1987

South Dakota Soybean Production Yield and Land Use Trends 1961-1986

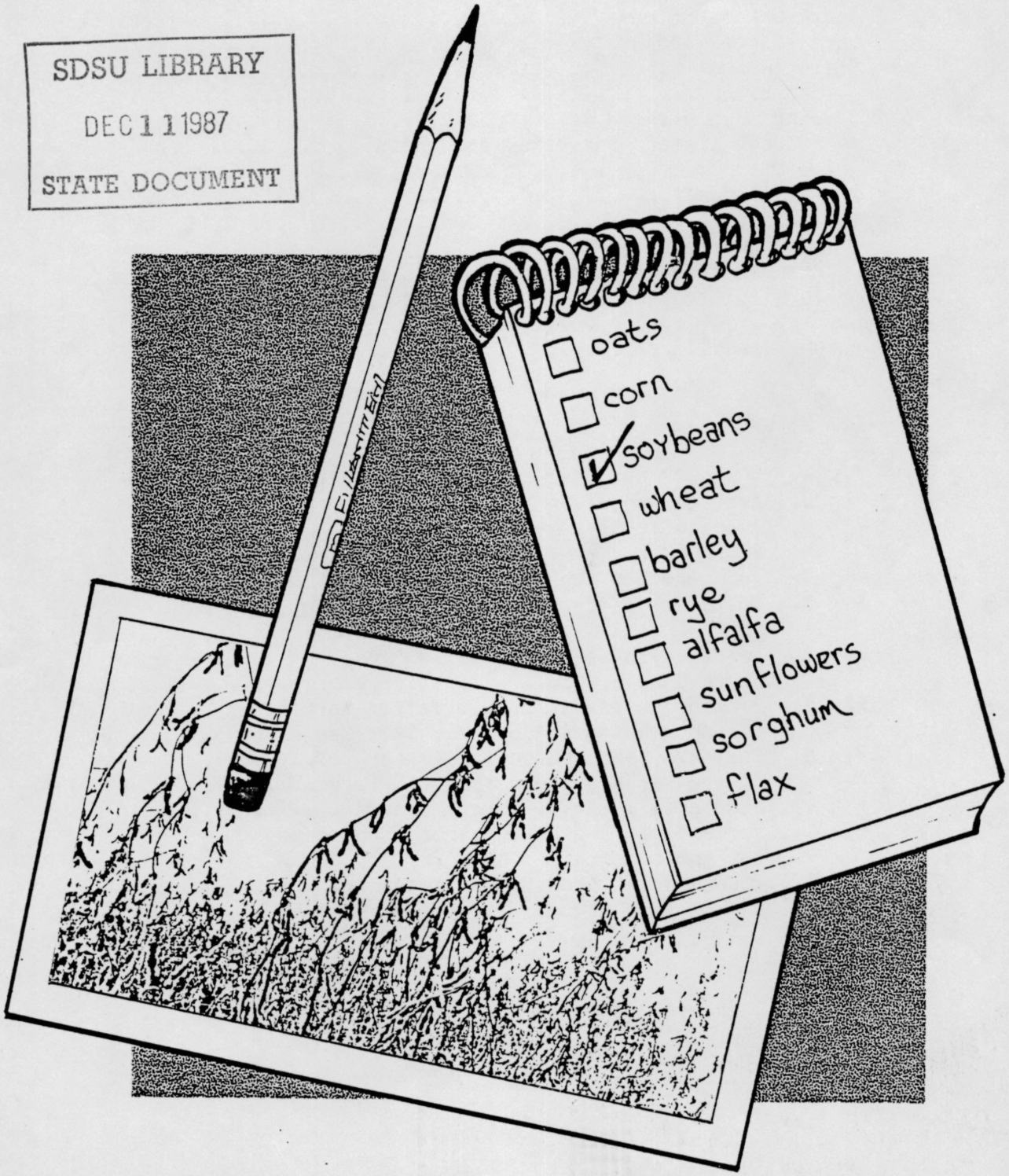
D.D. Malo

M.E. Juba

TB 70

South Dakota Soybean Production

Yield and Land Use Trends 1961-1986



Agricultural Experiment Station • South Dakota State University • Brookings, South Dakota 57007

Contents

Figures

Tables

July 1987

South Dakota Soybean Production[1]

Yield and Land Use Trends 1961-1986

by

D.D. Malo and M.E. Juba[2]

INTRODUCTION

Soybeans have been an important crop for human use since the first written account of soybeans was recorded in ancient Chinese writings 5000 years ago (Probst and Judd, 1976). To the Chinese soybeans were one of the five sacred grains needed to survive (Caldwell, 1976). Soybeans are native to East Asia and are adapted to many environmental conditions around the world.

Soybeans were introduced into the United States in 1804 as a hay crop for livestock. Since 1900 soybean production in the United States has increased dramatically. In 1898 the USDA imported varieties to increase production in the United States (Martin, et al., 1976). Prior to the 1920's soybeans were grown primarily in the South. Because the climatic requirements of soybeans are similar to those of corn, soybeans moved rapidly into the corn belt of the United States resulting in a rapid increase in production.

Soybeans are used for livestock feed (hay, silage, and meal), human food (flour, shortening, margarine, salad oil, candies, ice-cream, bread, cake, milk, coffee substitute, and soybean butter), and industrial uses (plastics, glue, paints, candles, insecticides, soap, varnish, explosives, adhesive tape, paper, drugs, textiles and cosmetics).

