Chapter 16

Extension Entomology

Contents

The information that follows focuses on some of the insect problems that Extension Entomologists have faced.

This includes only a portion of the program areas served by Entomology, and should not be viewed as a totally comprehensive review.

Early Program Development

Professor E. A. Popenoe, Head of the Department of Entomology, Kansas State Agricultural College, was probably the first entomologist in the United States to do Extension work in this branch of natural science.

Popenoe discussed insects at numerous farmers meetings and was a member of the Farmers' Institute faculty on many occasions from 1898 to 1907.

T. J. Headlee also made many insect talks at Farmers' Institutes under the direction of Professor John Miller and Dean Edward Johnson.

First Kansas Extension Entomologist—1914

Thomas Talbert was the first regularly appointed entomologist for the Extension Service in Kansas. His term was from September 15, 1914 to August 1, 1915. While Extension Entomologist, he was in charge of Institutes and Extension Schools.

First "All-Insect" Train—1915

Talbert organized the first "All-Insect" agricultural train in the United States. The train operated in cooperation with the Santa Fe Railway and was known as the "Hessian Fly Special."

Frank Jarrell, Agricultural Reclamation Agent for the Santa Fe Railway, called it the "Institute Train."

The entomologists and agronomists from Kansas State Agricultural College and Dr. E. G. Kelly, entomologist with the United States Bureau of Entomology, were speakers on the train.

The crowds were often so large that they were divided into four groups, with a speaker for each group. The largest crowd at any train stop was 317 at Stafford.

T. H. Parks succeeded Thomas Talbert on March 15, 1916, and continued in that position to April 15, 1918. E. G. Kelly, after his service with the Bureau of Entomology, became Extension Entomologist for Kansas on April 16, 1918, and served until his death on February 6, 1949.

Dell Gates served from June 1, 1949 to June 30, 1982. Specialists appointed later, and their areas of responsibility, are cited below.

Extension Entomologists with the Extension Service through 1988, were:

Leroy Brooks, 1965.

Donald Mock, 1973.

Lynne Thompson, 1978-80.

Donald Cress, 1978.

George Lippert, 1978.

Robert Bauernfeind, 1978.

Phillip Sloderbeck, 1981.

Randall Higgins, 1982.

Judy Bertholf, 1983-85.

Extension Entomology Diagnosticians were:

James Johnson, 1978-83.

Timothy Gibb, 1983-86.

Kevin Shufran, 1986.

Grasshopper Control

According to the first annual report of the United States Entomological Commission, grasshoppers were abundant in what is now Missouri and the states west and north.

Old Indians recalled the swarming pest which devoured the grass and moved the buffalo away as early as 1800.

L. Brunner, United States Entomology Commissioner, while on a trip through the West in 1875 and 1876, learned from the Indians that grasshoppers had destroyed vegetation 25 years before that, indicating that grasshoppers were numerous in Kansas in 1850.

Grasshoppers in Kansas—1870's

From 1873 to 1876, great swarms of grasshoppers came to Kansas and the surrounding states. At that time, no control was available and the hoppers literally drove settlers back to their homes in the East.

From 1877 to 1910, there was very little damage from grasshoppers in Kansas. There were a

few scattered reports or a mere mention of grasshoppers throughout these years.

Grasshopper Outbreak—1910

In 1910, there were plenty of grasshoppers in southern Kansas. E. G. Kelly was employed by the Research Department of the Bureau of Entomology, and stationed at Wellington, Kansas.

Grasshopper damage was so extensive in 1910 that hopperdozers were constructed for experimental purposes and plans were made for research work on grasshopper bait.

Grasshopper Baits—1910's

In 1911, many different kinds of bait were tried. It was found that the addition of certain foods improved the bait. It was also found that the application of the bait before sunrise gave the best kills.

Oranges, tomatoes, onions, cantaloupe, watermelon, peaches, and apples added to the attraction of the bait to grasshoppers. Later, essential oils were tried.

Entomologists indicated that the next severe infestation was during 1912 and 1913. The Department of Entomology at the College presented a control program in the southern counties of the state.

In 1913, many tons of poisoned bran were scattered. The formula consisted of 20 pounds of bran, 1 pound of Paris green, 3 oranges or lemons, 2 quarts of molasses, and about 3 gallons of water. These materials were well mixed and broadcast very early in the morning.

Credit for this formula, which was the first grasshopper bait to be widely and successfully used, went to George Dean who was Head of the Entomology Department, Kansas State Agricultural College, at that time.

The bait was known throughout the U.S. as "Kansas Grasshopper Bait."

Grasshoppers were not particularly destructive again until about 1917. In July of that year, T. H. Parks, Extension Entomologist, went to Northwest Kansas where the hoppers were devastating alfalfa and corn.

Parks gave several demonstrations on mixing bait and broadcasting it. He invented a hand bait spreader that was used to good advantage, designed after the commonly used hand seeder.

Extension Entomology Specialists—1918

Parks resigned April 15, 1918 and Dr. E. G. Kelly was employed April 16, 1918 to continue grasshopper control work. H. H. Niniger followed Parks in this program in 1919.

In May, 1918, Dr. Kelly and A. L. Ford, Federal War Emergency Insect Control Agent, went to Western Kansas to organize counties for grasshopper baiting. Meetings were held to demonstrate how to mix and scatter poisoned bran mash.

In early June there was evidence of great numbers of hoppers. By the middle of June they had destroyed over 300,000 acres of wheat in Ford County alone.

On July 15, 1918, Karl Knaus, District Extension Agent, held a district conference in Dodge City, with County Extension Agents from 12 Southwest counties to discuss plans for the control of insects.

Grasshopper damage was very severe in 1918, 1919 and 1920, making it easier to get farmers to attend grasshopper control meetings.

With the aid of poison bait and continued numerous rains, grasshoppers seemed to be on the decrease after 1921.

In 1927, there was another heavy infestation and much bait was used in the Western Kansas counties.

As usual, farmers became negligent during the years of light infestation and by 1930 grasshoppers were on the increase.

Wheat Train—1930

In 1930, the wheat train carried displays calling attention to the development of grasshoppers and the importance of controlling them.

The Extension Entomologist, E. G. Kelly, stressed the fact that farmers should not forget to practice control measures for grasshoppers all of the time.

Farmers in the counties of Thomas, Cheyenne, and Sherman scattered bait for young hoppers before they moved into the wheat. These three counties spent approximately $20,000 for bait materials and the County Agricultural Extension Agents estimated that the bait was responsible for a savings of at least $1.5 million.

Crop Carnivals—1932

A grasshopper survey in the fall of 1932 indicated that considerable educational work on grasshopper control should be done. During the winter, exhibits and demonstrations were conducted at meetings.

"Crop Carnivals" were organized in 25 Western counties where exhibits were displayed to more than 10,000 farmers. Farmers were developing more interest in learning how to do a better job of controlling grasshoppers.

Cost of Grasshoppers—1934-1939

During the five-year period from 1934 to 1939, estimates were that grasshoppers devastated approximately $45 million of crops and grasses.

The savings made by the use of tillage and baits was estimated at about $60 million, on over 11 million acres.

Federal Mixed Bait—1935

A survey made by farmers, County Extension Agents, and the Extension Entomologist in the fall of 1934 indicated that grasshoppers would be rather plentiful in the spring.

In the spring, 1935, 25 railroad cars of mixed bait were allotted to Kansas by the Federal Government. In addition, 15 additional cars of mixed bait that had been made for use in South Dakota but were shipped to Kansas in the fall of 1933. The bait was used by farmers to protect their corn and alfalfa.

Counties Mixed Bait—1936

In 1936, Kelly, the Extension Entomologist, sent an estimate of bait requirements to the Federal Bureau of Entomology with a request that the materials be allocated to Kansas. It was learned that Congress was not in favor of an appropriation sufficient to provide the materials.

So that Kansas might be ready to comply for any possible Federal allotments provided by Congress, each County Extension Agent was appointed as county leader. The Agent appointed three or more men to act as his grasshopper committee.

A contract was arranged with the Boards of County Commissioners so that counties would store the materials and mix the grasshopper bait.

In May, grasshopper eggs began to hatch. Farmers were anticipating rains which would reduce the infestation, but the rains did not come.

When the grass began to dry up the first week of June farmers realized it was necessary to scatter bait to save their corn. There was some bait ready but not enough to supply the needs.

The hoppers moved into the wheat in the Southern and Southwestern counties of Kansas.

It soon became apparent that the late baiting would not stop the hoppers from going into corn unless the farmers had started to combat the insects earlier in the season.

Federal Funds for Grasshopper Bait—1936

A Kansas Congressman visiting the state learned of the seriousness of the situation and immediately made a resolution to provide funds to aid in a grasshopper control program.

In July, 1936, Kansas was allotted about $35,000 to purchase sodium arsenate. The control campaign was paid for mostly by farmers.

Grasshopper control by baiting was practiced in 103 counties, with 54,314 farmers used 9,648,000 pounds of wet bait at the edges of fields to protect 2,269,300 acres of corn, sorghum, alfalfa, and wheat.

It was estimated that the devastation amounted to approximately $21 million in 1936. Millions of trees were lost because of defoliation by the hoppers.

The devastating grasshopper outbreak of 1936 called farmers' attention to control measures.

In December, 1936, representatives of 21 states met in Omaha, Nebraska, to make plans to reduce grasshopper damage and ask Congress for a larger sum of money to fight grasshoppers the coming year.

