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SOYBEANS—
A New Generation of Herbicide Applicators

See Page 10
IANR Energy Concerns

As we enter the 1980 planting and growing season, we become more aware of energy consumption and costs on Nebraska farms. Along with this awareness, we must look hard at measures which can be taken to conserve energy and at alternate sources of energy for potential use in agriculture.

One-half of the energy expended in farming operations in Nebraska is used in irrigation. Fertilizer, pesticides and field operations consume another great share of energy consumed in agriculture.

The Institute of Agriculture and Natural Resources recognizes a commitment to energy needs. In several divisions of the Institute, we are working to conduct research and to provide information and training in energy conservation and alternative energy sources.

Through on-going programs like irrigation scheduling, pumping plant efficiency testing, minimum tillage and Ecofallow systems, tractor testing and others, the Institute is seeking viable methods for energy conservation in agriculture.

In the area of energy alternatives, the Institute's field lab at Mead is the site of a proposed Advanced Technology Energy Farm. A major proposal to the Department of Energy would create this essentially zero-base petroleum farm. Through this project, we will try to show that such a farm can produce all of its own fuels, lubricants and other petroleum-base products, with the exception of pesticides.

The central core of this farm is already in operation in the form of a photo-voltaic solar array which powers an electric motor for irrigation during the summer, is converted for use in grain drying in the fall and during the winter, is used to generate nitrogen fertilizer, through the use of a high voltage arc reactor. The farm will produce its own fuels through methane generation, grain alcohol production and the use of vegetable oils as lubricants.

These energy alternatives and a continued effort in energy conservation will be some of the concerns of the Institute in its continuing commitment to provide the best technologies for Nebraska agriculture and the citizens of this state.

M. A. Massengale

Vice Chancellor for Agriculture and Natural Resources .................... Martin A. Massengale
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Acting Director, Nebraska Water Resources Center ........................ Gary L. Lewis
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On the cover:

There's a great deal of enthusiasm over the new herbicide applicators for soybeans. These new applicators do away with walking and corn-knife chopping of weeds. Stories on these machines begin on pages 10 and 12. (Photo by Dick Dodds. Cover background: Nebsoy, a new soybean variety, released by the IANR Agricultural Experiment Station.)

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Rust, Leaf Spot
Winter Wheat’s Costly Foe

By John E. Watkins, Eric D. Kerr, and Ben Doupnik, Jr.

Two leaf-spotting fungi and one rust fungus commonly cause damage to the foliage of winter wheat grown in Nebraska. Annual yield losses of approximately $3 million are common, but this figure is even greater when these diseases become severe and fungicides for disease control are not applied.

Tan spot (Pyrenophora trichostoma) and Septoria leaf blotch (Septoria tritici) are the principle leaf spot diseases of winter wheat in Nebraska. Tan spot is a relatively new disease to confront Nebraska wheat growers, being first reported in the state in 1977 when it occurred in epidemic proportions. Septoria leaf blotch, another destructive leaf spot disease of wheat, has been present in Nebraska for some time. The fungi causing these leaf spots survive on the stubble and attack the leaves in spring and early summer. Frequent rains and prolonged periods of cool, moist, cloudy weather favor disease development. Under these conditions, both diseases cause severe blighting of the lower leaves and progress to the upper leaves (Figure 1).

Wheat leaf rust (Puccinia recondita tritici) occurs in all wheat growing regions of the world. In Nebraska, yield losses in winter wheat are usually less than 5 percent, but under conditions favorable for rust development, losses may be much higher. Winter wheat in Nebraska becomes infected in late May (Figure 2), when rust spores are blown north from rusted fields in the southern Great Plains states. Whether or not leaf rust develops during the growing season is then determined by the virulence of the rust population to the commonly grown wheat cultivars (varieties) and by weather conditions favorable for infection and spread.

Each of these diseases can reduce grain yield. The diseases are most damaging when cool to moderate, wet weather extends well into June. Fortunately, in most years, the hot, dry, windy weather that prevails during the yield-crucial post-boot stage is unfavorable for rust or leaf spot development. This helps to keep down yield losses from foliar diseases. Occasionally, as in 1977 and 1978, weather conditions from April to June are ideal for rust and leaf spot development and the yield decline is much greater. Although many factors influence yield, it is estimated that foliar diseases result in

(Continued on next page)
Winter Wheat…
annual losses of up to 5 percent. A reduction in yield as small as 1 percent translates to approximately one million bushels, which at current wheat prices, represents an economic loss of $2 to $3 million.

Incidence and Severity
The incidence and severity of leaf rust and the two leaf spots in 1979 was generally greatest in eastern and south central Nebraska (Tables 1 and 2). Foliar disease readings were taken on twenty winter wheat varieties at six small grain variety test locations. Leaf rust was moderately severe on Turkey, Centurk, Centurk 78, Lancer, Agate, Buckskin, Sentinel, Scout 66, Scoutland, Larned, Bennett and Homestead in Pawnee and Webster counties. Low rust severities occurred on Lancer, Sage and Gage in both the Pawnee and Webster county trials. The varieties Lindon and Vona were not in the Pawnee county trial. In Webster county Lindon was moderately rusted, whereas the severity on Vona was light (Table 1).

Lancota, Gage and Sage developed only light amounts of rust at all locations. The resistance of these varieties appears to be holding up well, especially the resistance in Lancota. The newly released varieties, Centurk 78 and Bennett, were moderately rusted at two locations and developed only light amounts of leaf rust at the other locations (Table 1).

The development of leaf rust on Centurk and Lancota was monitored in foliar fungicide trials in Deuel and Dawes counties. Leaf rust did not occur on either variety in the Dawes county trial and occurred in only light amounts at the Deuel county location.

Although leaf rust severities reached 50-60 percent on some cultivars in Pawnee and Webster counties, economic loss from leaf rust was probably minimal because weather conditions in June delayed rust development. Under environmental conditions ideal for rust development, leaf rust will become severe on susceptible varieties about 40 days after initial presence in a field. For this to occur, temperatures must be moderate and the leaves continually wet for 6-8 hours each day (Figure 3). The free moisture requirement can be attained through frequent rain showers and/or heavy dews. Even though these conditions may exist in Nebraska, if leaf rust does not build up to an appreciable amount in the states to the south, the prevailing winds will carry fewer rust spores to initiate infection in Nebraska fields. In 1979, the incidence of leaf rust in Kansas was light to moderate. This, along with the drier and warmer than normal weather in June, probably accounted for the low rust severities in Nebraska.

Resistant Cultivars
Development of leaf rust resistant cultivars through breeding has been the principal method of controlling this disease. Unfortunately, rust resistance is not permanent because the pathogen keeps forming new
races capable of attacking the newly developed cultivars. The winter wheat cultivars Gage and Lancota are rated as moderately resistant to leaf rust, and Sage is rated as moderately susceptible. All other wheat cultivars grown in Nebraska are susceptible. Shifts in the natural leaf rust population emphasize the importance of continued cooperative research between plant pathologists and plant breeders to reduce losses from wheat leaf rust.

If rust resistant varieties are not grown, the disease can be controlled by applying a protectant fungicide. Under potential epidemic conditions, proper timing of foliar fungicide application is needed to prevent the rapid buildup and spread of rust within local wheat growing areas. New systemic fungicides are being developed which may offer an effective and economical means of chemical control.

Another important factor to consider when winter wheat is planted early for grazing, is that fall infection can result in moderate to heavy rusting of susceptible cultivars. This additional stress can contribute to a higher incidence of root and crown rot causing increased winter killing of plants.