Soybeans contain about 40% protein and 20% oil. This protein is inexpensive to produce and has a high nutritional value (contains all essential amino acids) for humans and livestock. Soybeans contain calcium, phosphorus, and B vitamins, especially B_1-thiamine.

Following wheat, soybeans and corn are tied for land area planted in the United States. The United States produces 60% of the world's soybeans and over 59% of our production is exported annually (FAO, 1985; Kost and Jabara, 1985). The United States,

---

[1] Contribution from the Plant Science Department and the South Dakota Agricultural Experiment Station, South Dakota State University, Brookings 57007. Project H-184.

[2] Professor of Soils, Plant Science Department, and Computer Science Intern, South Dakota State University, Brookings 57007.

Brazil, and China annually produce 85 to 90% of the world's soybeans.

In 1897 researchers at South Dakota State College tested the adaptability of soybeans (soja beans) as a forage crop. The crop was not recommended because it did not ripen and livestock would not eat it (Chilcott, 1897). The development of new adapted varieties in the late 1960's through the 1970's has allowed soybeans to be successfully grown in the state.

Since 1982 about 1.3 million acres have been seeded to soybeans each year in South Dakota. This represents about 6.5% of the land suitable for cultivation or 2.7% of the total state land area. Soybeans are raised primarily in the counties east of the Missouri River. Only the counties of Lyman and Gregory in the western part of the state have significant acreages planted to soybeans. In the last five years South Dakota has moved up in rank from 19th to 11th in the nation in total soybean production (Statistical Reporting Service, 1982 to 1986).

Since 1960 major changes in management practices (row spacing, fertilization, new varieties, herbicides, new crops, fewer general farms, more mechanization, new tillage systems) climatic shifts, economic factors, and government programs have caused dramatic shifts in the acreage planted, yield, market demand, and total production of soybeans. As a result, a study was initiated to identify changes in yield, land use, and total soybean production by county in South Dakota.

The objectives of this study were to:

1. prepare and develop a data base of county soybean acreage (planted and harvested) and soybean yield information;

2. calculate long term averages for soybean yields, land area harvested, land area planted, and total production; and

3. identify yield and land use trends on a state and county basis.

This bulletin emphasizes county average values and does not provide detailed farm specific information. It is a guide for seed dealers, farmers/ranchers, bankers, real estate brokers, state officials, and others who evaluate soil productivity, land values, and land use.

STUDY LIMITATIONS

Users of the county data presented in this bulletin are cautioned against using this data for individual farms because the information is expressed as average values for either a 5- or 26-year period. For example, the county yield data is averaged over all soils, climatic conditions, and management practices present in a county for the time period studied.

Thus wide variations in yields are to be expected when comparing one specific farm with another. The data presented in this bulletin are meant to illustrate county and statewide trends.

GROWTH REQUIREMENTS

Soybeans are raised over a wide range of climatic conditions due to the wide diversity among varieties. They are grown primarily on areas suited for corn production. Soybeans have

the same general climatic and soil requirements as corn. They can be raised in soils with low fertility more successfully than corn, provided the proper nitrogen fixing bacteria are present in the soil or have been added to the soybean seed at planting. Inoculation of soybean seed is needed if the crop has never been raised in the field before or not within the last 3 to 5 years (Hartwig, 1976).

Soybeans are well adapted to warm, temperate (moist) climates and should not be seeded in cold soils. A critical soil temperature of 50°F is needed for soybean germination. If soil temperatures are in the 60° to 70°F range then only 5 to 7 days are needed for emergence after planting.

Soybeans are tolerant of a wide range of soil conditions but do best on well-drained, neutral, medium to fine textured soils with moderate to high P and K levels with nitrogen fixing bacteria present (Janick, et al., 1981). Soybeans respond well to P and K fertilizer. Soybeans grow on soils too acid for alfalfa and red clover (Martin, et al., 1976).

Germination is one of the most critical times in the soybean growth cycle. Soybeans require more water at germination than corn or small grains (Scott and Aldrich, 1970). Sometimes there is just enough water to imbibe the seed and then the plant dies because there is not enough water to continue growth. An excess of water is just as harmful to soybeans as too little water. Water-logging or over-irrigation causes oxygen deficiencies resulting in severe reduction of germination, growth, and yield. When compared to corn, soybeans tolerate short periods of water-logged conditions better (Martin, et al., 1976).

Another problem at germination is crusting of the soil surface after a heavy rain. This reduces or inhibits emergence of the soybean plant from the soil. In 1986 sixteen counties in the state had fields infected with Pytophthora root rot. The rot is most severe in low, poorly drained, clay textured soils. The disease may appear in any soil if wet conditions persist for several days. The juvenile growth stage (newly emerged seedlings) is most susceptible to the fungus (personal communication with Joe Bonnemann, 1987). Resistant varieties are available.

Once established the plant can withstand drought during certain growth stages. For example, during flowering drought has much less of an effect on flower abortion than on pod abortion during pod filling. The soybean plant compensates for aborted flowers by producing more flowers. Generally, high temperatures and low relative humidities are detrimental causing a reduction in yields, lower oil percentage, and poor oil quality (Martin et al., 1976).

Research has shown soybeans do not respond to early planting like corn. There is very little yield reduction (<4%) until planting is delayed until June in the northern cornbelt for most soybean varieties (Hartwig, 1976). Because of this, soybeans compliment corn, by spreading out the work load, and utilizing the same equipment. Recent research shows that a 3-day delay in planting results in a 1-day delay in maturity (Hartwig, 1976).