More than $2 million was appropriated. The fund was placed at the disposal of the Secretary of Agriculture, USDA, who in turn made the Department of Agricultural Entomology responsible for distribution of the money.

Although Kansas did not have a fund for insect control, the State Grasshopper Law permitted counties to participate in control measures. Each county was organized to handle the Federal bait.

In 1938, there was a fifth year of severe grasshopper infestation. A concentrated effort was made to deal with the anticipated outbreak in 1939.

It was estimated that more than 500,000 acres were tilled for control and more than 17,000 miles of roadside were tilled and baited.

An adult grasshopper and egg survey in the fall of 1938, indicated that grasshoppers would continue to be bad in about 50 of the Western counties in Kansas.

Hoppers were especially numerous in the 12 far Southwestern counties. Much educational work was required to keep the grasshoppers under control in 1939.

Grasshopper Bait Used—1940's

Grasshopper control, from 1940 through 1949, was by use of bran, sawdust, and sodium fluosilicate baits. The total dry bait tonnage used in Kansas each year was:

1942 - 787 tons	1946 - 1,244 tons
1943 - 196 tons	1947 - 1,424 tons
1944 - 690 tons	1948 - 3,021 tons
1945 - 454 tons	1949 - 2,797 tons

Insecticides for Grasshopper Control—1949

After 1949, baiting materials were no longer available from Federal sources because insecticides were available as sprays, so grasshopper control went on a volunteer basis.

Grasshoppers were reported to have been controlled on the following acreages:

1950 - 2,858,768	1954 - 2,638,906
1951 - 2,138,275	1955 - 3,011,769
1952 - 2,633,205	1956 - 3,025,470
1953 - 1,063,145	1957 - 5,366,455

Range Spray Program—1956

In 1956, a cooperative range spray program on 110,000 acres was conducted in Comanche, Kiowa, and Barber Counties. Two-thirds of the cost was paid by individual ranchers and one-third by the Federal government.

The application of two ounces of aldrin in one gallon of oil by airplane cost about 48 cents per acre.

A range spray program on 88,000 acres of the U. S. Government Land Utilization grass project in Morton County was also conducted in 1958.

Roadside and Farm Spraying—1958

In 1958, roadside spraying for grasshopper control extended throughout most of central and western Kansas counties.

An organized program in 18 counties in Western Kansas treated 120,000 acres of roadsides. In that program, one-third of the cost was borne by the Federal government.

Many Boards of County Commissioners furnished farmers with either spray materials or paid part of the cost of the insecticides, based on the grasshopper law of 1925.

Grasshoppers Increase —1970's

After 1958, grasshopper control did not require special attention again until the mid-1970's.

From 1976 through 1979, there was a noticeable buildup in grasshopper numbers in Kansas.

Many species were involved, but redlegged, lesser migratory, and differential grasshoppers caused the most damage to crops and gardens in the Eastern part of the state.

In the Western counties, the lesser migratory grasshopper was most devastating to rangeland and wheat fields.

In South Central and Western Kansas this species and the differential grasshopper damaged corn, alfalfa, and even soybeans and grain sorghum, two crops generally considered less susceptible to grasshopper damage.

By 1978, grasshoppers were causing such an outcry for control measures that politicians became involved. On July 7, 1978, Governor Robert Bennett toured Western Kansas to see the problem first hand.

His office later released a statement estimating that 25.2 million acres of Kansas farmland was affected, with damage costs estimated at a potential $150 million.

Bennett and various state legislators took the U.S. Environmental Protection Agency to task in a misguided attempt to have heptachlor, which had been banned, released for use in the grasshopper war.

KSU Extension Entomologists met with some disfavor when they explained to the public that currently available insecticides had proven more effective than heptachlor in killing grasshoppers.

However, Special Local Needs (SLN) Registration was granted to expand the uses of Sevinol, Sevin-4-Oil, Furadan 4 Flowable, Cygon 400, Lorsban 4E, and Penncap-M to meet various cropland and roadside grasshopper control needs in Kansas.

Treat Rangeland—1979

In 1979, the outbreak continued. Nearly 121,000 acres of rangeland were treated in Western Kansas.

This included a 44,000-acre area in Kearny County that was sprayed by air between July 4 and July 13 under a Federal-State cooperative effort.

Croplands were again hard hit and thousands of acres were treated privately for grasshopper control.

Some farmers built and used "grasshopper dozers" for the fronts of their tractors, patterned after the horse-powered ones from decades earlier.

Throughout this time, Extension Entomologists were very busy explaining the intricacies of

pesticide laws pertaining to the new array of grasshopper-killing insecticides. They also explained how grasshopper biology, wheat planting dates, and other factors could best be meshed to avoid grasshopper damage.

A large demonstration of grasshopper control was conducted in Greeley County, in August, 1979, by Extension Specialists Dell Gates, Leroy Brooks, Don Mock, KSU Experiment Station personnel, and the State Board of Agriculture.

Grasshopper Damage—1980

The summer of 1980 was extremely hot and dry. Grasshopper problems were much reduced in the West but croplands and gardens over much of the state again incurred heavy damage from differential and two-striped grasshoppers.

Even shrubs and young trees were destroyed by grasshoppers in Southeastern Kansas counties.

For the rest of the 1980's, grasshopper problems were mostly minimal or localized.

In 1988 a Federal grasshopper control program was conducted on several thousand acres of the Cimarron National Grasslands in Morton County.

Colorado Potato Beetles

The original home of the potato bug was long thought to have been on the Eastern slope of the Rocky Mountains.

Severe floods in 1903 deposited thousands of yellow and black striped potato bugs along the banks of Kansas rivers.

However, this species was present in Eastern Nebraska in 1859 and had spread to the Atlantic Ocean by 1874.

Arsenate of Lead Control—1900's

In 1905, Professor Popenoe found the potato growers in the Kaw Valley alarmed at the destruction caused by potato bugs on potato plants. Popenoe suggested spraying the potato plants with Paris green.

When growers followed the suggestion they learned that Paris green burned the plants. One good grower commented, "the bugs got fat on Paris green."

A year before, E. G. Kelly, then employed by the Bureau of Entomology, had tested spraying liquids for the control of potato bugs in Southern Illinois. He found that materials such as Paris green and London purple had burned the leaves of the potato plant.

Potato Bug Control Demonstration—1918

Several years later, 1918, Kelly became Extension Entomologist in Kansas. He and A. G. Van Horn, County Extension Agent in Wyandotte county, visited the farm of Senator Edwin Taylor to ask for permission to spray two rows of his potatoes with arsenate of lead for control of potato bugs. Reluctantly Senator Taylor consented.

In cooperation with E. P. Taylor, Wyandotte County, a supply of arsenate of lead was manufactured and found to be very satisfactory to kill the bugs and did not burn the plants.

The plants were badly infested and there were not many leaves left on the plants. Spraying was done early in the morning. By night of the second day practically all of the insects were dead and more were moving in.

New leaves were soon in evidence on the third day. Those two rows produced real potatoes.

Potato Bug Control Meetings—1919

During the winter of 1919, meetings were held in the Kaw Valley to discuss potato bug control measures with the growers.

Usually the meetings ended with a demonstration of how to repair an old out-of-date spraying machine.

In 1920 and 1921, potato growers were controlling potato bugs satisfactorily along the Kaw River and efforts were being made to spread the practices to other parts of the state.

By 1922, potato bugs had practically disappeared from the Kaw Valley.

Chinch Bug Control

Chinch bugs were one of the few native pests already in Kansas and established on the prairie when pioneers turned the first sod to plant corn and other crops.

Chinch bugs were probably in Kansas many years before the state was settled. Frontier history is filled with vivid descriptions of the destruction they caused.

The Flint Hills Region and other parts of Eastern Kansas have long been known as a haven for this pest. It is here that bunch grass suitable for over-wintering is present.

Wheat for early spring food is likewise available, along with nearby planted sorghum, a source of readily available food after the wheat has matured.

First Chinch Bug Report—1894

The first report of the chinch bug in Kansas was made in 1894, by C. L. Marlatt, a resident of Riley County. Marlatt was a student at Kansas State Agricultural College and later became a member of the Bureau of Entomology, USDA.

The report in *Insect Life*, called attention to the great numbers of chinch bugs that were hibernating in the clump-forming grasses (probably bluestem).

F. M. Webster called attention to chinch bugs in his reports from Illinois. He reported that chinch bugs had attracted the attention of farmers in Southern Illinois, Iowa, Kansas, and Missouri in 1855.

In 1894 Dr. Snow of the University of Kansas began his famous research on the chinch bug fungus disease.

Early Chinch Bug Damage—1890's

Very severe infestations continued throughout the end of the nineteenth century when millions of dollars worth of damage was done.

The bugs were plentiful from 1904 to 1910. In 1910, burning the bugs in the winter was recommended. Chinch bugs were increasing in numbers rapidly and caused much damage.

There was an increase in damage from chinch bugs between 1910 and 1913, but due to hot dry summers and warm, wet springs the bugs were on a decrease from 1914 until 1916. T. H. Parks, Extension Entomologist, reported few chinch bugs any place in 1916.

Burning to Control Chinch Bugs—1922

In the fall of 1922, campaigns were organized to burn along the roads and similar places to destroy chinch bugs. It was found that the insects moved to wheat and barley. Thousands of acres of small grains were burned in order to stop the insects before they got to the corn. This proved to be very costly.