Tan spot was the predominant leaf spot at all locations evaluated except Howard county, where Septoria leaf blotch was the most evident. Leaf spot intensity was highest at the Howard, Hitchcock, and Polk county locations, intermediate in Pawnee and Webster counties and lowest in Custer county. At all locations leaf spot was severe on lower leaves and usually present on the flag leaf (upper most leaf) in trace to moderate amounts (Table 2). Leaf spot intensity, representing largely tan spot, was recorded on Centurk and Lancota in the foliar fungicide trials in Dawes and Deuel counties previously mentioned for leaf rust. On both varieties in Deuel county, leaf spot was moderate to severe on the flag leaf. Both varieties at this location were more severely infected than in the six variety trials. Contrastingly, the incidence of leaf spot was lower in Dawes county than all other locations. In this trial, leaf spot failed to develop beyond the mid point of the plant on either Centurk or Lancota. The upper leaves were free of tan spot and Septoria leaf blotch lesions.

Specific varietal resistance to tan spot or Septoria leaf spot apparently is not present in those winter wheat varieties evaluated at the six small grain variety trials. The average intensity of leaf spots for each variety at all locations showed little difference between varieties. All varieties developed severe average infection of lower leaves with lesions present on the flag leaf in at least trace amounts (Table 1). Apparently leaf spot severity is influenced more by inoculum intensity and environmental conditions than by varieties.

Higher Intensity in 1979

The higher intensity of the leaf spot diseases in 1979 than that of leaf rust is not surprising. Both leaf spotting organisms overwinter in Nebraska and begin to infect wheat four to six weeks earlier in the spring than leaf rust. Weather conditions in April and May were much more favorable for discharge and spread of spores of foliar pathogens and infection of leaves. Consequently, leaf spot diseases were well established on plants by the time rust spores began to arrive. Continued leaf spot development in June was influenced by the same weather conditions that affected leaf rust development.

There is little doubt that leaf rust and leaf spot diseases are potentially dangerous threats to winter wheat production in Nebraska. Much of the Nebraska wheat acreage is planted to leaf rust- and leaf spot-susceptible cultivars. The three diseases are well established in the state, and when favorable weather conditions occur, they can build up rapidly to damaging levels.

Epidemics are difficult to forecast, but the monitoring of outstate variety trials and other experimental plots throughout the state can aid in detecting build-up of these diseases sufficiently early for effective application of fungicides.

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Acknowledgment: The authors wish to express their appreciation to Professors August Dreier and Philip Grabouski, Drs. Lesen Nelson and Edward樊CUS and other members of the small grains outstate testing project for their assistance in planting and harvesting of plots mentioned in the text. The authors also wish to express their appreciation to the growers on whose land these plots were located.
There are four species of canids, or the dog family, in Nebraska. The coyote (Canis latrans) occurs throughout the state. Gray foxes (Urocyon cinereoargenteus), are found in the southeastern portion of Nebraska and along the Platte River drainage. Red foxes (Vulpes vulpes) are most abundant in the eastern one-third of Nebraska and are found in most parts of the state except the Sandhills. Swift foxes (Vulpes velox) are found in the Panhandle and southwestern portion of the state.

Swift foxes are the smallest of this quartet. Adults weigh 5 pounds (2.3 kilograms) and are about 32 inches (80 centimeters) from the tip of their nose to the end of their tail. They have a buffy-yellow coat and are distinguished from all the other canids in western Nebraska by having a conspicuous black-tipped tail. Red foxes are larger (11 pounds; 5 kilograms), reddish in color, and their tail is tipped with white. Swift foxes are much smaller than coyotes which weigh about 30 pounds (13.6 kilograms).

Population

Swift foxes once occurred across all except the extreme eastern portion of Nebraska. They were fairly common in the western and central portions of the state when it was first settled. Their numbers dwindled drastically after settlement and may have been entirely absent from Nebraska in the early 1900's. They have returned to Nebraska, probably from our neighboring states to the west and south, and presently are scattered over the western one-fourth of the state with a small population in Sioux county. Swift foxes apparently were extremely vulnerable to poison baits which were placed on rangeland to control coyote populations, a practice which has since been banned.

Today swift foxes are an endangered species in Nebraska. An endangered species is one that is in jeopardy of maintaining itself as a viable part of the wild animal in the state. Judgment is made by the Nebraska Game and Parks Commission and typical considerations include present or threatened habitat loss, overutilization, disease or predation, inadequacy of existing regulations, or other natural or man-made factors affecting its continued existence within the state. Swift foxes are fully protected under the state endangered species law of 1975.

Study Findings

The Nebraska Game and Parks Commission funded this study. Objectives of the study included gathering information about swift foxes such as ranges, selection of den sites, litter sizes and habitat preferences in order to formulate a sound management program to assure the continued existence of this species in Nebraska.

Swift foxes do not present a threat to ranchers in our state. They appear to subsist primarily on the remains of dead animals throughout winter. During the summer their diet is more varied and includes rabbits, mice, birds and insects.

One of the major food sources for swift foxes appears to be road-killed animals. This also represents a major threat to these foxes since they frequently fall victim to vehicles on the highways themselves. We found...
Swift foxes are a small and beautiful member of the dog family.

Dens are found in open flat shortgrass prairies and usually have one to four entrances with one to two mounds.

Cage traps were used to capture foxes for tagging and radio-collaring.

Pups were marked with identifying ear tags.

Adult foxes were bound and blindfolded while being fitted with a radio collar.

Fox lives may end by being hit by a vehicle as happened to this 3-month-old pup, pictured above, in the cage, a few days earlier.

Adult foxes were bound and blindfolded while being fitted with a radio collar.

four road-killed foxes during our study.

Swift foxes mate in early March and have a litter of 4 to 6 pups in early May. Males probably do not participate in rearing pups.

Our primary study methods consisted of live-trapping foxes, fitting them with radio-transmitter collars and then "observing" them with radio receivers. Walk-in, steel live-traps baited with canned sardines were very successful in capturing foxes. Fifteen foxes were trapped at least once during 10 months of field study. Foxes were identified with numbered ear tags. Only adults were equipped with transmitter collars. Measurements were taken whenever the foxes were captured so that growth rates could be determined.

Home ranges of swift foxes were as large as 11 square miles (28 square kilometers). This is an extraordinarily large range for such a small animal. It is possible that this may be due to the sparseness of food which requires foxes to range widely in order to survive.

Swift foxes are active primarily at night. During the summer they may be seen loafing near their den sites in early morning and late afternoon. They spend the morning and early afternoon in their underground dens which may have from one to four entrances. At night they are active along roadsides.

We could not have been successful in locating as many swift foxes as we did without the help of many of the ranchers in Sioux County. The Harrison Drugstore was a frequently-used site to discuss possible locations of foxes.

You may see swift foxes from the road if you are alert when driving through swift fox country. One den with four pups was found within 20 yards (18 meters) of the highway. However, please drive with caution at night as swift foxes hunting roadside ditches and feeding on road-killed animals are particularly vulnerable to vehicles traveling on highways.

Terrence D. Hines is a graduate student and Ronald M. Case is associate professor, Department of Forestry, Fisheries and Wildlife.
The Role of Women in Public Affairs

'I like to pay rent for the space I occupy, I feel I should get involved and contribute to my community ...'

By Ron Daly, Lois Olive and Kathy Sullivan

Some may think a woman's place is in the home, but a growing number of women also are taking their place "in the house"—whether that be the State House, city hall or even the U.S. House of Representatives.

Nebraska women are no exception, they are involved in politics and public affairs.

The why and how of this involvement was the focus of a study funded through Title V of the Rural Development Act at the UNL Institute of Agriculture and Natural Resources.

The study was designed to examine the characteristics of Nebraska women involved in public affairs and to learn firsthand why they got involved and their advice to others who might follow them.

Nebraska women have made significant contributions in governmental affairs, but the numbers serving in key positions still are quite small. It was hoped this study could be a first step in helping and encouraging more women to assume leadership positions in public affairs.

Participant Characteristics

The women who participated in the study came from two sectors of public affairs: those in certain elected positions at local, state and federal levels of government; and women serving in leadership positions in the two major political parties.

The women interviewed included mayors, county commissioners, state senators, a congressional representative and those in political party positions. They ranged in age from 28 to 72 years old. All had completed senior high school and nearly half had completed some type of advanced training in the form of college, technical or business school.

These women come from all types and sizes of Nebraska communities. Involvement in public affairs did not seem to be predetermined by the size of community, be it large or small.