Varietal development has been the key in establishing soybeans as a major crop in South Dakota. Soybeans are a plant which depends on photoperiodism (daylength) to initiate flowering and grain production. Soybeans are a short-day plant which means as the night lengthens then flowering will begin. Varieties differ in the daylength required to initiate flowering. As a result, soybeans have been divided into 10 maturity groups in North America. Groups 00, 0, and I are maturity groups for the northern states and Canada. Groups VII and VIII are for southern states. Each maturity group has about a 10 to 15 day maturity range (Scott and Aldrich, 1970; Hartwig, 1976). Each soybean variety is adapted to 100 to 150 miles of latitude (Martin, et al., 1976). The soybean varieties adapted for South Dakota fit into maturity groups 0, I, and II (Figure 1). If one takes a variety in any maturity group and moves it north it will flower later than normal and if moved south will flower earlier than normal (5 to 10 days for each degree of latitude).

The climate and soils found in eastern South Dakota (especially the southeast corner) favor soybean production as shown by the high total production, the large acreage, and the relatively high yields.

South Dakota has a continental climate with extremes of summer heat, winter cold, and rapid fluctuations of temperature. Cold winter (<-20°F) and warm summer (>100°F) temperatures are common in most areas. Cold fronts moving across the state may cause temperatures to drop 40° to 60°F in 24 hours (Spuhler, et al., 1971). The average annual temperature is 46°F and ranges from 48°F in the south to <42°F in the north (Figure 2). The annual average number of days with temperatures >90°F, ranges from <20 (excluding the Black Hills) in the northeast to >50 in south-central and southwestern parts of the state (Figure 3). July temperatures, which also significantly influence soybean yields, are shown in Figure 4. August temperatures average about 2°F cooler than July's values.

In a recent study, September low temperatures were significantly related to soybean yields in 12 counties studied in South Dakota over a 17-year period (Kenefick, et al., 1984). The average frost date (<28°F, 50% probability) ranges from September 30 in the north to October 15 in the south in the soybean producing region of the state (Figure 5).

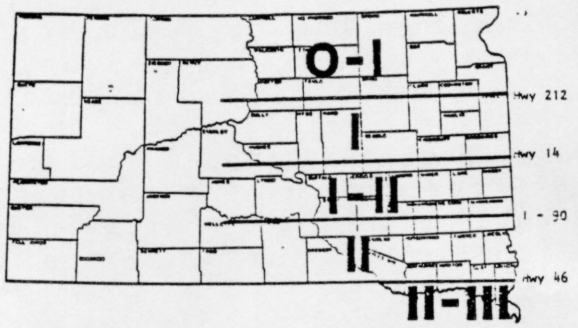


Fig 1. Soybean maturity groups for South Dakota.

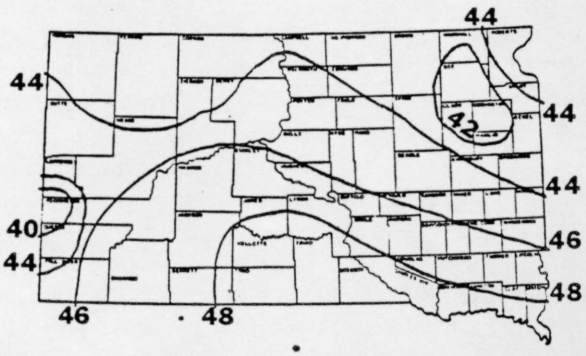


Fig 2. Average annual temperature (F) for South Dakota.

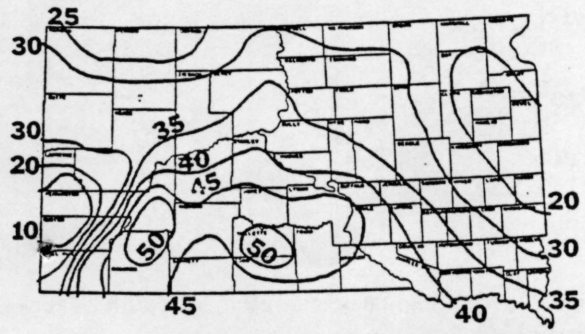


Fig 3. Average total number of days with temperatures above 90 F (May 1 to September 30).

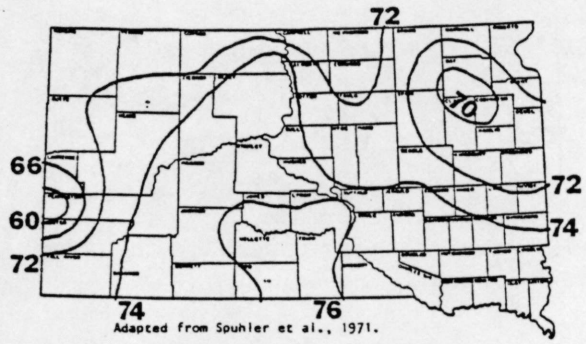


Fig 4. July average mean temperatures (F).