The weather was hot and dry and dusty furrows were easily made. Many other experiments were tried in an effort to find suitable control measures but many of them failed because they proved impractical or too expensive.

Creosote Barriers for Chinch Bugs—1925

In 1925, chinch bugs were very plentiful but farmers were reluctant to burn fence rows. Since demonstration barriers using creosote soil had been effective, farmers decided to wait for the chinch bugs to move to the corn and catch them with barriers.

Calcium cyanide was used to kill the bugs in post holes in place of torches, the method formerly used. In 26 counties, 281 barriers were built to protect 118 miles of corn frontage.

Chinch Bugs in the 1930's

From 1926 to 1930, there was a decline in chinch bug numbers and the related damage by them.

Chinch bugs increased in numbers in 1930. In 1934, the Federal government allocated creosote to Kansas to be used to build barriers. Creosote was shipped into the counties as rapidly as it could be mixed.

Although no Federal aid was available for 1936, County Extension Agents and leaders built 95 creosote-cyanide barriers in 36 counties. More than 5,000 farmers protected 300,000 acres of corn with 2,672 miles of barriers.

The cold winter of 1936 was too much for chinch bugs. When spring came in 1937, with its freezes and thaws, chinch bugs died by the millions. The ones that lived through the winter were very weak and did not move to the small grain until May.

There was little damage to wheat, barley or row crops. County Extension Agents had prepared to build barriers and had ordered the creosote and cyanide, but by the middle of June the orders were all canceled.

In early May 1938 it appeared that many barriers would be needed in the Eastern counties but timely rains destroyed most of the chinch bugs.

However, good cover provided protection during the winter of 1938, and in the spring of 1939 a generous brood moved into corn, and sorghum.

Spraying for Chinch Bugs—1956

In 1956, demonstrations on sprayer calibration using dieldrin for chinch bug control were conducted in 23 counties.

Further mention of chinch bug presence or damage was not made in the reports of Extension Entomologists.

Chinch Bug Infestation—1970's-80's

During dry periods chinch bugs increase. After a series of wet seasons, they decline. In the 1960's, for the most part, chinch bugs were of relatively minor importance, except for some localities in 1967.

This trend continued into the early 70's. It was not until 1976 when relatively widespread economic infestations began to appear again in many parts of Eastern Kansas.

Each year thereafter, until 1981, infestations became more widely dispersed across the Eastern half of the state, and intensity of infestations generally increased.

When overwintering surveys revealed populations in the range of 250 individuals per square foot of bunch grass sod, the chances were considered good that this would lead to at least some local early season damage.

Counts averaging an excess of 2000 bugs per square foot were common in at least one half of the counties surveyed in the Eastern half of the state during the winter of 1980. Some counts ranged as high as 20,000 bugs per square foot.

Chinch Bugs in Sorghum—1980-82

The problem became so severe and out of control that growers were advised to avoiding planting sorghum in the infested areas of the state.

The combination of bugs and dry weather extracted a terrible toll on the sorghum crop. In Saline County in 1980, the county average was only 11 bushels per acre.

Fortunately this period of extreme activity lasted only two growing seasons. By 1982, chinch bugs were on the decline and remained a relatively non economic problem through 1987.

By 1988, with a return to dry weather, populations began to increase and once again growers suffered severe losses from chinch bug devastation in certain areas of the Flint Hills Region.

Control Methods

The development of carbofuran as a planting time treatment was a salvation to growers in many areas. This was usually combined with foliar treatments to control the migrations out of wheat. Growers were advised to avoid planting sorghum next to thin wheat and to select hybrids that had some tolerance, at least to mid season infestations.

Demonstrations were established to show how to equip sprayers for treating for chinch bugs. Extension programs in practically every county in Eastern Kansas provided assistance to growers seeking more information on ways to combat this problem.

Abundant crops from 1940 through 1948 resulted in an increase in the stored grain insect population.

Stored Grain Insect Controls

Kansas Wheat Quality Council—1950

The Kansas Wheat Quality Council was organized in 1950 to reduce the amount of weevilly grain in the state.

Interviewed after his 1982 retirement, Dell Gates, longtime State Leader of Extension Entomology, said:

> When I started as an Extension Specialist, Kansans couldn't recognize the 15 insects you find in stored grain. Farmers didn't do much storage until after World War II, when government programs had them piling grain everywhere.

In the 1940's, Gates and a co-worker, Norman Whitehair, Extension Grain Marketing Specialist, produced a "picture book" leaflet showing which stored grain insects were problems.

That publication was not only the first of its kind, but also a classic that KSU distributed worldwide for almost 40 years. Its publication number, L-30, was a byword among stored grain workers in many countries.

Weevil Control Results

Demonstrations on bin spraying and fumigation were held from 1949 through 1953.

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The amount of weevilly wheat decreased each year, based on records of shipments to terminal markets.

Before the cleanup program started, contamination ranged from three to eight percent of the railroad cars received at terminal markets. By 1953, that percentage had been reduced to less than one percent (.75).

A Pure Food and Drug regulation required that wheat with more than one percent infestation of weevils be diverted to feed grain.

In 1953, County Extension Agents reported 43,771 bins sprayed, 14,407 farmers added protectant to stored grain, and 32,494 farmers fumigated grain in storage.

Grain elevator managers took an active part in influencing farmers to give their stored grain adequate protection.

Extension Livestock Entomology

Livestock production in Kansas has been important since early times.

As of 1988, Kansas ranked second among states in number of beef cattle and ninth in number of swine produced.

The number of dairies declined but dairying was still important, especially in the Eastern part of the state.

Sheep numbers increased steadily in response to a lamb slaughtering facility built in Harper County in 1985.

In 1988, sales of livestock and livestock commodities made up 65 per cent of Kansas' $7 billion farm income.

There were also numerous horses in the state, primarily for pleasure riding, but also including many pedigreed breeding horses and race horses.

Several thousand horses were still used daily by feedlot cowboys and on ranches where the responsiveness and agility of four-footed mounts could not be replaced by wheels.

Early Entomology Livestock Program

All classes of livestock incur annoyance and reduced productivity from infestations of several fly species, lice, mange, ticks, gnats, and mosquitoes.

Together such pests cause an estimated annual loss of $130- to $200-million to Kansas agriculture.

Since the days of E. G. Kelly, Extension Entomology Specialists had conducted a low-key livestock entomology program, responding to clientele requests and making occasional news releases, but with very few public Extension schools.

Horse Bots—1930-1945

The control of horse bots received much attention during the 1930's and until 1945. By then the economic importance of draft horses had greatly lessened.

Hand Control of Grubs

Grubs in cattle were doing great damage to cattle for many years until rotenone was discovered as a control measure.

This drug destroyed the grubs when applied to the backs of infected cattle either as a dry powder or in solution, as they appeared by making a hole through the hide on the backs of cattle. Hand application was laborious when attempted for large numbers of cattle.

Nevertheless, it proved effective when enough farmers participated. When the U.S. became involved in World War II, patriotism was invoked to gain cooperation.

"When you control the grubs in the backs of your cattle, " read a 1942 news release, "you are also helping your country win a war. The men who are fighting for us need more beef, milk, and leather."

Clip art and posters produced by the USDA for Extension use featured heel flies (adults of the cattle grub) with Hirohito's face and grubs with a marked resemblance to Hitler!

Cattle Grub Control Program—1941

In 1941, the Kansas legislature appropriated $10,000 to the State Livestock Sanitary Commissioner to develop a control program for cattle grubs. Three power sprayers were purchased.

Livestock Sanitary Commissioner, Will Miller, and the Kansas City representative of the National Livestock Loss Prevention Board Ray Cuff, cooperated with E. G. Kelly, Extension Entomologist, to develop an educational program.

The first demonstrations on the use of power sprayers to control cattle grubs were in Wabaunsee and Butler counties in 1944.

Cattle Lice Control—1944

It was found that rotenone, used for cattle grubs, also effectively controlled cattle lice. That dual benefit very soon commanded much attention from cattlemen in Kansas.

Fly Control—1945

In 1945, DDT became available and was used for fly control. After a year or two, it was found that some flies had built up a resistance to DDT.

Other chemicals such as benzine hexachloride (BHC) and methoxychlor were mixed with DDT or used separately with success.

Because of residue from DDT around dairy barns, and subsequent contamination in the milk, methoxychlor was recommended for use on dairy animals and in dairy barns.

In 1949, County Extension Agents reported 1,691 power sprayers and 31,033 hand sprayers in use.

Army Sprayer Loan Program—1946

In March of 1946, the army agreed to loan surplus power spray equipment to Kansas State College which in turn loaned it to counties.

Approximately 20 truck-mounted power sprayers of large capacity were brought into Kansas for the cost of transportation.

Soon many farmers purchased their own power sprayers to use in the control of cattle grubs, lice, and flies.

Stationary Insecticide Applicators—1953

In 1953, stationary insecticide applicators came into use to control cattle grubs, lice, and flies.

That device was constructed so cattle could rub against solution soaked chains or cables, and apply insecticide to their necks and backs where the insects prefer to lodge.

Systemic Insecticides—1957

In 1957, Trolene (Dow ET-57) received approval for use in controlling cattle grubs. The next year, Co-Ral (Bayers 21-199) became available. These were systemic materials which could be mixed with feed. Their effectiveness was very satisfactory.

Other Livestock Insects

Certain livestock insects occasionally increased to serious numbers. These included hog mange, sheep ticks, certain species of flies, screw worms, and others.