For the most part, they were active in a host of local, state and national activities. A little less than half of the women also combined their civic and political involvement with employment.

Forty-two of the 45 participants had followed the more traditional patterns of marriage and raising a family. For the majority of these women, combining family responsibilities with public affairs involvement, and in some cases additional employment, did not pose insurmountable problems.

Of course, this blending of roles is not totally without problems. As one woman said, "Politics and family don't go together easily for a woman. She needs a lot of support and encouragement if she's going to make it work."

Although the numbers of women in public affairs is increasing, this is still a new frontier for them. At the time this study was done (Summer, 1979) there were 18 women in Nebraska serving as mayors, eight as county commissioners, three as state senators and one congresswoman. Those who are in positions such as these can still be considered pioneers in terms of women's involvement. A number of the women interviewed were the first women to serve in their respective positions.

Telephone Interviews

Perhaps one of the most enlightening aspects of the study were the telephone interviews, which were conducted by Kathy Sullivan, project consultant. The interviews were done with each of the participants and provided personalized accounts of the women's experiences and feelings about their involvement in public affairs. While each was unique and different, there were common threads and feelings that surfaced about the role of women in public affairs.

What motivated them to get involved? For many it was a feeling of responsibility. They are not persons content to sit on the sidelines and complain about something.

As one commented, "I like to pay rent for the space I occupy. I feel I should get involved and contribute to my community."

Many indicated that while they had an interest in getting involved, it was support and encouragement from family and friends that made them commit themselves to a specific role or position.

More than any one individual, the husband was cited as a key person in helping the women decide to take the step into public life. Overall, many termed their spouses as supportive, encouraging, willing to share the load of home responsibilities, and proud, not threatened, by their wives assuming leadership positions.

Who and what was helpful along the way? They commented:

"I've been sincere and honest in my approach. People can spot a phony right away."

"I have a lot of personal optimism; most things I try turn out well. I'm confident and appear confident to others."

"I've always set high goals for myself. I'm an extrovert and my thinking process is, I think, a lot like a man's."

Family, supporters, co-workers, whomever they might be, the women did believe the help of other individuals was key to success in public affairs. As one woman remarked, "I don't believe any man or woman who says no one helped them along the way. Everyone needs help up the ladder."
What barriers keep more women out of public affairs? The barriers cited many times by these women were of a subtle, internal nature. For example, 20 of the participants said “women, themselves” were their own worst barriers to involvement.

The following comments illustrate some of their feelings:

“Our culture tells women they aren’t able to do this sort of thing. Women are afraid to try, they don’t want to be laughed at.”

“Many women are timid, not sure of themselves, especially if they’ve not seen women in their own families assert themselves.”

Other barriers cited were family commitments, lack of financial backing and not enough support for women by women.

As many admitted, the life in public affairs can be rough and some are just not willing to put up with it. One woman said, “There’s a lot of pressure . . . it definitely changes your lifestyle. Many women just don’t care to put up with these problems and put them ahead of their families.”

What advice do they have for other women? Most believe the first step is simply to get involved. The involvement can be as simple as circulating a petition or attending a school board meeting.

Secondly, they feel it’s important for a woman to make a commitment—is this really what I want to do?—then take the necessary steps to accomplish it.

“The opportunity is there for women, but it does take a lot of work—and some savvy and experience. A woman can’t run so much as a woman, but she must stand for something,” one woman said.

And while the method of operation in public life has more or less been established by men, the participants encouraged women to look at their own unique capabilities and qualities rather than try to emulate men.

Special Challenges

While most of the women in this study did not feel they needed any special mention or recognition because they were women, many did admit that the role of women in public affairs rightly or wrongly carries with it some special challenges. Several indicated that it was, at times, difficult to be a “woman in a man’s world,” but none felt it was an unworkable situation.

Some commented about how they handled the issue during their campaigns.

“I was the first woman to run for this office. The fact that I was a woman was an issue in my campaign, but so were my qualifications.”

“I urged people not to vote on the basis of whether I was a woman, but whether or not I could do the job.”

While most said there wasn’t as much obvious discrimination and that doors were opening up, they felt the more subtle kind still exists. “Women have to work twice as hard and twice as long to establish their credibility. It’s necessary if they’re going to get anywhere,” one woman commented.

A concern expressed by several was that women still do not do enough to support other women. They believed more support needs to come from women and particularly those who are already in key positions.

Temperament Profile

A temperament profile of the women in this study was developed as a result of their response to a series of descriptive phrases indicating which were least and most like them.

The temperament scale itself was developed by Lincoln psychologist Lois Olive. Using a technique that characterizes various personality temperaments as X, Y, Z and placing them around a cone-shaped diagram, temperaments can actually be plotted to show which most describe a particular individual or group.

Basically, the group can be described in two different ways which bring together a unique combination of characteristics.

On one hand, these women can be described as organizers, those who are able to get along with and work well with people. They value orderliness, efficiency and harmony in their lives.

On the other hand, these women are idea persons, striving for change and new ways of doing things. They invest themselves totally in what they are doing.

The scores of the temperament scale indicated a balance between these two sets of characteristics, both of which would seem to be very beneficial to those involved in politics and public affairs.

The scores also indicated what particular traits least characterize and describe the group. Such adjectives as dominant, close-minded and impulsive least describe the women. It would seem these traits would be far too extreme for anyone hoping to be successful in politics.

Women undoubtedly have a contribution to make in public affairs. Those interviewed in this study, as well as others, will hopefully pave the way for more to enter leadership positions. As one woman so aptly commented, “It may take the evolution of an attitude before we see more women truly involved in public leadership positions. Changes will be slow, but they will come.”

As those in this study believe, women must make a commitment to getting involved and playing a part in public affairs. They must also recognize the need to help each other and promote the cause of women becoming involved.

Many in the study believe organizations and institutions must help educate, guide and counsel women and girls in recognizing their potential and choices in various leadership positions.

And lastly, several participants expressed concern that society in general must change somewhat in its view of women in public affairs—recognizing their accomplishments, accepting their involvement and encouraging them to become involved.

Ron Daly is former Family Life Specialist with the UNL Cooperative Extension Service and now Family Life Specialist with SEA-Extension, USDA. Dr. Lois Olive is a psychologist in Lincoln, Nebraska and Kathy Sullivan is a professional home economist and project consultant, Mason City, Nebraska.
Soybean Applicators

New Weapons Against Weeds

By John D. Furrer

"Our herbicide roller saved 80 acres of soybeans that would have been lost to Johnsongrass and shattercane," according to Scott Feller of Eklhorn. "The bean rows were closing together; the shattercane and Johnsongrass had taken over and were beginning to head. We went in with our herbicide roller and Roundup. In about 4 days the weeds turned brown and the soybeans came on finally yielding 25 bushels per acre."

It was the first year the Fellers farmed that piece of Eklhorn river bottom. They were unaware of the serious weed problem.

Craig Boltz of Palmyra expressed the feelings of many users, "The rope-wick applicator has given me new confidence in soybean weed control. I'm not afraid to plant soybeans on any piece of ground."

These comments of Scott Feller and Craig Boltz are typical of the enthusiasm expressed by owners and users of recirculating sprayers, rope-wick applicators, and herbicide rollers—a new generation of applicators that have suddenly appeared in Nebraska fields.

Applicator History

The history of the new type of applicators is brief. Experimental work began in 1974 using the box-type recirculating sprayer to control milkweeds in soybeans. In 1978, emphasis shifted to the weed-roller which is similar to a giant self-propelled paint roller. Broadcast type recirculating sprayers (weed sickles) entered the state in 1978. In the winter of 1979, the rope-wick applicator concept was introduced at Crop Protection Clinic meetings. Also in 1979, the wet apron type applicator made its appearance. By the summer of 1979, there were hundreds of new special applicators operating in Nebraska fields. As Allen Boettcher, Lancaster County Agent for 24 years put it, "I have seen no other new technique adopted so quickly in my Extension career."

