sprayers may be used to apply Gramoxone Extra as a directed spray between the rows of sunflowers. Extreme care must be exercised to avoid contact of the nonselective herbicide and the sunflower. This treatment is most effective on weeds less than 6 inches tall and should not be used as a rescue treatment on large weeds.

Finally, between row cultivation may be necessary to obtain adequate weed control in sunflowers and should be available as a backup. Heavy-duty cultivators that combine disk hillers in front with single, wide, rear-mounted sweeps are especially useful where row crops are grown in heavy crop residues. Cultivating sunflowers that have been planted into wheat stubble may reduce the soil moisture saving benefits associated with wheat stubble on the soil surface.

Herbicides

Herbicide	% Crop Treated 1999 Oil Conf.		Application Rate er/ acre Labeled Average		Timing	Weeds Controlled
2,4-D Amine (4L)	2.4	NA	8-16 oz	6 oz	early pre-plant	broadleaf

Eptam 7E	NA	NA	2.5-3.5 pts		pre-plant	grass and some broadleaf
Eptam 20G	NA	NA	10 lbs		pre-plant	grass and some broadleaf
Gramoxone Extra	NA	NA	16-24 oz	NA	post-emerge	desiccant
Poast	1.3	2.3	16-24 oz	24 oz	post-emerge	annual grasses
Prowl (3.3 EC)	46	38	1.2-3.6 pts	3 pts	pre-plant	grass, some broadleaf
Roundup Ultra	5.1	5.3	8-32 oz	19 oz	pre-plant	grass, broadleaf
Sonolan	13.1	4.2	24-48 oz	34	pre-plant	grass, some broadleaf
Sonolan 10G	5.7	2.9	5.5-11.5 lbs	10 lbs	early pre-plant	grass, some broadleaf
Spartan* (section 18)	1.4	9.3	2.6-5.3 oz	5.2 oz	early pre-plant	small seeded broadleaf
Treflan	34.6	23.5	16-32 oz	26 oz	pre-plant	grass, some broadleaf
Treflan TR-10	NA	NA	5-10 lbs	NA	fall or spring pre-plant	grass, some broadleaf

* Spartan (sulfentrazone), was used in no-till or conservation-till sunflowers grown in the U.S.1999 through a section 18 emergency registration. Section 18 registration was also assigned in 2000 waiting for federal registration. Spartan controls most annual small-seeded broadleaf weeds such as biennial wormwood, kochia, common lambsquarter, waterhemp, pigweed species, nightshade species, and annual smartweeds. Spartan can suppress other weeds such as buckwheat, mustard, ragweed, and Russian thistle. It has some grass but no perennial weed control. Spartan requires precipitation for activation.

Diseases

Sunflower production in the High Plains has been increasing as the sunflower oil and confection seed industry have established local markets. As with other crops, as planted acreage increases, the probability of disease also increases. The problem is compounded by native sunflowers that serve as a reservoir for diseases and pathogen carrying insects.

There are about a dozen diseases known to occur in the High Plains region, all of which are caused by fungi. These fungi may attack the roots, stems, leaves, or heads, but only a few of these diseases cause

significant economic loss.

Many disease problems are more severe under irrigated conditions, especially with center pivots. The most effective control for sunflower disease is accomplished with resistant varieties and the use of 4 year rotations in fields showing disease symptoms. Seed treatments are available for the control of seed rots and seedling blights but they are not used extensively. Currently, no foliar applied fungicides are registered, although emergency exemptions have been granted in recent years for the control of sunflower rust.

Rhizopus Head Rot. There are two fungal species, *Rhizopus arrhizus* and *R. stolonife*r, that have been implicated in disease development. The disease first becomes noticeable when the back of the head turns brown and becomes soft and mushy. During periods of wet weather, or when examining the internal hollow part of the flower head, you may see threadlike strands of the fungal mycelium. Small, black fruiting structures the size of a pinhead develop later, giving the mycelium a grayish appearance. In later stages of disease development, as the head dies, the tissue begins to shred and occasionally the head may fall to the ground. Losses to Rhizopus head rot in some fields have been near 100 percent. Although no chemical controls are available, disease development can be strongly correlated with sunflower head moth infestations. It has been demonstrated that a good insect control program, particularly sunflower head moth, will limit infection and yield losses. Infection also can occur through wounds created by birds and hail. Physical injury on the back of the sunflower head, coupled with wet or humid conditions, can result in the development of Rhizopus head rot.

Phoma black stem. This disease is caused by the fungus *Phoma macdonaldii*. It appears as large black lesions on the stem, sometimes reaching several inches in length. Infection is favored by moist conditions during and after flowering. Lesions usually appear where the leaf petioles attach to the stem. Eventually, leaves wilt and dry up and stalks often turn dark brown to black. Small black spots (pycnidia) may be observed in mature lesions with the use of a hand lens. Infected plants are weak and more susceptible to lodging. Heads may be smaller with reduced seed yield and oil content. When *Phoma* girdles the stem base, symptoms of pre-mature ripening can occur, including early dying and blackening of plants. Plants affected by *Phoma* girdling have black to brown roots and a black to brown lesion at the soil line. The fungus overwinters in infected debris and is spread by splashing rain or insects. While no control measure is totally effective, crop rotation will reduce the population of *Phoma* in the soil. A good insect control program will also limit disease spread. Although no hybrids are immune to the disease, some seem to have more resistance than others.

Phomopsis stem canker. The disease is caused by *Phomopsis helianthi*, and is similar in appearance to Phoma black stem. Compared with Phoma black stem, the *Phomopsis* lesion is much larger, sometimes reaching 6 inches in length. It is also lighter in color being a tan to brown color. *Phomopsis* causes more pith degradation than does *Phom*a, so that the stalk is easily crushed when thumb pressure is applied to the lesion. Like Phoma black stem, plants infected with *Phomopsis* ripen prematurely and have a reduced oil content. No specific control measures are reported, but since the disease overwinters on crop debris, long rotations should be effective.