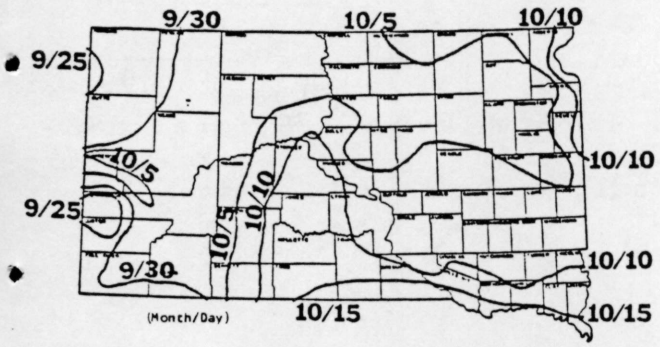


Fig 5. South Dakota frost hazard map for fall (28 F basis).

Soybeans are an important crop to South Dakota. They are raised for livestock use and as a cash crop. The crop is easy to plant, cultivate, control pests, harvest, and has a high nutritional value for humans and livestock. Because it fixes nitrogen, it is used in rotations to help provide N for subsequent crops. All of these uses plus favorable climatic conditions are reasons why soybeans are vital to South Dakota's economy.

SOUTH DAKOTA CLIMATE

Annual precipitation ranges from 24 to 25 inches in the southeast to less than 14 inches in the northwest (Figure 6). Most precipitation occurs during the spring and early summer. Approximately 65% of the total annual precipitation falls when temperatures are ideal for soybean growth, May 1 through September 30 (Figure 7). Growing season precipitation was significantly related to yields in a 12 county study area in South Dakota in a 17-year study (Kenefick, et al., 1984). Much of the precipitation received during June and July comes as short, hard showers of the convectional thunderstorm type. During April and May most of the moisture falls as frontal precipitation resulting from condensation when warm, moist air from the Gulf of Mexico overrides cool, heavier, polar air.

DATA SOURCES AND ANALYSIS PROCEDURES

Crop yields, acres planted, and harvest acreage for each county for years 1961 to 1986 were obtained from South Dakota Crop and Livestock Reporting Service records. These data represent the most accurate and complete data set available. For statewide and national use these data are accurate to within 2% of

actual values, while on a county basis the data are accurate to within 5-10% of actual values (McQuigg and Stromman, 1976; Kenefick, et al., 1984). Previous years were not considered in this study because fewer than 130,000 acres of soybeans were raised annually in South Dakota prior to 1961.

The data were entered into a computer file for storage, data analysis, and future activities. The data were analyzed using the SAS computer package (SAS Institute Inc., 1982).

STATE TRENDS

Yield

Soybean yields have been increasing since 1961 (Figure 8a). Yield increases are due to improvements in new soybean varieties; improved fertility management; new row spacings; and control of insects, weeds, and plant diseases (Malo, 1979). Since 1961 soybean yields have increased from 16 to 32 bu/a or a 100% increase over the 26-year study period. The increase in yield is even more spectacular when considering the additional acreage brought into production since 1961.

The wide scatter of data points in Figure 8a is due to wide climatic fluctuations common in our state. In 1964, 1976, and 1984 droughts struck the state, while in 1969, 1979, and 1985 above average precipitation was received. Even with all the precipitation variation which caused soybean yields to fluctuate, there was a definite trend of increasing yields.

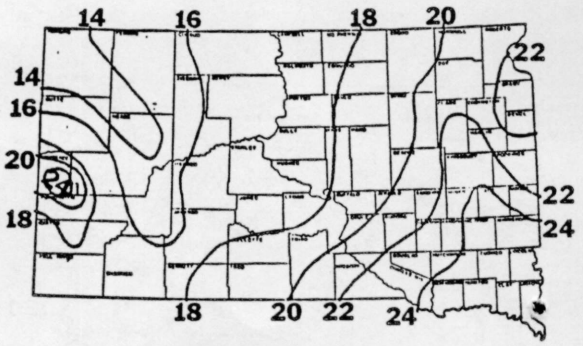


Fig 6. Average annual precipitation for South Dakota (inches).

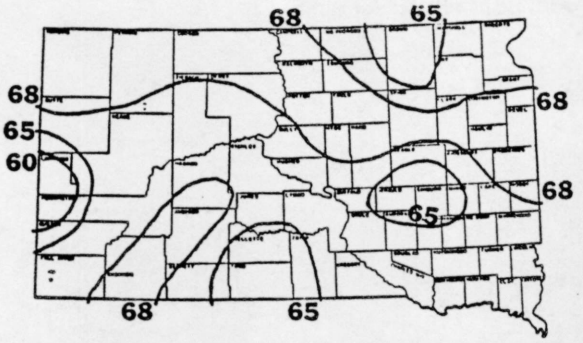


Fig 7. Percentage annual precipitation falling during growing season (May 1 to September 30).

Land Area Planted

Since 1961 there has been a 10-fold increase in land area planted to soybeans (Figure 8b). This increase has taken place in 3 steps (1964, 1979, and 1983). The reasons for these changes are unclear; however, the development of new varieties adapted for our environmental conditions, government programs (PIK), and economic concerns in the 1980's (cash flow needs) are three probable explanations for the large increase in soybean acreage. Some farmers indicate they can compete with the major area of the corn belt better in soybeans than in corn (personal communication with Robert Hall, 1987). In addition, new markets for soybeans and soybean products have developed which increased the price received per bushel, thus increasing the soybean acreage. Since 1961 the acres

planted to soybeans has increased from 130,000 to 1.4 million acres or an average gain of 48,000 acres per year since 1961. This represents a 1075% increase in acres planted to soybeans since 1961.