A late summer survey of 217 soybean fields in Southeast and East Central Nebraska showed that 11 percent of the fields had been treated with new generation applicators. This was only one-third of the fields that could have benefited from a treatment with a rope-wick, roller or recirculating sprayer.

High Enthusiasm

Why all the enthusiasm over the new breed of applicators? It's primarily because they do away with walking and corn-knife chopping of weeds in soybeans. Shattercane, volunteer corn and many broadleaf weeds seem to die like magic when touched or sprayed with the plant-potent Roundup solution. A second, equally important reason, is that the new type applicators conserve herbicide and are environmentally sound. Only the herbicide that is deposited on the weeds is left in the field—a savings of 75 to 95 percent over conventional sprayers.

The basic principal with all of the new generation applicators is to treat tall growing weeds in short growing crops. As a general rule, 8 to 12 inches (20 to 30 cm) greater height for the weeds over the crop is preferred. Even greater height differences are desirable but not always possible. Naturally, if the Roundup solution gets on the crop plant, injury will occur. Fortunately, soybeans seem to be able to "shake-off" mild cases of Roundup exposure. However, other low growing crops like sugar beets and milo are not as tough as soybeans and are readily damaged or killed.

In 1979, we performance tested four types of equipment in the field near Mead, Wahoo, Nickerson and Waverly. The principal weeds were shattercane and volunteer corn in soybeans. The rope-wick and wet apron applicators were operated one time through the field as well as up and back on the same rows (double coverage).

The weed sickle, a broadcast type recirculating sprayer, was manufactured in Arkansas. The herbicide roller was made in Scottsbluff, Nebraska. Both applied a 5 percent Roundup solution. We built the rope-wick unit ourselves and used a 33 percent solution in it. The wet apron unit was manufactured in Omaha and applied a 10 percent solution.

The weed sickle recirculating sprayer gave the best weed control; however, we also experienced the most soybean injury with it. Recovery was fairly rapid and didn't appear to affect yields. The roller and rope-wick performed similarly. We had poor luck with the wet apron
Weed sickles or broadcast type recirculating sprayers catch the spray material that isn't deposited on weeds. The caught spray is recirculated through the system. Average cost is $3,127.00.

Rope-wick applicators contain no moving parts. Soft braid nylon rope inserted into PVC pipe are the basic components. They cost about $83.00 to build or between $300 and $750 to buy.

Wet apron applicators are basically sprayers in an enclosed system. The spray wets a fixed canvas; the excess spray is recirculated. Approximate cost is $1,567.00.

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<th>Equipment</th>
<th>Speed</th>
<th>% Weed Control</th>
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<td>6 mph (9.6 km/hr)</td>
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<tr>
<td>Herbicide Roller</td>
<td>4 mph (6.4 km/hr)</td>
<td>83</td>
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<td>6 mph (9.6 km/hr)</td>
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<td>Rope-Wick</td>
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<td>4 mph (6.4 km/hr) 2 way</td>
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</table>

Unit—nozzle plugging, a too dry canvas apron, and pump problems; consequently, weed control was not so good. Units that apply minimal amounts of solution, such as the rope-wick and wet apron, should give improved weed control if operated both directions on the same rows (up and back to give double coverage). This would be particularly true where weed infestations are heavy or clumps of corn or shattercane are present.

When is the best time to use Roundup for weed control in soybeans? We already mentioned the 8 to 12 inch (20 to 30 cm) height difference between the weeds and the crop. In general, shattercane and volunteer corn should be as close to the boot and early tasseling stage as possible. Annual broadleaf weeds should be treated prior to the bloom stage. Perennials such as milkweed and dogbane are most effectively treated at the early bloom stage. However, soybean row spacing and “closing of the canopy” between rows often determine the time of treatment.

**Informative Interviews**

During the summer and fall, we collected names of owners of new generation applicators. In November, we interviewed 15 owners of each of the four basic types—60 in all. We found out a lot of interesting information.

1. The average cost of the chemical Roundup on a per acre basis was $2.32 ($5.80 per ha). Rope-wick chemical costs were lowest at $1.60 ($4.00 per ha) while roller chemical costs were $3.05 ($7.63 per ha).

2. Average acreage treated ranged from 445 acres (178 ha) for the weed sickle to 156 acres (62 ha) for the wet apron application. One owner treated 2,000 acres (800 ha) with his weed sickle, another 2,500 acres (1,000 ha) with his roller. The average for the 60 machines was 265 acres (106 ha).

3. Rope-wick, roller and weed sickle users reported excellent control of volunteer corn, and a shade under excellent for shattercane control. The wet-apron units performed less effectively on shattercane.

(Continued on next page)
Applicators . . .

4. The weed sickle gave good control of velvetleaf, sunflower and pigweed; the rope-wick and roller users rated their control fair to good for these same species. Wet apron units scored between fair and poor. Velvetleaf is one of the toughest species to control. There’s initial injury, but the plants usually recover and resume growth.

5. Milkweed control was rated good by weed sickle, rope-wick and roller users and dogbane control was slightly inferior. Wet apron units were less effective.

6. There were problems with all four types of equipment. Most often mentioned were leaky hoses, pumps, nozzle plugging, glue failure and sensor adjustments. Many farmers plan to make improvements. Several owners of rear-mounted rollers and rope-wick applicators are planning to make them front-mounted.

7. When we ask the question, “have your 1979 experiences with new generation applicators influenced your cropping plans for 1980?”, thirty percent said they planned to plant more soybeans and 7 percent said more milo. (Yes, it’s possible to take tall stuff out of milo with the rope-wick and roller applicators, but EPA has not approved the practice.)

Some of the benefits most often mentioned to us by enthusiastic owners of rollers, rope-wicks and weed sickles include:
- We eliminated walking and costly handweeding
- Fields were salvaged that would have been otherwise lost
- Dockage at the elevator was eliminated
- Combining was improved
- We have new confidence in soybean weed control
- Finally, a complete weed control program for soybeans
- No milkweed cotton in the tractor radiator!

Figure A. Roller applicator rear-mounted on a Hi-Boy, in this case, used to control sunflowers and shattercane in soybeans.

Close-Up

Roller Herbicide Applicator

By Curt B. Koehler,
Gary L. Cramer,
Steve M. Iorns,
James S. Schepers, and
Orvin C. Burnside

Weed escapes can pose potentially serious future problems for midwest soybean and sorghum growers. A weed control program that incorporates cultural, mechanical, and chemical methods of control may destroy 95 to 99 percent of the weeds. However, the 1 to 5 percent that escape will produce seed and increase into major new weed problems. Shattercane and velvetleaf are examples of weed increasers in Nebraska.

Farming practices have changed from those of small, self-sufficient, diversified farms of our forefathers to the large specialized farms of today. With reduction in tillage, greater reliance on herbicides, increase in monoculture, and larger farms there has been an increase in weed escapes. In the past, these weed escapes were controlled by roguing and handweeding. Today with high labor costs, scarcity of labor, and large acreages, manual weed removal has become less feasible. A more practical, efficient, and faster method of controlling weed escapes on large acreages is needed.

The roller herbicide applicator is a machine that takes advantage of the height differential of tall growing weeds in short stunted crops. An example is shattercane or volunteer corn in soybeans. The carpet covered cylinder is wet with herbicide solution which is wiped on the weeds as the machine travels through the field. The cylinder rotates opposite to the direction of travel which enhances the wiping action (Figure A).

How It Works

The roller applicator is a carpet covered aluminum cylinder 8 to 12 inches (20.3 to 30.5 cm) in diameter and 10 to 30 feet (300 to 900 cm) long. This is supported by a metal framework. Rotation of the cylinder is accomplished by a hydraulic motor which operates at 20 to 50 rpm. The herbicide mixture is applied to the carpet via a steel tube mounted above the roller with 1/32 inch (.8 mm) holes drilled at 1 to 2 inch (2.54 to 5.08 cm) intervals. The herbicide is applied either manually or automatically by an applicator system with an electronic moisture sensor. Manual application is difficult because there are few visible guides to determine carpet wetness. If it is operated too dry, poor weed control and carpet erosion results. If it is too wet, herbicide dripping and crop injury occurs. Also, an over-wet carpet is more costly to operate.
The electronic moisture sensor incorporates pairs of electrodes which ride on the carpet, a control box for setting the level of moisture desired, and a solenoid spray valve for controlling application of herbicide solution to the roller. When it becomes too dry, the electrical conductivity between the electrodes is lowered and interpreted by the control box which opens the solenoid valve and lets herbicide solution spray onto the carpet until it reaches the desired moisture level (Figure D).