Control measures were effective and their use brought successful control in most cases.

Expand Extension Program—1982

In 1982, Don Mock was assigned 0.2 time from his IPM Coordinator responsibilities to develop an Extension program in livestock entomology.

It was fortuitous that Department Head R. G. Helgesen had been a young professor at Cornell University, New York, while Mock was doing his doctoral research there in 1969 to 1973.

Meanwhile, Mock had established an identity in Kansas as an Extension Crop Entomologist. Without Helgesen's personal awareness of his background, Mock would probably never have been assigned to livestock entomology.

Within a couple of years this developed into a full time assignment, the position he held through 1988, the end of this report.

Livestock Entomology—1980's

Mock's initial assignment to livestock entomology coincided with the beginnings of horn fly resistance to pyrethroids, a new class of insecticides upon which cattle producers had begun to rely heavily.

This subject, and teaching stockmen to use alternatives to pyrethroids, required much attention for several years.

Other highlights included:

1) A horse fly outbreak in Eastern Kansas, from 1983 through 1987, that was unparalleled in documented history.
2) Increased numbers of ticks in 1987 through 1988, coinciding with intense public awareness of ticks because of national media coverage of the tick-borne malady, Lyme disease.

When Mock issued a news release requesting Kansans to send him ticks with host and location information, and date of collection, he received over 2,700 ticks in response.

From this work he established a basis for understanding the distribution of ticks in Kansas for the first time ever. The ticks were deposited in the KSU Insect Museum, which previously had contained only four ticks.

Livestock producers, veterinarians, and County Extension Agents also kept Mock busy advising on a myriad of other routine insect, mite, and tick problems.

Horticultural & Household Insect Control

The first mention of orchard work in available reports was by William R. Martin Jr. on codling moth control in the Arkansas River Valley in 1918. Extension Entomologists worked with Extension Horticulturists making fruit tree insect surveys and issuing a spray calendar for effective control of those insects.

Tree Insects—1944

In 1944, special attention was given to beetles and borers found in shelterbelts and shade trees. In 1945, the elm leaf beetle and bag worms were present in large numbers.

Many cities obtained power sprayer equipment for the control of these insects.

In 1949, canker worms became very plentiful and many cities sprayed for the control of this insect.

Manhattan, Kansas sprayed the city area with results that were effective for several years.

Sanitation and Health— 1940's-50's

Following World War II, new emphasis was given to insects affecting sanitation and health, including mosquitoes, roaches, and flies. The use of the newer chemicals of that time, including DDT, made a control program effective.

Leader-training, mass media, and new literature were used to disseminate information to Kansas.

During the 1950's, commercial pest control came into being. Legislation provided for strict regulation and licensing of pest control operators under the supervision of the Kansas State Board of Agriculture.

Coordinated Leader Training

It was difficult for one Extension Entomologist to cover the state with an effective program on the control of all kinds of insects, so a home garden program was developed with the Extension Horticulturist and the Extension Plant Pathologist.

A five-year rotation plan for leader-training was carried out, with each Specialist doing training in one-fifth of the counties each year.

This system of leader-training was very effective in reaching a maximum number of people with limited resources.

Train Garden Leaders—1940's

Garden leaders in home demonstration units were trained in the five year rotation leader training system.

Leader-training schools were conducted in the winter time and garden tours in late spring.

Dutch Elm Disease—1957

In 1957, Dutch Elm Disease was found in Wyandotte, Johnson, and Douglas counties.

A vigorous campaign was started to inform people of the nature and seriousness of this disease, and the manner in which the disease was spread by the elm bark beetle. Control measures were widely distributed.

Residential/Horticultural Entomology—1978-85

A new position in Extension Entomology was created in 1976 to handle educational efforts on residential and horticultural insect problems. The position was filled in 1977 by Lynne Thompson.

He developed an active program, not only with commercial horticultural producers and pest control operations, but also with homeowner clientele.

In 1980 Thompson left for a forestry position in Arkansas, and for the next two years Entomology services in the horticultural and residential area were greatly curtailed.

In 1983, Judy Bertholf was hired to assume the position of Residential Horticultural Entomology. Bertholf's emphasis was primarily in the residential area, working with home owners and pest control operators with structural insect problems.

To provide further assistance in this area, Jim Nechols was employed in Extension part-time in 1984. He was primarily a researcher in the Entomology department, with some Extension time devoted to commercial horticulture, and entomology problems. He kept this assignment until 1986.

Bertholf resigned in 1985 to accept a position with Dow Chemical Company. From 1985 through 1988, Extension Entomology was without the services of an entomologist in the horticultural and residential area.

4-H Club Entomology Project

Early in the 1950's, work in entomology was recognized as an activity in the 4-H Club program. Several counties promoted a study of insects, primarily identification and control of the major livestock, crop, and stored grain insects.

In 1953 there were 74 4-H demonstration teams in crop and stored grain insects, 174 4-H teams on livestock insects, and 55 4-H teams demonstrating the control of household insects.

4-H Entomology—1960's-70's

In 1960, the activity was changed to a project. The first entomology 4-H exhibits at the Mid-America Fair at Topeka and the Kansas State Fair at Hutchinson were in 1960. There were 27 exhibits at the former and 46 at the latter fair.

The entomology project was organized into three classes—1) basic, 2) intermediate, and 3) advanced.

Members enrolled in the project were encouraged to prepare an exhibit, either insect collections or educational exhibits.

During one period, Dell Gates prepared scores of entomology boxes in his home workshop help youngsters participate in the project.

Interest in the project remained high during the 1960's and well into the 70's.

But with the latter part of the 1970's, the amount of time that Extension Specialists were able to devote to the project began to decline as a result of increasing involvement with other Federally-mandated programs.

Consequently, because of increasing competition from geology, interest in the entomology project began to taper off, the number of insect exhibits represented at the State Fair decreased and 4-H enrollment in entomology declined.

4-H Entomology—1980's

This trend continued until about the mid 1980's. At that time Emily Kling took over leadership responsibility in the 4-H department.

She and Leroy Brooks launched a program to revitalize the project. Most noteworthy in this effort was the time devoted to the project by Area Extension Entomologists Bauernfeind, Lippert, and Sloderbeck, by several volunteers, and by individuals in the State Board of Agriculture.

By 1988, enrollment had increased to over 3,000 youngsters in the 4-H Entomology project, and exhibits had doubled compared to the number being entered five years previously.

Insects in Kansas—1962

A publication, **Insects in Kansas** was published by the State Board of Agriculture in June, 1943. It provided a very helpful aid in insect identification. This, along with workshops designed to provide subject matter training to local leaders, helped to stimulate interest in the project.

In 1962, **Insects in Kansas** was revised and published by Kansas State University. This 307-page reference was widely used by farmers, teachers, pest control personnel, naturalists, and entomologists.

By the late 1970's, a reprinting was badly needed, but the plates for this book had been lost. A few dog-eared copies are still in heavy use.

Development of Insecticides

The period following World War II through the mid 60's represented a time of unparalleled insecticide development.

In the early part of this period, Extension Entomologists devoted a major part of their time finding new ways to combat old problems.

Indeed, it was an exciting period. Solutions to problems that people had previously only dreamed of suddenly became reality.

Control of field crop, livestock, ornamental, and many nuisance pests became practical for the first time.

On fruit, for example, the number of insecticide applications required per season was reduced by more than half, and at a fraction of the former cost as a result of the new petroleum based chemistry.

Pesticide Residues—1949

But such miraculous advances were not problem free. As early as 1949, residues of DDT were found in milk and it was demonstrated that chlorinated hydrocarbon insecticides were readily stored in the fatty tissues of meat and dairy animals.

Pesticide Residue Tolerances—1958

In 1958, the Miller Amendment to the Food, Drug and Cosmetic Act was passed to establish pesticide residue tolerances in raw agriculture commodities.

For the first time, some restraint on the part of the producer had to be exercised in order to avoid producing and marketing products with illegal residues.

Extension programs in Entomology began to focus on safety-related concerns as an ongoing part of pest control educational programs.

Pesticides In Environment—1960's

In 1962, following publication of **Silent Spring** by Rachel Carson, public concern over possible hazardous effects of pesticides reached new levels of intensity.

Not only was there concern about the safety of our food, but an even greater concern was developing over the possible wide-spread distribution of pesticide residues in the environment.

Extension Specialists—1965

In response, Congress approved additional funding to establish a National Extension Pesticide Education Program.

In Kansas, these funds were used to provide one additional Extension Specialist each in Entomology, Agronomy, and Grain Science.

Leroy Brooks assumed the position of the second Specialist in Entomology on February 1, 1965, to work with Dell Gates. This brought the staff level up to two full time Specialists in Extension Entomology.

Additional staffing had been needed for many years. At this time, Area Extension programs did not exist, and it was the responsibility of the State Extension Entomology Specialists to provide educational programs in all the counties that requested assistance.

Entomology Specialists often left town on Monday, returned Friday night and spent Saturday morning in the office.

Even with two Specialists, the subject matter responsibilities were very broad and at times somewhat unreasonable.

Extension Entomology was expected to maintain and conduct programs on insects in field crops, livestock, stored grain, ornamental and household pests, commercial fruit and vegetables.

They were to have a program in 4-H entomology, and devote approximately half of one position to pesticide education.

The two Specialists agreed on field schedules and subject matter responsibilities. The need to have one Extension Specialist in the office to provide telephone assistance and perform diagnostic services became increasingly apparent.