Red Rust. This is caused by the fungus *Puccinia helianth*i, and is one of the most common diseases found on sunflowers in the High Plains region. Yield losses are limited when it occurs late in the growing season, but in recent years, development has begun early in the season and significant losses have occurred, particularly in the confection seed crop. Recent surveys have detected many new races of rust. Good resistance is available to these new races in many oil hybrids, and a few newer confection hybrids. Rust may first appear as pale yellow spots on the upper surface of the leaf. As it develops, cinnamon colored spots will form on the underside of the leaf. Later, these spots will turn black. Changes in color coincide with the different stages of fungal development. Severely diseased leaves dry up and die. No fungicides are currently registered for use in the United States, but emergency exemptions have been granted for tebuconazole (Folicur) in recent years. Besides resistant hybrids, destruction of volunteer sunflower, controlling wild sunflower near commercial fields, and avoiding high nitro-gen rates and high plant populations will aid in disease management.

Seedling Blight and Seed Rot. Sunflower seed may be attacked by various soilborne and seedborne pathogens. Affected seeds may rot before emergence or seedlings may be killed within a week or two following emergence. Such seedlings often exhibit damping-off, which is a collapsing of the stem at or below the soil surface causing the plant to die. Other symptoms may include darkened, rotted roots or stem discoloration. *Pythium* and *Rhizoctonia* species are the most common fungi associated with such diseases but other fungi may occasionally cause problems as well.

Seedling diseases are best managed by making sure there is good contact between the soil and seed at planting, and that soil temperature (above 50 degrees Fahrenheit) and moisture are favorable for rapid germination and growth. When planting or germination conditions are less than ideal, there are several recommended planter box seed treatments available.

Verticillium wilt. This disease, also called leaf mottle, is caused by the fungus *Verticillium dahlia*e. Symptoms are most obvious at flowering when infected plants occur singly or in groups. Symptoms appear on lower leaves first and gradually progress up the plant. Tissue between leaf veins becomes yellowed, then brown, giving the leaf a mottled appearance. Black areas occur on the stem, particularly near the soil line. The vascular system of the stem is brown to black when cross-sectioned. Severely infected plants are stunted and may ripen prematurely or die before flowering. Verticillium wilt occurs only occasionally in the High Plains region. Management is by a 3 to 4 year rotation with small grains or other non-host crops, and avoiding fields with a history of Verticillium wilt.

Fungicides

Fungicide	% Crop Treated 1999 Oil Conf.		Application Rate per/acre Labeled Average		Timing	Disease Controlled
Apron XL, LS	NA	NA	1.28 oz/ cwt	NA	Seed trt.	Rots, seedling blights

Captan 30 DD	NA	NA	4 oz/cwt	NA	Seed trt.	Rots, seedling blights
Captan 400	NA	NA	2-4 oz/ cwt	NA	Seed trt.	Rots, seedling blights
Nu-Gro Captan	NA	NA	2-4 oz/ cwt	NA	Seed trt.	Rots, seedling blights

Contacts

David Baltensperger
Alternative Crops Specialist.
University of Nebraska
Panhandle Research and Extension Center
Scottsbluff Nebraska
(308) 632-1261
e-mail: dbaltens@unlnotes.unl.edu

Paul Burgener
Agricultural Economic Research Analyst
University of Nebraska
Panhandle Research and Extension Center
Scottsbluff Nebraska
(308) 632-1241
e-mail: pburgene@unlnotes.unl.edu

Gary Hein
Entomologist University of Nebraska
Panhandle Research and Extension Center
Scottsbluff Nebraska
(308) 632-1369
e-mail: ghein@unlnotes.unl.edu

Drew Lyon
Dryland Crops Specialist
University of Nebraska
Panhandle Research and Extension Center
Scottsbluff Nebraska
(308) 632-1266

e-mail: dlyon@unlnotes.unl.edu

Prepared by:

John A. Thomas
Research Coordinaor, Entomology
Panhandle Research and Extension Center
4502 Ave. I
Scottsbluff, NE 69361
(308) 632-1250
e-mail: jthoma1@unlnotes.unl.edu

Dr. Gary Hein
Extension Entomologist
Panhandle Research and Extension Center 4502 Ave. I
Scottsbluff, NE 69361
(308) 632-1369
e-mail: ghein@unlnotes.unl.edu

Dr. Shripat Kamble
Professor of Entomology and Extension Specialist
Department of Entomology
University of Nebraska, Lincoln
Lincoln, Nebraska 68583
(402) 472-6857
e-mail: skamble@unlnotes.unl.edu

References

1. Crop Protection Reference. 1999. 15th Edition. C&P Press. New York.

2. Guide for Weed Management in Nebraska. 2000. University of Nebraska Cooperative Extension EC 00-130-D.

3. High Plains Integrated Pest Management Guide for Colorado-Western Nebraska-Wyoming. No. 564A. 1998. Colorado State University, Fort Collins.

4. High Plains Sunflower Production handbook. 1999. Kansas State University Agricultural

Experiment Station and Cooperative Extension Service. MF-2384.

5. Nebraska Agricultural Statistics Service. http://www.agr.state.ne.us/agstats/nebpubs2.htm.

6. Sunflower Production in Nebraska. 1991. NebGuide published by Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska- Lincoln. G91-1026.

7. University of Nebraska, Entomology Website. entomology.unl.edu

8. Influence of planting dates and populations on seed yield and plant characteristics of sunflower in the high plains. Journal of Production Agriculture, Vol 12, no. 1, Jan-Mar. 1999.