**Weed Susceptibility to Glyphosate**

For most applications a nonselective translocated herbicide should be used. Glyphosate (Roundup) works well to control shattercane, volunteer corn, other grasses, certain susceptible broadleaf weeds and perennials such as common milkweed in soybeans (Figure B). Shattercane and volunteer corn are very easily controlled while most broadleaf species need a higher concentration. Timing is critical for good control. Shattercane must be killed before going into the boot stage and volunteer corn before tasseling. After these growth stages their kill is not as complete due to lower translocation rates. Weeds may still produce viable seed if treated too late. The broadleaf annual weeds are more difficult to control with the roller than the grassy weeds. Of these, sunflowers and velvetleaf are common problems in soybean and sorghum fields.

**Mixtures and Rates**

Shattercane and volunteer corn can be controlled fairly easily with a 5 percent solution of Roundup [1 gal (3.8 l) Roundup and 19 gal (72.2 l) water] (Table 1, Figure C). Sunflowers can usually be controlled using a higher Roundup concentration, i.e., 10 percent [1 gal (3.8 l) Roundup and 9 gal (34.2 l) water] (Table 2). Velvetleaf is more difficult to kill with the roller even at the higher Roundup concentrations. Sunflowers are more rigid plants than velvetleaf and will remove more solution from the carpet which may account for the greater control. With both species it was found that a mixture of 5 percent Roundup and 5 percent 2,4-D amine resulted in the best control but 2,4-D is cleared only in corn and sorghum, not soybeans. Common milkweed needs a higher rate such as a 10 percent Roundup solution (Table 3).

More important though than the solution concentration is the moisture level on the carpet. The level should be such that when a finger is pressed firmly into the rotating carpet only an occasional drip comes off at the point of contact. More moisture than this will cause dripping and foaming from the carpet and lead to crop damage. Too low a moisture level may not apply enough herbicide to kill the weeds unless the herbicide concentration is greatly increased. If the moisture level and herbicide concentration are adequate to kill protruding weeds there still may be need for more than one treatment. Shattercane germinates erratically with some plants at optimum height for

<table>
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<tr>
<th>Herbicide</th>
<th>Concentration %</th>
<th>Weed control %</th>
<th>Grain yield Bu/A @ 13% moisture</th>
<th>Grain yield kg/ha oven dry</th>
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*Injury scale: 0 = no injury  **Shattercane control continued to increase after these 14 day visual estimates: 1-3 = slight  4-6 = moderate  7-9 = severe  10 = complete kill

Table 1. Shattercane control in soybeans using glyphosate (Roundup) and the roller applicator at Lincoln, NE.

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Table 2. Sunflower control in soybeans using glyphosate (Roundup) and the roller applicator at Lincoln, NE.

Table 3. Common milkweed control using the roller applicator in wheat stubble, Lincoln, NE. Year of application 1978.
Roller Applicator...
treatment while others are still below the crop canopy.

Although all precautions should be taken to minimize drip and crop injury, soybeans are able to withstand mild doses of Roundup exposure. Grain sorghum, however, is as easily killed as shattercane and any touch or drip means a dead plant.

Speed of travel across the field makes little difference in weed kill and crop injury in the 2 to 4 mph (3.2 to 6.4 km/hr) range, assuming correct moisture level on the carpet. Weed control was slightly lower and crop injury slightly higher at 6 mph (9.6 km/hr).

Figure B. Shattercane being controlled in grain sorghum. Pictured are a number of herbicide rates and carpet moisture levels but most were effective in controlling shattercane.

Figure C. Shattercane kill in soybeans using a 5% Roundup solution and 50% carpet saturation. Picture taken one week after treatment.

Figure D. Moisture sensor mounted on roller applicator. Paired electrodes detect carpet wetness, electric solenoid valve opens to allow solution to be sprayed on the carpet. Note also the inline filter (80-mesh) to stop particles which could plug holes in spray pipe.

List of Nebraska Manufacturers

Roller Applicators
Irrigation Specialties Mfg. Co.
P.O. Box 1306
Scottsbluff, NE 69361

Oakland, NE 68045

Moisture Sensor
Precision Machine Co., Inc.
2933 No. 36th St.
Lincoln, NE 68504

Curt B. Koehler, Gary L. Cramer, and Steve M. Irons are graduate research assistants in Agronomy; James S. Schepers and Orvin C. Burnside are assistant professor and professor, respectively, in Agronomy.
Range Forage Utilization

Donald C. Clanton, beef cattle, and James T. Nichols, range and forage, are heading a four-year project supported by the Cooperative State Research Service, USDA aimed at optimizing the utilization of range forage with beef cattle by integrating range and complementary forages.

The objectives of the project are three-fold: (1) determine animal performance and production from several beef cow-calf-yearling production systems utilizing complementary crops with range; (2) determine dry matter production and forage quality for major forage components at appropriate sampling dates throughout each calendar year; and (3) develop system models incorporating the major components of forage-cattle production systems with emphasis on economic returns.

The project, being conducted at the NU North Platte Station's Sandhills Agricultural Laboratory, involves superimposing three winter management systems over three summer management systems for approximately 225 cows. The calves from the cows are grown and finished in one of two growing-finishing programs.

Forage, in addition to native grass, included cornstalks, native hay, introduced dryland cool season pasture, irrigated pasture, and corn silage.

Proso Millet Herbicide

Research by C. R. Fenster at the Panhandle Station has developed a herbicide for weed control in proso millet which has been approved by the EPA.

Weed control is generally a problem in proso millet. The research at the High Plains Ag Laboratory at Sidney, Nebraska has shown atrazine to be a very effective herbicide for weed control in proso millet.

Since millet is a minor crop, no commercial company would spend the money to provide performance data for the atrazine on proso millet so it could be registered with the EPA. Fenster developed data to establish the rates and time of application of atrazine for proso millet. It was then necessary to establish tolerances for residues of atrazine in the grain and forage of proso millet. Working with Dr. Roger Gold, coordinator of Environmental Programs at Nebraska, the Interregional Research Project No. 4 of EPA and chemical companies, residue limits of atrazine of 0.25 parts per million for grain and 5 parts per million in millet forage were established.

This work was essential to establish a company or state label for the use of atrazine on proso millet.

Use of atrazine for weed control is essential for producing good, clean proso millet. Most of the proso millet is used for birdseed. Limited quantities are used for livestock feed and human consumption.

Corn Borer Control

Nebraska corn producers have sustained heavy yield losses due to damage caused by the European corn borer. Economic control of the second generation of this insect by insecticide application has not been totally successful to date.

New research initiated at the Northeast Station at Concord, however, is aimed at determining the proper timing of application(s) of an insecticide and the economic benefits derived as a result of controlling the pest.

Additional research directed by John F. Witkowski, entomology, related to European corn borer insecticide screening trials, evaluating commercial varieties of corn for first brood borer resistance and the basic survey of borer seasonal activity as an input in local Integrated Pest Management programs.
Human Development and the Family

A Career to Touch all Ages, Areas of Family Life

By Greg Sanders, Jacque Voss and Nick Stinnett

Much of our happiness in life is influenced by the quality of our human relationships. Many people around the nation are increasing their human relationship skills and knowledge of human growth and development, and at the same time preparing for a career.