Planted Acreage Harvested for Grain

The percentage of acreage harvested for grain has steadily increased since 1961 (Figure 8c). Better land is being used to raise soybeans. Soybeans are now competing with corn for some of the best suited crop land. The development of new, better adapted varieties has also helped to minimize crop failures which were more common in the 1960's. These reasons along with high prices received per bushel and the need for cash flow, have helped to increase the percent of planted acres harvested for grain in the last 8 years. Since 1961 there has been an increase from 92.3 to 99.2% of acres harvested for grain. During the 1980's over 98% of the planted acreage was harvested.

Total Production

There was a significant increase in soybean production with time (Figure 8d). The total increase in production was the result of increased yields per acre and increased acreage of soybeans. Since 1961 total production has increased 19 times from 2.3 to 41.2 million bushels annually or an average annual increase of 1.5 million bushels per year. Climatic events significantly impacted total soybean production (the dry years in 1976 and 1980; above normal precipitation in 1979 and 1985).

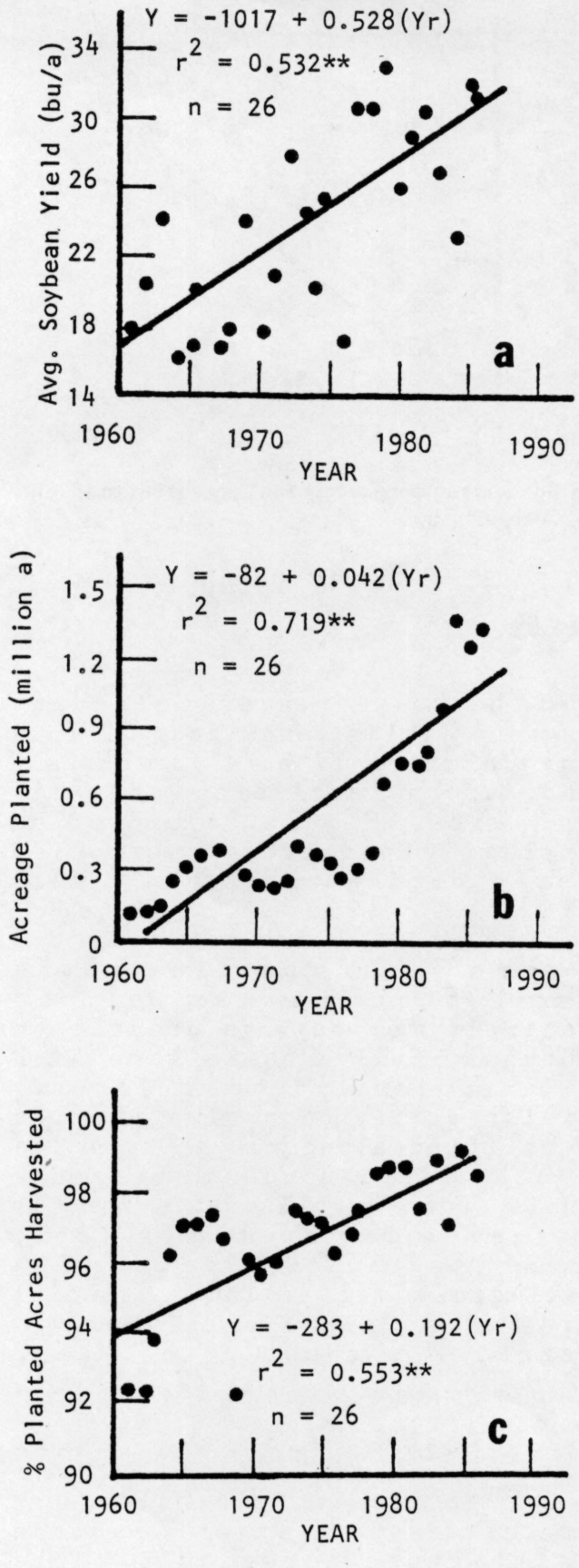


Fig 8. State soybean production trends (1961 to 1986). a = yield, b = acres planted, c = percentage of planted acreage harvested for grain, and d = total production.

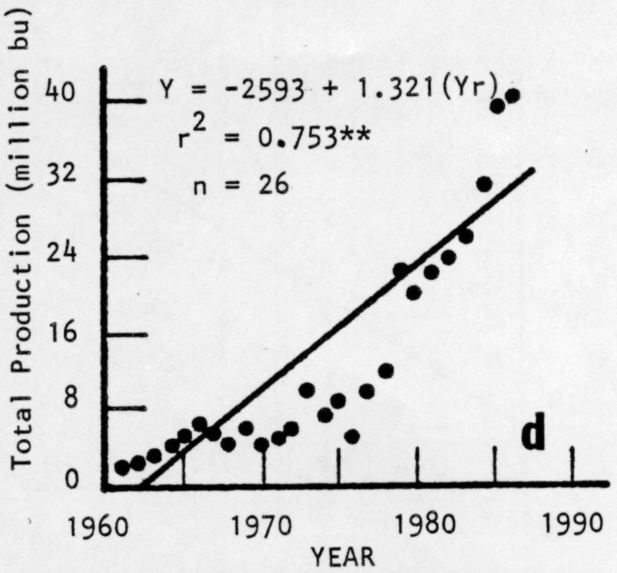


Fig 8d. State soybean production trends (1961 to 1986). d = total production.