Pest Management Program—1973

From 1965 until 1973, the department continued to operate with two full time Extension Entomology Specialists.

At that time, funding for Pest Management became available and a grant proposal was made to establish a demonstration Pest Management project on sorghum in Southwest Kansas.

The grant request was approved and Kansas received $30,000 a year for a three year period. To implement the Pest Management program, Donald Mock was hired as a Pest Management Specialist in the Southwest Area Office to administer the Pest Management Program.

At the end of the pilot project Mock became the first regular Area Extension Entomology Specialist.

Fund Crop Protection—1978

The success of this program helped to spark an increased interest in Pest Management.

As a result, the College of Agriculture prepared a special crop protection package for the Kansas legislature.

The package was passed and created funding for 10 additional position in Extension, including two Area Extension Crop Protection positions.

In South Central Kansas the Extension Entomology Specialist employed was Robert Bauernfeind; in the Southeast, George Lippert was hired; and in Northeast Kansas, Larry Bonczkowski assumed the position of Extension Crop Protection Specialist.

The Residential/Horticultural Entomology position in which Lynne Thompson was employed was also funded through the State Crop Protection package.

Diagnostician—1978

Until 1978, all the diagnostic services were performed by either Dell Gates, Leroy Brooks or Lynne Thompson in their spare time. The samples sometimes piled up for weeks before they could be processed and identified.

At this time a half-time Extension Assistant position was created for a graduate student diagnostician. For the first time good, rapid diagnostic services could be offered to the public.

James Johnson was the first to be hired. Johnson was superseded by Timothy Gibb in 1984. The position in turn was filled by Kevin Shufran in 1987.

Chemical Task Force (CTF)

When a Chemical Task Force (CTF) was created in late 1964, Frank Bieberly, Extension Section Leader in Agronomy, was appointed as the Task Force Coordinator. He held this assignment for a number of years.

At that time the Task Force Coordinator remained housed in Extension Agronomy and served as the multidisciplinary coordinator.

CTF members came from the Departments of Entomology, Grain Science, Agronomy, Horticulture, Veterinary Medicine, and Agricultural Engineering.

As Frank Bieberly neared retirement, Clifford Poindexter, a former Environmental Protection Agency (EPA) official, was appointed to become the first full time Pesticide Coordinator and Chairman of the Task Force.

After two months, September and October, 1975, Poindexter, who had found it extremely difficult to sell his house in Kansas City, resigned his position at KSU and returned to his old job with EPA.

Following Poindexter's resignation, Dave Emerson, another former EPA official, and also a former chemist with Mobay Chemical Company, assumed the coordinator position. He held the position from March, 1976 through January, 1978. Then he resigned to become Research Manager at Marion Laboratories in Kansas City.

After David Emerson resigned, the position was entitled, "Extension Pesticide Coordinator" and redescribed to include coordination of Pesticide Applicator Training (PAT) (Private and Commercial), Pesticide Impact Assessment Program (PIAP), and IR-4 (A research program), and Chair of the CTF.

Donald Cress, then research entomologist at the Garden City Experiment Station, became the Extension Pesticide Coordinator in March, 1978.

Since Cress was an entomologist by training, he become a part of the Extension Entomology staff. He was housed in Entomology, and the position of Chemical Task Force Coordinator was housed in the Department of Entomology. Cress remained as Coordinator of Pesticide Programs through the time of this report, 1988.

A CTF newsletter, entitled *Chemical Task Force Reports,* was published monthly from December 1965 through April 1976. Input came from the Chemical Task Force members and covered a wide range of topics which served to educate pesticide applicators.

In addition, the CTF coordinated numerous district pesticide clinics which went into detail about safe pesticide use and handling.

Full-Time Pesticide Coordinator—1972

Amendments in 1972 to the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and subsequent passage of the Kansas Pesticide Use Law, made it necessary to establish a full-time Pesticide Coordinator.

The basic role and activities of the CTF remained the same. Departmental representation on the CTF remained the same but the people changed, to include: Leroy Brooks, Bill Willis, Erick Nilson, Dennis Kuhlman, Charlie Long, Les Pinkerton, and Bob Henderson.

The CTF advised higher administration in the University on issues involving pesticides and hazardous chemicals.

In addition all new Federal programs, including endangered species, groundwater protection, non-point pollution (of water) control, community right-to-know, and others were reviewed by the CTF.

The CTF, as a body, planned and served as the major resource in the compilation of an auto-tutorial Private Pesticide Applicator Training Manual and 19 auto-tutorial Commercial Pesticide Applicator Training manuals for certification.

The CTF served to revise these manuals. They also planned and carried out commercial applicator renewal certification meetings. The Pesticide Impact Assessment Program (PIAP) primarily accessed the National Pesticide Information Retrieval System (NPIRS). NPIRS was a computer data base containing Federal and State data on all pesticide registrations.

This information was used in other programs such as endangered species, special reviews, Sec. 24(c) etc., where pesticides impacted on these program areas.

The IR-4 program was coordinated through the Extension Pesticide Coordinator's office . Departments of Horticulture, Plant Pathology, and Entomology participated annually.

Integrated Pest Management (IPM)

In 1972, the Federal Extension Service began to fund State Cooperative Extension Service projects to test and develop Integrated Pest Management (IPM) practices in crops other than cotton.

IPM was a concept of protecting crops or livestock from yield reductions by integrating appropriate cultural, biological, and chemical control measures.

The timing of such measures was based on field-specific current information on crop and pest development, and the measures are selected on the basis of efficacy, compatibility, economics, and environmental safety.

Kansas IPM Project—1973

Leroy Brooks and Dell Gates, Extension Entomology Specialists, with collaborators from other departments, secured funding for 1973 to 1975 for a Kansas IPM project in grain sorghum, coordinated with Texas, Oklahoma, and Nebraska.

Meade, Haskell, and Stevens counties hosted the project initially and were joined later by Kiowa, Scott, Wichita, Greeley, and Nemaha.

Demand for IPM in corn became strong, so corn was emphasized in the Kansas project after 1973.

The Southwest Area Extension Entomology Specialist position originated through this project was first filled by Don Mock.

This was an interdisciplinary project but was primarily an entomological effort from the start. In addition to Mock, several state Specialists were heavily involved: Leroy Brooks and Dell Gates in Entomology, Claude King and Bill Willis in Plant Pathology, and Erick Nilson in Agronomy.

In 1980, Mock moved to the Kansas State University campus to become IPM Coordinator and was replaced in Garden City by Phil Sloderbeck as Southwest Area Extension Entomology Specialist. The IPM program has continued to the present time (1988).

Agribusiness Developed—1970's

The Integrated Pest Management project was the springboard for a new type of agribusiness in Kansas.

In 1972 there were two crop consultants in Kansas, scouting 25,000 acres. The KSU project employed 11 scouts, in 1975, serving 54,500 acres.

By 1976 there were nine consulting firms with 36 employees serving 370,000 acres.

Within a few years, growth of such firms leveled off with about 100 professionals serving over a million acres.

Extension Entomology Positions —1978

Based on the success of the Extension "Crop Protection/IPM" concept in Southwest Kansas, several additional positions were created.

Entomology and Plant Pathology Department Heads, Richard Sauer and Lindsey Faulkner, along with Roger Mitchell, Vice President for Agriculture, were successful in receiving permanent funding for a proposal made to the State Legislature in 1976.

Thus were created the Area Extension Crop Protection and Extension Entomology positions occupied in 1978 by George Lippert, Bob Bauernfeind and Larry Bonczkowski, plus two other area positions and six state positions—some of which were later lost.

Introduce Computers—1978

In 1978 and 1979 another round of Federal Extension funding launched a new phase of IPM endeavors in which research entomologists Fred Poston and Steve Welch figured heavily.

Their efforts introduced computers and software to Extension applications outside of economics and engineering. Later, they received a grant from the Kellogg Foundation to finance the PRO software series, including CORNpro and BEEFpro.

In 1984, both Poston and Welch joined the Extension Service, as Associate Director and Computer Systems Office Coordinator, respectively. Poston later moved to Washington State as Director of Extension.

Educational Program Methods

In July 1919, the Extension Entomologist, E. G. Kelly, met with a committee of County Extension Agents and G. A. Dean, head of the Department of Entomology, to develop county plans of work for entomology.

The County Extension Agents were A. B. Kimball, F. H. Ptacek, H. J. Adams, and W. A. Wunch.

The plans of work were reviewed each year and revised when revisions seemed desirable. Those county Extension plans of work received recognition by being published in the *Journal of Economic Entomology*.

Entomology Leader-Training

Leader-Training was used widely in Extension Entomology education.

Leaders representing Extension Home Demonstration Units received training based on a correlated plan developed with Extension Specialists in Plant Pathology and Horticulture.

Other adult leaders (men) were selected and trained to meet specific problems such as grasshopper outbreaks, and chinch bug campaigns.

Agent Training in Entomology

Agent-training was of great importance in the conduct of the Extension Entomology program.

As a result, County Extension Agents became more familiar with control measures for many insects affecting the operation and management of the farm and home, and emergency calls for assistance to State Extension Specialists from Agents were held to a minimum.

Agent-training included field days, winter schools, and information from insect surveys about the possibility of outbreaks at various times of the year.

Agents were supplied with colored slides of insect life, possible damage, and control measures. Posters and other educational materials were prepared for their use.

For many years an Entomology newsletter provided on-going Agent training on applied entomological topics, especially during the April through September growing season.