Want to start a career in an exciting, expanding field with an interesting variety of opportunities? Would you enjoy working closely with other people in nursery school and day care programs; rehabilitation counseling and education for independent living; family planning, family life education; marriage and family counseling; gerontology; mental health programs; the areas of stress, alcohol, and drug education or many other possibilities? If so Human Development and the Family may be a career choice. Human Development and the Family is an area which includes many aspects of child development, human relationships, family life, marriage, and human growth and needs.

UN-L Program

The Department of Human Development and the Family in the College of Home Economics at the University of Nebraska, which has an excellent program of this type, has looked into Human Development and the Family (HDF) career opportunities across the country.
This is one of the few national surveys in this particular area. Such information benefits students, faculty, and school counselors.

Opportunities for professionals in this area range from college teaching to early childhood education and social work positions. Our study shows that most professionals with graduate degrees from HDF programs have found careers in their own field.

How do students of Human Development and the Family fare in the job market? We surveyed 343 professionals who have master's or doctoral degrees in HDF from 36 institutions across the nation to discover:

- The types of careers they are now involved in
- Their salaries
- The strengths and weaknesses of the graduate programs from which they received their degrees
- The things they enjoyed and disliked about their graduate programs
- What helped them obtain their jobs

**HDF Characteristics**

What are the characteristics of the people who choose to go into the profession of Human Development and the Family? The majority of professionals in the field of HDF are females (81%). Ages of the respondents range from 23 to 59, with the majority falling in the 24-35 age range. Most received their graduate degrees from universities and land grant colleges (77%) as opposed to private and state colleges. These professionals received their graduate degrees from 36 different institutions and graduated between 1970 and 1978. Of the 343 respondents, 74 percent received master's degrees and 26 percent received doctoral degrees.

A major question asked of any professional training unit is "Can the graduates get jobs?" This is an increasingly relevant question in view of the fact that many people have been unable to find jobs in some professions. Graduates of HDF programs across the nation are faring quite well in the job market. Most Human Development professionals were able to secure a job soon after graduation. More than half (57%) had secured jobs before they graduated and 85 percent had secured jobs within six months. Another 7 percent were homemakers or working on advanced degrees and therefore weren't looking for jobs. Approximately 87 percent of the group employed were working in their field of training or a related field, which compares very favorably with the placement record of other disciplines.

**Career Possibilities**

These HDF professionals were involved in quite a variety of careers. Some of the general areas in which they were working include college teaching, counseling, social work, child care, research, extension home economics, school psychology, high school teaching, and rehabilitation training. There is a wide variety of possibilities within each of these general areas. Teaching marriage and family living in college, birth control counseling, counseling teenagers and married couples, licensing day care programs, teaching preschool, family life work in extension, and teaching high school home economics are just a few of the careers in which our group of professionals were involved.

One of the greatest concerns of people interested in starting careers is the amount of money they make. HDF professionals fare rather well in this respect. The average salary of these professionals was $14,000. Approximately 55 percent were making over $12,000 and 75 percent had a salary of over $10,000. Many of those below this salary were working part-time or were not working at present, primarily due to being a full-time homemaker or to continuing graduate study.

Normally, people with higher degrees make a higher salary. The average salary of persons with a doctoral degree was $16,200. The greatest proportion of the master's degree professionals reported salaries in the $12,000-$14,000 range.

Although nearly all of the graduates (85%) were able to secure jobs soon after graduation, a few reported some difficulty in the process. Of those who experienced some difficulty in getting a job, the most common reasons cited were lack of job openings, lack of experience, lack of recognition of HDF by some employers, and poor placement programs.

For those students who had difficulty obtaining a job, we asked what their graduate department could have done to make job placement easier. Several (27%) felt there was nothing the department could have done, while 18 percent thought a placement office would have been helpful. Other responses to this question reflected the need for more practicum experience, and public relations work to get employers to understand the value of HDF. One important suggestion was to get graduates to understand what their degree qualifies them to do.

These professionals were also asked what courses and/or experiences graduate programs could provide for students which would assist them in job placement. Vocational guidance (26%) and practicum experience (27%) were the most needed changes. Others reported that the graduate program should consider current job trends in their students (13%). One specific suggestion was to hold a job forum to draw prospective employers to campus. Another suggestion was to have a list of where previous graduates secured positions.

**Rewarding Aspects**

There are many rewarding and exciting aspects of being in a graduate program in Human Development and the Family. The exchange of ideas with students and professors was listed most often (26%) by the respondents as the thing they most enjoyed about their graduate experience. Field experiences (11%), course work and its application (10%), and research (10%) were other well-liked aspects of their graduate programs.

Some of the least-liked experiences of graduate school for HDF graduates were the pressures of school, courses that were not (Continued on next page)
Human Development ... applicable to interests, and comprehensive exams. These problems are likely in any area of graduate work and aren't specific to HDF programs. For example, financial and time pressure during graduate school is an almost unavoidable experience in any field of study.

The majority of HDF specialists were pleased with the careers they have chosen. When asked if they had to do it over again would they study in the same field, 72 percent replied that they would. Approximately 26 percent said they would not study in the same field. These people cited lack of career opportunities, need for higher pay, need for broader background, and the desire to study in a related area to offer diversity as reasons they would like to change fields. Those who would study in the same field again stated that this area applied to their interests, provided background for their work, had practical value (such as in the home), and offered a diversified background.

What aids did these graduates use to help them obtain jobs? Many relied on professors' recommendations (31%). Others found jobs through university placement (9%), at conventions (3%), or through announcements in professional journals (3%). The majority (52.9%) made their own contacts or they already had jobs before graduation. Several students reported securing their jobs as a direct result of their practicum experiences.

Human Development and the Family is steadily gaining popularity and recognition as a profession that is growing in importance. HDF is now receiving well deserved recognition as an area that offers many fine career opportunities for those who like to work with people and who are interested in enriching the quality of family life.

*All salary data was collected in 1978.

Greg Sanders is a graduate student in the Department of Human Development and the Family. Jacque Voss is dean of the College of Home Economics at North Dakota State University and Nick Stinnett is professor and chairman of the Department of Human Development and the Family, College of Home Economics, University of Nebraska.

Land Use

Nebraska's Changing Profile

By Donald A. Wilhite

Have you noticed the dramatic changes which have occurred in the way Nebraskans use their agricultural lands? Much of this change is due to technological developments such as new crop varieties, mechanization, synthetic fertilizers and irrigation. Response to climate variability, changes in the economics scene and federal conservation programs have also substantially affected our agricultural system.

Nebraska agricultural crop statistics document the nature of these agricultural land use changes. In 1925, crop production in Nebraska was almost exclusively on dryland, and corn was the primary crop. Although corn is still our primary crop, irrigation and other factors have greatly altered its distribution. Additionally, alterations in the pattern of wheat acreage and the introduction of sorghum and soybeans have modified and diversified Nebraska's crop production system.

Agricultural land use changes in Nebraska for the period from 1925
to 1974 are summarized in Figure 1. The principal crops of dryland and irrigated corn, wheat, dryland sorghum and dryland soybeans are shown. The percentage of total cropland acres harvested is shown in this figure. The convergence of the land use trends for each of the crops illustrates today's greater agricultural diversification. In 1925, dryland corn was produced on approximately 55 percent of the cropland in the state. The percentage declined to 18 by 1974. By contrast, wheat has remained stable during this same period, especially since the late 1950s. In 1974, wheat accounted for about 20 percent of the total cropland acres harvested in the state. Irrigated corn, sorghum and soybeans constituted 21 percent, 13 percent and 8 percent, respectively, of the total cropland acres. Thus, corn (dryland and irrigated), wheat, sorghum and soybeans accounted for 80 percent of the total cropland acres harvested in Nebraska in 1974.

According to preliminary figures from the Nebraska Crop and Livestock Reporting Service, these crops continued to be the principal cultivated crops in Nebraska in 1978. In that year they constituted almost 82 percent of the total cropland acres harvested. Irrigated corn comprised about 32 percent; winter wheat, 18 percent; dryland corn, 13 percent; dryland sorghum, 11 percent; and dryland soybeans, 8 percent. Acreages of each of these crops have become quite regionalized during recent decades. Present patterns will be discussed in more detail later.