COUNTY TRENDS

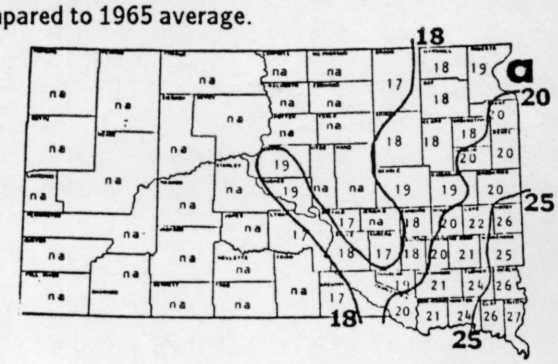
Yield

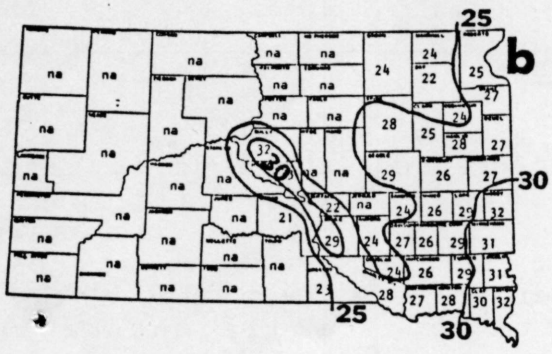
The 26-year average county soybean yields range from 27 bu/a for Union to 17 bu/a for Buffalo and Aurora (excluding the "NA" counties, Figure 9a). Similar dryland yield trends were also noted during the last 5 years (1982 to 1986 of the study, Figure 9b). During the last 5 years, in counties where irrigation is used almost entirely for soybean production (Hughes, Sully) there were high yields also. Highest dryland yields during both time periods were found along the eastern and southeastern borders where the soils (Udic Ustolls, Udic Borolls formed under a warm or cool, moist subhumid climate with tall-grass vegetation in glacial drift or alluvial parent materials (Westin and Malo, 1976).

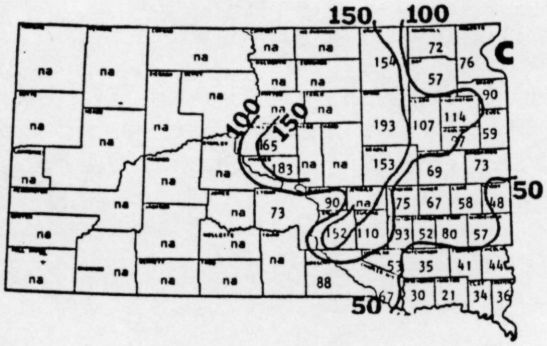
Lowest yields and fewest acres devoted to soybeans are found in the western half (west of the Missouri River) and the north-central regions. Soils there are (Aridic Ustolls, Aridic Borolls) formed under a warm or cool, semi-arid climate with short-grass vegetation in residual, eolian, or glacial drift parent materials. The low yields and lack of soybeans acreage are caused by unfavorable environmental conditions (low total annual precipitation; too cold; low amounts of effective growing season precipitation; a large number of hot days with temperatures >90°F with low relative humidities, <40%) and soils which have a lower capability for soybean production.

Recently (1982 to 1986), soybean yields have increased significantly throughout the state where soybeans are raised when compared to 1961 to 1965 averages (Figure 9c). Increases of 30 to 50% in the southeast corner were common while increases of 100 to 150% occurred in the rest of the state. The greatest average increases were in Spink, Hughes, and Sully Counties while the smallest increases were in Yankton, Bon Homme, and Clay Counties. Irrigation has increased yields along the Missouri River. The large yield are partially due to improved soil management, better weed control, closer row spacing or solid seeding, and the development of new higher yielding soybean varieties (eg. Corsoy, Weber, Swift, Hardin) suited to the state's environmental conditions.

Fig 9. County soybean yield trends. a = average yield for 1961–1986, b = average yield for 1982=1986, and c = percent change in mean yield (PCMY) – 1982–1986 average compared to 1965 average.







Land Area Planted

The largest percentages of total county area planted to soybeans over the past 26 years are found south and east of a line from Roberts to Bon Homme Counties (Figure 10a). Highest percentages of land area planted to soybeans (17 to 18%) were found in Clay and Union Counties, while the lowest percentages were in Lyman (0.02%) and Gregory (0.04%). The total land area in acres for each county is presented in Table 1.

The counties of Union, Clay, Turner, and Lincoln have averaged at least 45,000 planted acres/yr of soybeans while the counties of Lyman, Gregory, Sully, Aurora, Buffalo, and Sanborn had less than 700 acres planted/yr. The low acreages seeded to soybeans in the central and western parts of the state are the result of low average dryland soybean yields, lack of adapted varieties from 1960 to 1975, and less favorable environmental conditions.

In the past five years this trend has changed dramatically (Figure 10b). Soybean production has increased in every county of the state. Lincoln, Clay, and Union Counties now have about 30% of their total county area planted to soybeans each year. Since 1961 soybean acreage has increased from 15,000 to 95,000 acres in Turner, Minnehaha, and Lincoln Counties while in Sully, Hughes, and Gregory Counties the acreage has increased from 150 to 1600 acres/yr. The gain in land area planted to soybeans in the southeast corner of the state has resulted in decreases in oat acreage (Malo, 1984). As a result of better management techniques, the development of new varieties, and irrigation, the soybean production areas in South Dakota have expanded north along the Missouri River. The soils in this area (Typic Ustolls) formed under a warm, dry subhumid climate with mid-grass vegetation in either glacial drift, loess, alluvial, or residual parent materials. Note how the 1% line has moved westward (compare Figure 10b with Figure 10a) and the southeast corner has seen a concentration of soybean production.