The newsletter began with single-subject updates produced periodically by Dell Gates, at least as early as 1962.

By 1963, the newsletters were issued more regularly, in conjunction with State Survey Entomologist, Leroy Peters, and were renamed *Kansas Insect Survey Reports*.

Beginning in 1967, the newsletter was written solely by Extension entomologists and was again renamed, *Kansas Insect Newsletter*. It continues to this day under that title. Archives of this newsletter provide a fascinating and detailed overview of entomology in Kansas.

Coordinated Programs

Extension Entomology Specialists coordinated their programs through many years with Extension Specialists in Agronomy, Animal Husbandry, Dairy, Livestock Marketing, Dairy Marketing, Rodent Control, and Engineering.

Extension Specialists Change—1981

In 1981, Dell Gates retired as senior Extension Entomologist and Program Leader, a position he had held since 1949.

In 1982, Randall Higgins was hired to assume his vacant position. Higgins came in with a split appointment —0.4 in research and 0.6 in Extension. His responsibilities were divided among corn, alfalfa, soybeans, and stored grain.

Field Crop Insects

Corn Insects

Southwestern Corn Borer—1930's

Any discussion of Extension work in entomology in Kansas would not be complete without some reference to the Southwestern corn borer. This insect entered Kansas during the early 1930's.

During the early 1940's southwestern corn borers occurred in outbreak numbers and spread to 51 counties of Central and Western Kansas.

They caused loss to corn as far north as Norton and Phillip counties on the Nebraska border.

A bulletin written by Wilber and Bryson (1951) describes an outbreak that was occurring at that time. According to stories, this insect had a lot to do with the decline in dryland corn production.

After 1951, little attention was given to Southwestern corn borers in areas outside of Stafford

County. There it had survived and growers in that area frequently expressed concern about it.

At times during these years, research and Extension Entomologists worked with growers to establish demonstration and/or research plots.

However, efforts were never intensive enough to develop a good understanding of its biology.

For the most part, the insect was ignored as interest in irrigated corn production increased in the sandy land areas of South Central and Southwest Kansas.

At the beginning of this expansion, Experiment Station Director Floyd Smith, warned growers that the Southwestern corn borer would eventually drive corn growers out of business in this section of the state.

For a time, most growers remained unaware of the existence of the Southwestern corn borer in their fields.

Southwestern Corn Borer Outbreak—1974

But in 1974, the pest exploded throughout most of the sandy land region of the state. Second generation infestation levels reached 90 percent of the plants infested. By mid-October, when girdling was completed, growers became aware of the devastation as field after field began to lodge. The plants fell flat to the ground, and made harvest all but impossible.

In the winter of 1974, Conall Addison, Stafford County Extension Agent, called a fact-finding conference at St. John. Area farmers filled the high school auditorium.

Dell Gates; Bob Nuttelman, Area Extension Agronomist; Leroy Brooks; Jay D. Stone, Research Entomologist; and Don Mock, then Southwest Area Extension Entomologist, outlined what was known about Southwestern corn borer, information gaps that existed, and what to expect if growers continued with the same production practices as they were currently using.

The overriding sentiment was that additional information would need to be generated before a practical control program could be put in place.

Corn Growers Action Group—1970's

Corn growers organized into an action group to deal with the Southwestern corn borer problem. They met at various times with staff members in the Department of Entomology, the Director of the Experiment Station and finally with legislators in Topeka, to obtain additional support for southwestern corn borer work.

During the next year, Dr. Charlie Pitts, KSU Research Entomologist, undertook a commitment to provide direct assistance to growers in the region South of Great Bend.

In the late winter of 1975, Pitts and other faculty members took turns making the journey to South Central Kansas to be met by Stone and Mock from Garden City. Together they surveyed hundreds of fields to learn the extent of the previous year's infestation and to ascertain the borers' overwintering success—hence, the threat for 1975.

That summer, Stone was directed by the administration to conduct southwestern corn borer control trials at Sandy land Field in Stafford County. He tested over two dozen chemicals at various rates.

Late in 1975, Dr. Fred Poston was hired as research entomologist and assigned to develop a successful Southwestern corn borer management program. Poston placed his Graduate Research Assistant, Jeff Whitworth, at St. John in Stafford County, and together they conducted research on the biology and control of this pest.

Within a short time he was able to demonstrate that the use of carbofuran and certain pyrethroid insecticides would, if properly timed, provide a significant reduction in corn borer infestations.

It was determined that early planting, combined with early harvesting, could allow growers to harvest before a significant amount of lodging occurred. Later, a timing model was used as part of a pest management project to help growers and applicators properly time insecticide treatments.

Meanwhile, Don Mock, as Southwest Area Extension Entomologist, concentrated on documenting the impact of Southwestern corn borers on southwest Kansas. He pointed out that while the hue and cry about this pest, and the ensuing research efforts, were centered in South Central Kansas there were only about 95,000 acres of corn there.

Further west, there were 103,000 acres of corn in Haskell County alone, and nearly 350,000 acres in the Southwest Area where the Southwestern corn borer was also thriving. Growers there were incurring staggering losses.

In the fall of 1976, Mock conducted detailed loss assessments in dozens of fields in that area. He concluded that a minimum of $3.8 million worth of corn had been lost to the Southwestern

corn borer in just seven Southwestern counties.

European Corn Borer—1949

The greatest concern with European corn borer was probably during the late 1940's.

It was about this time that an article in the *Kansas City Star*, written by Harold Gunderson, Extension Entomologist at Iowa State University, reported collecting 200 to 300 borers out of a sample of less than 10 corn plants.

The European corn borer entered Kansas in 1949. Because of improvement in hybrids there were fewer problems with European corn borer, but it was still a concern, especially during the first generation.

In 1965, damaging infestations were limited primarily to the Northeastern portions of Kansas. This trend continued until about 1975 when distribution began to change.

At first there were only a few occasional fields, usually on sandy land in parts of South Central Kansas, where extremely high infestations began to appear.

In the mid to late 1970's, infestations spread throughout most of the corn growing areas of South Central Kansas, into Southwest Kansas and finally into areas of Northwest Kansas. Concern centered primarily around damaging second generation infestations.

Fred Poston, who was at the time devoting most of his research activity to Southwestern corn borer management, began to conduct European corn borer investigations.

There was no effective means of obtaining second generation control at this time. Building upon the knowledge gained in management of Southwestern corn borers, control approaches gradually became identified.

Treatment thresholds began to be developed as new knowledge became available. It was well into the 1980's before entomologists had sufficient knowledge to begin to develop an effective European corn borer management system.

At this time Randy Higgins, who had replaced Dell Gates in 1982, began to refine and improve a computerized timing and management software program.

It later served as a model for many of the other surrounding corn producing states.

Western Corn Rootworm—1950's

Meanwhile, in Eastern Kansas, perhaps the biggest insect problem was the Western corn rootworm. Infestations were common on continuous corn land.

During the late 50's and early 60's, preventive treatments for corn rootworm control consisted of planting time applications of aldrin and heptachlor.

In 1962, corn growers in Nebraska began to experience difficulty in obtaining control with these compounds. Suddenly, it required a thousand times more insecticide to obtain the same amount of rootworm control.

Resistant populations spread rapidly. By 1965 this was a major concern of corn growers in Kansas. That year a map was prepared showing the area of resistant populations in Kansas as well as areas where populations were still susceptible to the older insecticides.

Alternative methods of rootworm control were topics of prime interest among corn producers of the region.

Irrigation Development—1965

In 1965, Extension Entomology information was directed almost exclusively to dryland production.

Irrigation was developing rapidly in western Kansas, but serious insect problems had not yet arrived on irrigated farms.

During the years of 1965 through 1967, Extension Entomologists were trying to promote insect management with irrigated corn producers.

In response to one of these inquiries, for example, Jack Wilson, Wichita County Agricultural Extension Agent, told Extension Entomologists that corn producers were not experiencing problems except for an occasional flare-up of mites.

His response was typical of the feelings and experiences of most of the producers throughout the Western part of the state.

Another five or six years would pass before the scene would begin to change. By the late 1970's, corn growers were spending in excess of $50 per acre for insect and mite control on irrigated corn land.

Corn Rootworm—1960's-80's

Evaluation of planting time insecticides was started by Professor Burkhardt in about 1960. This work was continued by Dr. Wilde and continued up through 1988.

In 1965, in heavily infested non-treated fields, it was not unusual to find from 50 to 60 corn

rootworm larvae per plant. Later, beetle numbers would average anywhere from 10 to 30 per plant.

Nebraska at this time talked about beetle populations averaging 100 or more per plant. Numbers within this range were not seen in Kansas, as of 1988. However, rootworm control continued to be an important element of corn production.

Diazinon became the product of choice, and research indicated it was frequently superior to Thimet. Performance of thimet interestingly changed very little over the years.

It was rarely outstanding, but just good enough to continue to be recommended, except for one brief period in the 1970's.

A new product called Bux, a carbamate insecticide, came out and rapidly climbed to the number one spot in rootworm control.

Before long, performance of Diazinon began to decline in research tests in Kansas as well as in other states and it was soon dropped.

Within a couple of years Bux was also dropped because of lack of performance.

By that time, Furadan had entered the scene. It rapidly took over the number one spot in rootworm control for several years.

During the 1980's, Furadan was largely replaced by Counter. For a period during the mid 1970's, rootworm populations were on the increase in Kansas, and the level of control obtained was disappointing.