Other interesting facts are shown in Figure 1. First, total cropland acres harvested in the state declined from a peak of 18.6 million acres in 1931 to about 12.3 million acres in 1965. This decline reflects a response to government programs which gave farmers the incentive to set aside some of their cropland. Since 1972 a substantial proportion of this cropland is once again being cultivated. Preliminary figures for 1978 indicate that approximately 14.6 million acres of total cropland were harvested in Nebraska.

The variability in total cropland harvested, demonstrated in Figure 1, indicates the impact of weather on the state's agricultural productivity. This is most conspicuous in 1934 when severe drought reduced total cropland acres harvested to only 11.5 million, as compared with 17.3 million in 1933. The expansion of irrigation has served to stabilize corn production. During the dry year of 1974, irrigated corn accounted for 54 percent of the total acreage in corn for grain; however, it accounted for 82 percent of the total grain produced.

Regional Characteristics

Regional differences in cropping systems characterize Nebraska agriculture. Regional differences were much less apparent in the past. As noted previously, dryland corn and/or wheat dominated early agriculture in most Nebraska counties. Four counties which illustrate the diverse nature of historic agricultural land use changes and current cropping systems are shown in Figure 2. Counties shown include Cheyenne, Dawson, Burt and Lancaster. North central Nebraska is not represented in this analysis as rangeland is the predominate land use there. Attempts at general farming in this area have been sporadic although substantial irrigation development has

(Continued on next page)

Figure 2. County land use changes in Nebraska. Compiled from data reported by the Nebraska Crop and Livestock Reporting Service.
Land Use...

occurred in Holt and adjacent counties in the past 15 years.

During the period of study, land use changes in Cheyenne county have mainly represented an interplay between dryland corn and wheat. In 1925, these two crops accounted for 75 percent of the acres harvested in the county. Since that time, dryland corn acreages have become negligible while wheat acreages now account for over 90 percent of the acres harvested. Nearly all of the wheat grown is produced under a fallow cropping system.

Corn has continued to be the major crop in Dawson county during the past 50 years, although a significant shift from dryland to irrigated has occurred. In 1948, dryland and irrigated corn acreages were first reported separately by the Nebraska Crop and Livestock Reporting Service. Irrigated acres represented 26 percent of the total cropland harvested at that time. Irrigated corn comprises about 55 percent of the cropland harvested today. Alfalfa and dryland corn account for most of the remaining acreages. Sorghum and wheat acreages are negligible.

During the 1920s and 1930s, dryland corn and wheat were the primary crops in Lancaster County, accounting for about 75 percent of the cropland acres harvested then. Since the mid-1950s, sorghum has replaced dryland corn as the major crop. Wheat acreage has remained almost constant, averaging between 20-25 percent of the cropland acres harvested. In the past decade, there has been a slight expansion of irrigated corn. Corn, wheat, sorghum and soybean acreages presently account for about 90 percent of the acres harvested.

In Burt County, dryland corn has remained the dominant crop during the past 50 years although by 1974 the acreage had declined to 47 percent of the total cropland. Soybean acreage has shown a substantial increase in the past 15 years, accounting for 27 percent of the cropland acres harvested in 1974. Dryland corn has continued to decline while soybeans increased in importance according to preliminary 1978 figures. Corn and soybeans accounted for over 83 percent of the acres harvested in the county in 1974. Alfalfa and oats make up most of the remaining acreage.

Changing Cropping Patterns

How has the distribution of the principal crops in Nebraska changed over the past 50 years? These patterns are illustrated in Figure 3 for corn, wheat, sorghum and soybeans. Values are expressed as the percent of total cropland acres harvested. By representing county values in this way the effect of differences in county size is removed. It should be remembered that this figure illustrates the primary uses of cropland only. Other uses of land, such as rangeland, are not included.

As previously indicated, dryland corn was the primary crop throughout the state in 1925. In that year, 85 of Nebraska's 93 counties devoted over 40 percent of their cropland to corn. By 1974 dryland corn was mainly concentrated in an 18 county area in the northeastern portion and the extreme southeastern corner of the state. In 1955, irrigated corn acreages were concentrated primarily along the Platte River in central Nebraska and along the North Platte River in Scotts Bluff and Morrill counties. By 1974, irrigated corn had expanded greatly in the central portion of the state. Much of this expansion is due to the development of the center pivot irrigation system. Irrigated corn accounted for over 60 percent of the cropland acres harvested in Hall, Merrick, Hamilton, Phelps, Brown, Rock and Holt counties.

In 1925, winter wheat was mainly concentrated in the Panhandle region and the southern half of the state. By 1974, there had been little change in this pattern. However, a larger proportion of the cropland in these counties was devoted to wheat. In fact, in Cheyenne, Kimball and Deuel counties wheat was grown on over 90 percent of the cropland harvested. Most of the wheat in the Panhandle and southwestern portion of the state is grown under a fallow cropping system.

Dryland sorghum had its early importance in the southwestern and south central portion of the state. Since that time sorghum has become more concentrated in the southeastern part of the state. The principal producing counties in 1974 were Lancaster, Gage, Nuckolls, Jefferson and Pawnee. Each devoted between 40 to 60 percent of their harvested cropland to dryland sorghum.

Significant amounts of dryland soybean were first planted in Washington, Dodge and Saunders counties in the early to mid-1950s. Acreage has grown steadily since that time throughout eastern Nebraska. By 1974, fourteen counties had between 20 and 40 percent of their harvested cropland devoted to soybeans.

Conclusion

The trend and pattern of agricultural land use in Nebraska show that changes have resulted primarily from the development and application of new technology and in response to federal conservation programs. The primary technological influences on this change in Nebraska have been the development of corn and sorghum hybrids, the introduction of soybeans, and irrigation technology. Synthetic fertilizers and mechanization have also played an important role. Future land use changes will continue to reflect both the impact of technology and response to federal programs. It is important that we continue to monitor these changing patterns of land use so that decisions regarding the utilization of our natural resources will be made on the basis of a knowledge and understanding of current, as well as historic trends.

The results described in this article are presented in greater detail in a report published by the Water Resources Center entitled "Changing Fields: Agricultural Land Use Changes in Nebraska, 1925-1974." Copies of this report are available on request.

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Figure 3. Changing cropping patterns in Nebraska, expressed as a percentage of total cropland acres harvested.
Energy Management

Best Weapon Against Rising Fuel Costs

By David P. Shelton and Elbert C. Dickey

Diesel fuel shortages! Higher fuel prices predicted! These have been recent headlines. As yet, severe shortages have not been a reality, but fuel costs have certainly increased during the past few years.

What can be done to combat rising fuel costs and possible fuel shortages? Since complaining seems to be of little benefit, a more positive approach is needed. In the long run, our energy supply will be supplemented with energy derived from alternative sources such as solar, wind, crop residues, alcohol, methane, and vegetable oils. However, none of these are likely to completely replace fossil fuels. Therefore, the main weapon available is careful energy management.

While not as glamorous as an ethanol plant or burning soybean oil in a diesel engine, energy management or conservation is the simplest and most direct method of reducing fossil fuel use. It is something that everyone can do to some extent.

In Nebraska, on-farm fuel use is dominated by irrigation, with field operations ranking second. According to a recent fuel use survey ("Nebraska Fuel Use Survey," Farm, Ranch, and Home Quarterly, Winter 1980) nearly one-quarter of the energy used for field operations was for diskimg, chisel plowing, and moldboard plowing. All tillage operations accounted for over one-third of the energy used.

Tillage represents the primary area for energy management in field operations. Many practices can be employed to reduce energy use and help counter rising fuel costs. Each practice is one additional step toward achieving good energy management.

Minimize Tillage Trips

Tillage operations are generally conducted to either prepare a seedbed or control weeds. The number of trips depends on soil type and condition, weather conditions, and the type of tillage system utilized. However, as indicated in a recent survey on Nebraska farms, the number of trips over a field may depend on the time available as well. For example, when utilizing a spring disk tillage system for corn, the number of tillage trips over the field prior to planting ranged from a low of 1 to a high of 6. Excessive tillage operations increase fuel consumption, operating costs, and labor requirements.