In recent years (1982 to 1986) land area planted to soybeans has increased significantly when compared to 1961 to 1965 averages (Figure 10c). The largest percentage increases were noted in the James River Valley and along the Missouri River (due to very low acreages in the 1960's). The gain in land area planted to soybeans in the James River Valley in the 1980's is a result of decreases in sunflower acreage (personal communication with Dwayne Beck, 1987). The greatest increase in acreages planted to soybeans occurred in the southeast corner of the state. There has not been a major reduction in soybean

acreage in South Dakota since 1961 (Figure 8b). These increases in soybean acreage throughout the state are in response to economic conditions (price and cash flow needs), the introduction of new high yielding adapted varieties, better crop management, and above-average precipitation for 1982 through 1986.

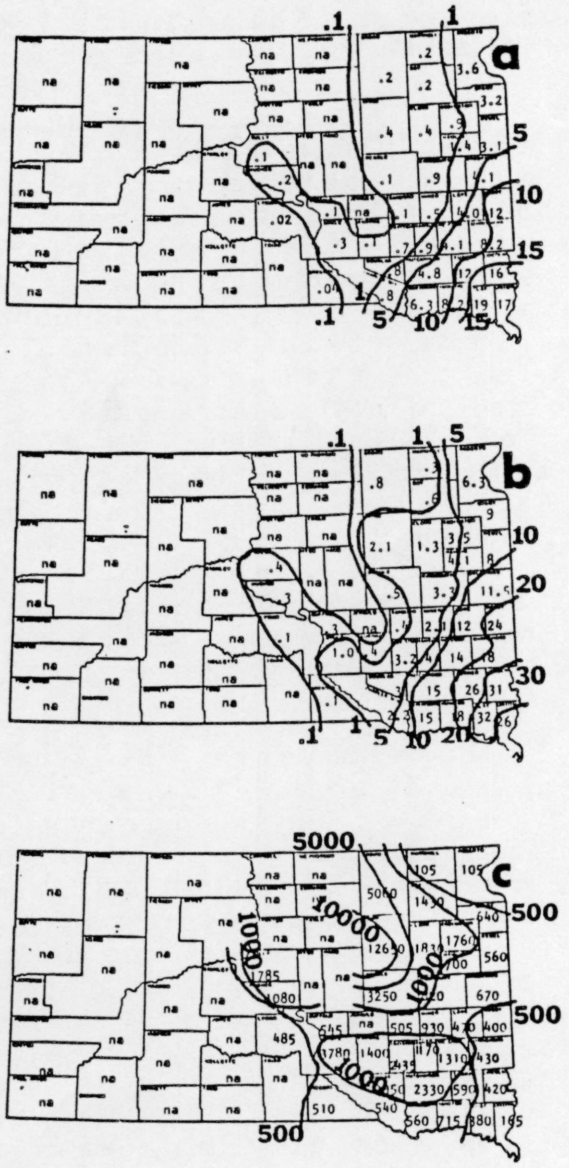


Fig 10. Land area planted, county trends. a = average percentage of county area planted (1961–1986), b = average percentage of county area planted (1982–1986), and c = percent change in area planted (PCAP) – 1982–1986 average compared to 1961–1965 average.

Planted Acreage Harvested for Grain

Statewide, there were differences in the percentage of planted acreage harvested for grain (Figure 11a). The eastern and southern regions harvested over 98% of the planted acreage for grain while the central region harvested 92 to 96% of the planted acres on the average during the 26-year study period. Lincoln, Clay, Turner, and Union Counties have averaged over 50,000 harvested acres each year, while Gregory, Lyman, Buffalo, and Sanborn Counties have averaged less than 500 acres per year.

In the last 5 years this trend has shifted upward, especially in the state's western and northern parts of the soybean belt (Figure 11b). With better climatic conditions and better adapted varieties, fewer crop failures occurred resulting in a higher percentage of planted acres being harvested in the 1980's. In addition, irrigation along the Missouri River has lowered the chance for crop failure for soybeans in this area. From 1982 to 1986 only Lincoln and Turner Counties averaged over 100,000 harvested acres each year while the counties of Buffalo, Gregory, and Lyman have averaged less than 1,000 acres harvested for grain/yr.

Since 1961 there has been little or no change in the percentage of planted acres harvested for grain in the southeastern corner of the state (Figure 11c). Day, Buffalo, and Brule Counties had the greatest percentage increase in the acres planted to soybeans harvested for grain. The greatest increase in acres planted, but not harvested for grain, was in Union, Moody, Lincoln, and Brookings Counties

Table 1. County Land Area.