Sales figures showed that growers paid close attention to KSU recommendations in trying to keep abreast of the changing pest problem.

Spider Mites—Late 1960's

The initial years of irrigated corn production in western Kansas were relatively pest free, but problems with spider mites begin to emerge during the latter part of the 1960's.

Once established, it continued year after year, and was generally heavier during the dryer years.

Spider mites were among the most difficult arthropods to control. Most of the KSU research attempts during the 1970's were disappointing.

Research Problems on Spider Mites

Several attempts to launch a research program were made. Research work began with Johnny Boling who traveled weekly from Manhattan to Stevens County to establish plots.

He left KSU and was followed by Jay Stone, as the position was moved to the Garden City Branch Experiment Station to be closer to the action.

Stone accepted a position with Texas A & M and was followed by Marshall Johnson.

Johnson was followed by Don Cress. None of these researchers stayed on the staff long enough to establish a viable program.

Research Progress—1980's

It was not until Dr. Lawrence Buschman took over the position of mite research at Garden City in the early 1980's that any real progress appeared.

During the 1980's, Buschman was able to launch a series of studies, each looking at a different aspect of spider mite behavior, its biology and methods of control.

These began to produce an understanding that led to modifications in Extension recommendations, including the use of more selective insecticides and choosing corn borer treatments to avoid aggravating mite populations.

The hope for the 1990's is to gain further understanding of the mite complex. This could lead to a variety of management practices which could lessen the problem caused by mites.

Wheat Insects

Hessian Fly Damage—1871

Early history indicates that the Hessian fly followed the planting of wheat in Kansas and developed along with the increase in acreage. In 1871, the Hessian fly caused much loss in the wheat crop.

From 1871 to 1923 there were eight outbreaks of the insect. These outbreaks had a duration of two to five years.

In the spring of 1909, severe drought and hot weather brought to a close a severe devastation following egg deposition.

Hessian Fly Campaign—1915

The first large campaign in Hessian Fly control was launched in 1915 with an All-Insect Train operated by the Santa Fe Railway.

When T. H. Parks became Extension Entomologist March 15, 1916, he found a real task

awaiting him. The Hessian Fly had devastated many thousands of acres of wheat in 1915. The fall infestation in 1915 was again severe and offered to devastate many more thousands of acres in 1916.

T. H. Parks immediately began to organize the state for county-wide Hessian fly control. R. R. Reppert, a student at the College, assisted in the effort to get farmers to observe the "fly-free-date."

Recommended Controls—Early 1900's

The recommendations of the Extension Entomology Specialists were:

1) Early plowing to cover the infested stubble.
2) Destruction of volunteer wheat.
3) Planting the wheat after the "safe seeding date."

These dates had been established for each county by the experimental plantings made by Dr. Kelly while with the Bureau of Entomology.

Farmers were reluctant to plow early because of heat and biting flies that affected the horses. They were reluctant to plant wheat after the fly free date as that was considered to be "too late."

Farmers wanted to get the seeding done earlier before fall rains started, and also they wanted to use wheat for their livestock pasture.

The Hessian fly infestation became rather severe in the spring of 1922. Much wheat was damaged beyond repair and many thousands of acres were not harvested.

The loss was tremendous and there was need for organization and control.

Extension Control Program—1922

In May of 1922, Dr. Kelly, Extension Entomologist, and Karl Knaus, District Extension Agent, met with County Extension Agents in groups to discuss plans for a control program.

Early plowing and the safe-seeding date were stressed in an attempt to wipe out the pest.

In spite of this effort, the Hessian fly continued to increase during 1923 and 1924.

In 1925, the "Opportunity Special" was operated by the Santa Fe Railway and the Southwestern Wheat Growers Association. Dr. Kelly, taught Hessian fly control to more than 100,000 persons.

A similar train was operated in 1926, and, in addition to the Santa Fe, the Rock Island ran the train over many of its lines. The story of Hessian fly control reached 156,000 persons.

Control Hessian Fly —1927

Another 100,000 persons were reached in 1927 by means of the "Wheat Festival" train. The story of how to control Hessian fly finally became effective. In 1929, losses were the least of any year since 1923. Farmers plowed early and delayed seeding until the proper time.

Hessian Fly Outbreak—1933

In 1933, there was an increase in the devastation caused by the Hessian fly. But the recommended practices of early plowing, destroying volunteer wheat, and late seeding, together with the drought of 1933, brought about control.

In 1936, another outbreak threatened but recommended practices prevailed and control was again accomplished.

Resistant Varieties of Wheat—1945

Hessian fly remained a problem until the general distribution of Pawnee wheat variety in 1945, followed by Ponca.

The resistance of Pawnee wheat failed to take care of the Hessian problem in Southeast Kansas so it was replaced by Ponca wheat which carried a high level of resistance.

R. H. Painter, Kansas State College, and Elmer Jones, USDA performed most of this early work on resistant wheat varieties.

These resistant varieties were planted if winter wheat was to be used for early pasture.

If not used for pasture, susceptible varieties were planted after the fly-free date to keep the Hessian fly under control.

Hessian Fly Outbreak—1963

Little damage or loss was experienced from Hessian fly through the late 1940's, the 50's, and into the early 60's.

A buildup of the fly then began, and some losses occurred in 1963. Recommended practices and resistant varieties again showed their worth.

In general, the trend in reduction of the Hessian fly problem after the introduction of the Pawnee variety in 1945 continued through the 1970's and into the early 1980's. Hessian fly levels did fluctuate from year to year, and from locality to locality.

Concern was usually on a localized level. Rarely was there ever a threat of the magnitude that growers had experienced during some years in the 1920's and 1930's.

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It has been argued that the use of resistant varieties were responsible for this decline in population levels. No doubt resistant varieties played an important role in combination with cultural practices.

In the mid 1980's, Hessian fly levels increased in areas where growers failed to observe traditional cultural control methods, and where certain new susceptible varieties were being grown.

Re-emphasis on Hessian fly control resurfaced in both research and Extension programs. Growers re-learned to recognize conditions that contributed to Hessian fly development.

By the end of the decade of the 80's, infestation levels were again on the decline. Weather conditions were also less favorable for fly development during that time.

Cutworms—1960's

The mid to late 1960's represented an extremely dry period especially in Western Kansas. Beginning in the spring of 1967 and continuing into 1968, growers suffered a devastating outbreak of army cutworms and/or pale western cutworms.

Several thousand acres of wheat were abandoned each of these years, 1967 and 1968, either as a result of these worms directly or due to a combination of the insects and lack of moisture.

Both cutworm pests were difficult to control, but research conducted by Les DePew at the Garden City Station provided answers that were used in educational programs.

Light traps established in the fall of 1967 resulted in huge catches of both army and pale western cutworm moths. In at least one trap in Southwestern Kansas, nightly counts totaled more than 2,000 moths.

These results were used to inform growers about what to expect during the coming year, 1968, and proved to be extremely valuable in alerting growers to the continuing problem.

Greenbugs—1967

The fall and winter of 1967 were unusually mild and dry. Greenbug development in fall planted wheat field was greater than it had been in many years.

An outbreak, the largest back to 1951, developed over a large portion of South Central Kansas. Some fields were destroyed by the insects before winter dormancy began.

Infestations were extremely severe in Butler, Harvey, and Sedgwick County areas. Infestations appeared to have survived in temperatures of minus 16 degrees in Northern Kansas in January of that year.

But as the greenup period approached in the spring infestations gradually declined in the North. However, they continued to increase in Southern Kansas and caused damage during January, February, and March, until beneficial insects developed in April and eliminated the problem.

Russian Wheat Aphid—1986

In March, 1986, the Russian wheat aphid was detected in the panhandle region of Texas, marking its first occurrence in the United States.

Within a short time, Stan Coppock, Extension Entomologist at OSU, and Leroy Brooks of KSU, visited the infested area of Texas to take pictures and collect video footage of the insect and the damage it caused.

By April 1, 1986, Phil Sloderbeck had found the Russian wheat aphid in Southwest Kansas.

A description of the new pest was printed in the *Kansas Insect Newsletter* and growers were informed about the probability of it spreading into other areas. Later, it was found in a number of counties in the Western half of Kansas.

Using the footage taken in Texas of the Russian wheat aphid, a 16 minute video tape was produced describing the insect and what to look for. This video tape was used in a variety of ways to inform interested persons about the pest.

By the next year, 1987, the insect had spread to at least 15 additional states, causing an estimated $53 million in losses in 10 Great Plains states in 1987 alone.

Infestations in Kansas increased during the spring, but unlike many places receded during the summer months, except where early emerging volunteer wheat was present.

In 1988, research emphasis was directed toward host plant resistance, biological control, and insecticide development. The Extension Service developed a management program to encourage growers to control volunteer wheat, avoid early planting, and use rescue treatments in problem fields.

A number of slide sets and publications were added to the educational materials available for use by people interested in this latest pest problem affecting wheat production.

Alfalfa Insects

Pea Aphids—1967-68

Insect problems on alfalfa took on a special significance during the 25 year period, through 1988.

One of the problems was with pea aphids. The winter of 1967 and early spring of 1968 was unusually mild and dry.

Alfalfa fields greened up early and began to make substantial growth only to be hit with a severe late winter freeze which froze the plants back to the ground.

Soon producers begin to notice an alarming number of pea aphids that were starting to overwhelm the freeze damaged plants.

Pea aphid numbers in Riley and Pottawatomie counties ranged up to as high as 2,000 to 3,000 aphids per sweep.