Reducing the trips over a field can be accomplished by; (1) eliminating one or more tillage operations, (2) substituting one type of tillage operation for another, or (3) combining
tilage operations into one pass over the field. The energy savings depend on the changes made.

According to the Nebraska Fuel Use Survey, diskilling generally requires approximately 0.75 gallon of diesel fuel per acre (7.0 l/ha). For row crop production, moldboard plowing requires about 2.2 gallons per acre (20.6 l/ha) and chisel plowing requires approximately 1.0 gallon per acre (9.4 l/ha). Based on these data, it is possible to save from 0.75 to 2.2 gallons of diesel fuel per acre (7.0 to 20.6 l/ha) by eliminating one primary tillage operation. Savings of over a gallon per acre (9.4 l/ha) are possible by changing from a moldboard to a chisel plow.

Sometimes, field operations can be combined by connecting two or more implements. Combined operations reduce both fuel consumption and labor requirements by eliminating at least one individual trip over the field. Light tillage, spraying, or fertilizing operations often can be combined with either primary tillage or planting operations. The amount of fuel saved depends on the operations combined. Generally, light tillage, spraying, and fertilizing operations consume 0.25 to 0.50 gallon of diesel fuel per acre (2.3-4.7 l/ha). Fuel savings of from 0.12 to 0.33 gallon per acre (1.2-3.1 l/ha) can usually be expected from combined operations.

Eliminating one primary tillage operation in addition to combining one light tillage, spraying, or fertilizing operation with another tillage or planting operation can usually save at least a gallon of diesel fuel per acre (9.4 l/ha).

Reduced Tillage System

In recent years, production techniques and equipment have been developed for reduced tillage systems. However, widespread acceptance of reduced tillage systems has been slow. Often, this has been because of a fear of yield reduction. With proper management, overall yield averages for conventional and reduced tillage systems have been found to be nearly identical.

On-farm fuel use can be reduced by adopting a reduced tillage system. In general, the diesel fuel requirements for a conventional tillage corn production system will be approximately 5 gallons per acre (47 l/ha). Only about 2 gallons per acre (19 l/ha) are required for a till-plant system, a savings of 60 percent. In addition to fuel savings with reduced tillage systems, substantial time savings are another benefit, allowing more timely operations.

The reduced tillage system employed must, however, be carefully matched to the soil and climatic conditions. A universal system has not been perfected. You should therefore be prepared to make certain changes or adjustments in the system.

Properly Ballast Tractors

Properly weighted tractors provide the best fuel efficiency during tillage operations. Without proper weighting, engine horsepower cannot be efficiently converted into drawbar pull.

To ballast a tractor for a particular drawbar load, begin by estimating the wheel slippage. As a general guideline, if wheel slippage is five percent or less, weight should be removed. If slippage is 20 percent or more, weight should be added. The ideal amount of wheel slippage for most field work is from 10 to 15 percent.

Drawbar horsepower will be reduced if the wheels slip too much or too little. Slippage below 10 percent for heavy draft operations may increase wear and maintenance of the transmission and drive train. Also, the excess weight will contribute to increased soil compaction and rolling resistance. Conversely, if wheel slippage is much above 15 percent, tire life will be reduced. For either underweight or overweight conditions, the tractor will require more fuel per acre than when properly ballasted.

Match Tractors and Implements

A major management decision facing many farmers and ranchers is matching implements with tractors. Proper sizing minimizes labor requirements while maintaining efficient field operations. In addition, a proper tractor-implement match increases fuel use efficiency.

If the tractor is oversized for the implement, fuel consumption and costs will be higher than necessary for the work done. If the implements are too large for the tractor, overloading will occur, reducing both field capacity and quality of work. Also, overloading causes excessive wear which increases downtime and maintenance costs.

Gear Up and Throttle Down

For most efficient operation, a tractor's engine should be operated near its rated capacity. However, there are many field operations which do not require rated tractor horsepower. This is especially true when older implements, which were sized for a smaller tractor, are used with high horsepower tractors. For these light load operations, fuel savings of 15 to 30 percent can result by shifting to a higher gear and slowing the engine speed to maintain the desired field travel speed.

Normally, operations giving engine loads that are about 65 percent or less than a tractor's maximum power can be performed by gearing up and throttling down. You should check the Operator's Manual for specific recommendations. However, it is generally safe to reduce engine speed by 20 to 30 percent of the rated RPM.

The most important thing to remember is not to overload the engine. Visible black smoke during operation at a reduced engine speed may indicate an overloaded diesel engine. To check for overloading, work for a short time at the desired field speed while geared up and throttled down. Then, rapidly open the throttle. If the engine easily regains speed, it is not overloaded. If the engine is overloaded, gear down and increase the engine speed to achieve the desired field speed.

Plan Working Area

Large areas usually require less fuel per acre than small areas. Extra fuel and time are required for turning and road travel.

For example, during the Nebraska Fuel Use Survey, one farmer kept records while chopping silage with a self-propelled diesel field chopper.
Energy Management ...
For areas of 20 acres (8 ha) or less, the average fuel use was 2.5 gallons per acre (23.4 l/ha). For areas over 20 acres (8 ha) the average fuel use was only 1.6 gallons per acre (15.0 l/ha). For windrowing hay, the average diesel fuel use was 0.88 gallon per acre (8.2 l/ha) for areas of 25 acres (10 ha) or less, but only 0.49 gallon per acre (4.5 l/ha) for areas over 25 acres (10 ha). A similar situation occurred for combining corn. Areas less than 25 acres (10 ha) required 0.27 more gallons of diesel fuel per acre (2.5 l/ha) than larger areas.

Maintain and Service Engines
An often overlooked factor for saving fuel is keeping tractor engines properly tuned and maintained. It is possible for a tractor to be operating below peak performance without noticeably affecting field performance. Preventative maintenance and scheduled tune-ups are recommended to insure that the engine operates efficiently.

Engine lubrication also affects fuel consumption. The oil recommended by the engine manufacturer helps clean and cool the engine in addition to reducing wear and friction. Periodic oil and filter changes, as recommended, provide fresh lubricant for peak performance and protection. A properly lubricated engine runs more economically.

For all tractors and self-propelled machines, follow the advice and service schedules given in the Operator’s Manual to achieve top, economical performance from the engine.

Good Fuel Storage Conditions
Fuel that leaks or evaporates from a storage tank is wasted fuel and money. Gasoline is particularly prone to evaporation.

Fuel leakage can often be corrected by simply tightening the connections. In more stubborn cases, the system may have to be reassembled after applying a thread sealant to the joints. Cracked or damaged fittings and hoses should be replaced. Also, the fuel filter should be clean and properly seated.

Substantial gasoline losses can occur by evaporation. Using the common 300 gallon (1140 l) tank as an example, representative evaporation losses for a variety of tank configurations are presented in Table 1. To minimize losses from above-ground storage tanks; 1) provide shade, 2) install pressure-vacuum relief filler caps, and 3) paint tanks white. For further information on fuel storage or any of the other practices discussed in this article, contact your local County Extension Agent.

Even though wise energy management may not have the appeal of an alternative energy source, it is certainly something that we all can do to fight rising fuel costs and the threat of fuel shortages.

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| Table 1. Gasoline evaporation losses for a variety of tank configurations. |
|---------------------------------------------|---------------------|-------------------|
| Tank configuration                         | Representative gallons/month | Liters/month |
| Red tank in sun                            | 9 to 10              | (34 to 38)        |
| White tank in sun                          | 6                   | (23)              |
| Red tank in sun with pressure-vacuum relief valve | 5.5               | (21)              |
| White tank in sun with pressure-vacuum relief valve | 3.2               | (12)              |
| Tank in shade                              | 2.4                 | (9)               |
| Tank in shade with pressure-vacuum relief valve | 1.3               | (5)               |
| Underground tank                           | less than 1         | (3)               |