Severe damage occurred throughout a large area of Central Kansas. Extension Entomologists estimated that growers lost more than a third of the first cutting in this section of the state.

Pea aphids did not resurface again as a major problem until 1987. Then another late winter freeze occurred, and the aphids once again caused a similar amount of concern.

Alfalfa Weevil, Western—1960's

As early as 1960, the Western strain of the alfalfa weevil was present in Cheyenne County. It gradually spread to the South and East but without causing too much concern.

In 1967, Dick Golladay, Hamilton County Agricultural Extension Agent, and KSU Extension Entomologists, took a tour of some damaged fields in Hamilton county. They found larvae and saw some injury on the plants but the crop was close to cutting stage at that time.

Eventually, the Western strain was detected as far East as Russell County before it was largely lost track of as the Eastern strain pushed westward.

Alfalfa Weevil, Eastern—1973

The Eastern strain was another story. Coming from a separate introduction into the U.S. on the East Coast (early 50's), it spread westward like "wildfire."

In 1973, the Eastern strain of alfalfa weevil exploded throughout Southeast Kansas. Within a couple of years, damage was occurring statewide. Damage was especially severe in 1974. More alfalfa was lost across the state than was saved.

An Extension program can only be as good as the information Extension Specialists have at their command. They had little information and no experience when the weevil first appeared and had to train themselves before they could provide meaningful information to others.

Success was largely because of the efforts of one young man—Bill Hilbert, who was working on his Masters degree in entomology.

As part of his research, he established a series of alfalfa plots on his uncle's farm near Lawrence, with observation plots at other locations.

Through his efforts Extension Entomology Specialists were able to piece together enough data and information to address the subject of alfalfa weevil control in useful terms.

In the following years, as the weevil problem continued, Extension Entomologists were able to really capitalize upon this experience.

Just a word about the intensity of some of those weevil problems. One way Extension Entomologists sample is with a sweep net.

This is dragged over the tops of plants, and in one sweep a sample is collected on about one square yard of plant surface.

Through experience, it was found that populations of weevil larvae averaging less than 20 to 25 per sweep were usually not of economic concern in fields where the growth averaged 8 to 10 inches in height.

As infestations were encountered at higher levels the damage caused was great enough to pay for the cost of treatment.

During those early years of infestations the count frequently averaged over 100 larvae per sweep.

The treated plots that Bill Hilbert worked in at Lawrence averaged more than 200 larvae per sweep for a short period of time before the larvae destroyed the alfalfa and began to die of starvation.

In a few fields populations actually averaged more than 400 larvae per sweep. The plants were a wiggling mass of green worms.

There was a vast decline in alfalfa acreage following the introduction of the alfalfa weevil, especially in parts of eastern Kansas.

The weevil kept up its heavy attacks for three or four years, then for a time receded. During a few years in the late 70's, it almost disappeared, but during the 80's it came back and was of economic concern throughout most of the decade.

Bob Bauernfeind undertook a project establishing demonstration plots in each of the counties in the South Central Area.

Growers could tell at a glance what the results were and this method was very helpful in helping County Extension Agents be more confident about the recommendations they were making.

Other refinements in weevil management and alternative methods of weevil control were developed by Dr. Higgins by the end of the decade.

Blister Beetle—1980's

Higgins was also deeply involved in finding a solution to the blister beetle problem on alfalfa that was used for horse hay.

Spotted Aphid —1980's

There was still interest and concern among alfalfa growers regarding the spotted alfalfa aphid in the 1980's.

Growers were encouraged to plant the varieties which had been developed at K-State and that were resistant to the spotted alfalfa aphid.

Growers still remembered the problems this insect had caused thirty years previously, although the pest had become much less of a threat than it was during the 1950's.

Sorghum Insects

Greenbugs—1960's-70's

A major insect infestation of sorghum in the 1960's and 1970's, and the steps that were taken, was described by Leroy Brooks, Extension Entomology Specialist:

In the 1960's, County Extension Agents gathered in district meetings for Summer Conference.

During the 1968 conference, an unusually large number of Agents expressed concern about corn leaf aphid infestations in grain sorghum, a common but seldom damaging pest to sorghum and other crops.

In retrospect, it was odd that no one questioned the species of aphid involved. The main question was why they appeared.

Corn leaf aphids were more abundant than usual, and while they appeared to be causing some damage to sorghum there was nothing unusual enough about these discussions to raise an alarm.

But, during the following week many Agents throughout the state made follow-up calls to farms to check further on corn leaf aphid infestations.

Then one afternoon toward the end of July, a local farmer brought in plants that were infested with insects (presumably corn leaf aphids) along with samples of the insects involved.

It was immediately apparent that the insects he had were not corn leaf aphids. Some specimens were winged and fit the description of greenbugs.

Occasional infestations of greenbugs had been reported on sorghum in the past, but the insect was certainly not recognized as a common sorghum pest, and even to find it on sorghum was highly unusual.

The following morning, Art Johnson, Jefferson County Agricultural Extension Agent, telephoned to report that some of the sorghum fields he had just visited were suffering serious damage that was being caused by a light green colored aphid rather than the dark olive corn leaf aphid.

Web Sill, Claude King and I (Brooks) went to Jefferson County that afternoon to see the fields in question. The insect was the same kind as the one that had been brought in the day before from Riley County.

The insects were indeed killing this field of extremely late planted sorghum. Upon further inspection, it was obvious that most of the fields of earlier planted sorghum in the surrounding vicinity were also infested.

Putting this information together with the telephone conversations that had been coming into the Extension Entomology office was enough to convince me that we were seeing the first of an entirely new problem.

A news release we issued the next day, had the following opening: "Within the past 36 hours it has become apparent that much of the Kansas sorghum acreage is being infested with an unidentified kind of aphid."

Within the next couple of days it was determined that damaging infestations of this pest

were also suddenly appearing from Nebraska to Texas, and westward through Arizona.

At the start many entomologists believed it to be a greenbug, but others disagreed. In an August 7 news release, we simply referred to it as the "light green aphid on sorghum." The news release mentioned that unofficial reports indicated it was not the greenbug.

Since it was obvious that it was damaging sorghum, emergency management measures had to be devised to help growers combat infestations.

These measures were derived by taking what we knew about control of greenbugs on wheat (since this certainly looked like a greenbug) and applying it as best we could to sorghum.

Fortunately these procedures worked well enough to get us through the season. There were places in other states where growers were advised not to treat, as this had not been determined to be a damaging problem - a mistake some growers have never forgotten.

Later it was confirmed that the insect was the greenbug, a new biotype identified as biotype C, a greenbug that had suddenly developed a healthy appetite for sorghum as well as wheat.

Infestations on wheat that fall were far fewer than anticipated, but during the spring of 1969 the first of what was to become a famous series of seedling infestations began to progress across the state.

This outbreak was particularly severe in parts of Northeast and North Central Kansas.

For the next 20 years the greenbug would become one of the most serious insects that Kansas sorghum growers would face. Damaging infestations would develop in some places within the state almost each and every year.

Often up to a third of the state acreage would have to be treated to prevent serious losses.

Almost from the start a new control approach was in the offing. Tom Harvey, working at the Hays Experiment Station, detected sorghum breeding material that showed a high degree of resistance to the new greenbug biotype.

Within five years, commercial sorghum hybrids containing the source of resistance were on the market. Acceptance by growers was good - in fact too good.

About 1980, an entirely new biotype (biotype E) emerged. This new one was able to overcome the resistance that had been bred into the resistant sorghum hybrids.

This latest biotype was first detected in Texas, but soon appeared in Kansas, and by 1985 it had not only become the predominate biotype in Kansas but it also appeared to have replaced the older biotype C throughout the state.

Once again, Dr. Harvey and his colleagues at other stations were successful in finding breeding sources of sorghum containing resistance. By the later part of the 1980's, large numbers of commercial hybrids were carrying resistance to biotype E.

By this time it was recognized that if too much of the acreage was planted to greenbug resistant hybrids, it might possibly speed up the development of resistance.

Our management program suggested that growers use a broader approach to pest management. Time will be the judge of its success.

Chinch Bugs—1970's-80's

There was severe damage to sorghum by chinch bugs in the seventies and eighties. The problem is discussed in more detail in the section on chinch bugs.

Other Grain Sorghum Insects

At the end of the 1980's greenbugs and chinch bugs constituted the primary insect problem faced by sorghum growers.

Concern over other pests arose from time to time, including mites in the Southwest corner of Kansas, sorghum webworms in some years in Eastern Kansas, corn earworm rather frequently through the Southern half of Kansas, and non-economic infestations of corn leaf aphids.

Combined efforts of the State Board of Agriculture and the Extension Service to provide outlook and forecast information on anticipated sorghum pest problems met with a high degree of acceptance among growers.

At that time grain sorghum suffered a relatively small number of problems. Chinch bug populations were relatively low in most areas of the state.

There had been times a few years previously that corn earworm infestations attacking the head of grain sorghum were of major importance.

Contributing Authors. The primary contributing authors to this summary of the Cooperative Extension Service educational programs and activities in Entomology, from 1965 through 1988, were H. Leroy Brooks, Extension Specialist, Insecticides (Pesticidal Safety); Donald E. Mock, Extension Specialist, Livestock Entomology; and Donald C. Cress, Extension Pesticide Coordinator.

A complete listing of personnel in Extension Entomology is included in Volume II, Chapter 6, Extension Personnel, pp. 51-52.