County	Total Land Area* (a)	County	Total Land Area* (a)
Aurora	454,016	Jerauld	337,216
Beadle	806,464	Jones	622,528
Bennett	756,032	Kingsbury	523,328
Bon Homme	358,464	Lake	362,560
Brookings	511,936	Lawrence	512,000
Brown	1,071,296	Lincoln	368,640
Brule	523,392	Lyman	1,077,120
Buffalo	308,224	McCook	368,128
Butte	1,439,680	McPherson	734,016
Campbell	468,736	Marshall	542,784
Charles Mix	702,272	Meade	2,217,792
Clark	616,640	Mellette	835,840
Clay	259,456	Miner	364,672
Codington	439,488	Minnehaha	520,384
Corson	1,580,928	Moody	334,656
Custer	996,480	Pennington	1,778,688
Davison	276,672	Perkins	1,830,464
Day	659,200	Potter	555,904
Deuel	408,768	Roberts	709,312
Dewey	1,504,576	Sanborn	364,672
Douglas	278,272	Shannon	1,344,128
Edmunds	738,432	Spink	963,136
Fall River	1,115,584	Stanley	904,960
Faulk	637,120	Sully	642,560
Grant	435,904	Todd	888,000
Gregory	638,336	Tripp	1,036,480
Haakon	1,162,304	Turner	391,424
Hamlin	326,912	Union	289,216
Hand	916,480	Walworth	459,328
Hanson	275,392	Yankton	332,032
Harding	1,716,480	Ziebach	1,267,776
Hughes	478,400		
Hutchinson	521,536		----------
Hyde	552,192		
Jackson	1,196,096	STATE TOTAL	48,611,904

* 1960 Census Data.

REFERENCE: Area Measurement Report 1960. Bureau of Census, GE-20, No. 43. March 1967.

where at least 1,500 more acres are not being harvested for grain (based on a comparison of 1982 to 1986 averages with 1961 to 1965 averages). Note that during 1982 to 1986 above normal precipitation received in the southeast and east-central regions of the state caused flooding and delayed planting, resulting in the reduction of planted acres being harvested.

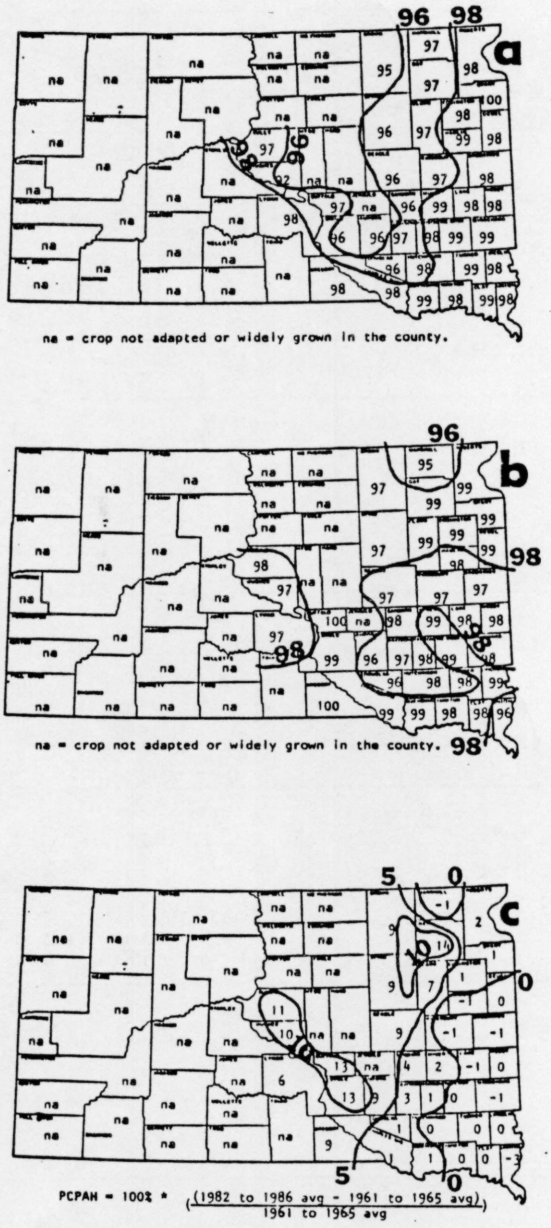


Fig 11. Percentage of planted acreage harvested for grain, county trends. a = average percentage of planted acreage harvested for grain (1961–1986), b = average percentage of planted acreage harvested for grain (1982–1986), and c = percentage change in planted acreage harvested for grain (PCPAH) – 1982–1986 average compared to 1961–1965 average.

Total Production

The total average soybean production ranges from a high of 1.5 million bu/yr in Lincoln to a low of <0.004 million bu/yr in Lyman and Gregory Counties for the 26-year study period (Figure 12a). Clay, Lincoln, Minnehaha, Moody, Turner, and Union Counties have averaged at least 1.0 million bu/yr, while most counties west of the eastern tier of counties averaged <0.3 million bu/yr. The greatest soybean production area in South Dakota is located in an area south and east of the line from Roberts to Bon Homme Counties.

Similar total soybean production trends were noted in the 5-year study period (Figure 12b). There were 8 additional new counties (Roberts, Grant, Brookings, Lake, McCook, Hutchinson, Bon Homme, and Yankton) producing at least 1.0 million bu/yr. Note how the 1.0 million bu/yr line has shifted to the west and north when compared to the 26-year average (Figure 12a).

Along with the significant increases in total state soybean production since 1961, there have been changes in county total production values (Figure 12c). The counties of Minnehaha, Moody, Clay, Hutchinson, Lincoln and Turner have had at least a 2.0 million bu/yr increase in total soybean production when 1961 to 1965 averages were compared to 1982 to 1986 averages. There has not been a significant decline in soybean production in any part of the state.

Counties like Spink, Brown, ıle, and Beadle had large creases in production on a rcentage basis. However, the tal production involved is low en compared to the counties in e southeast corner of the ate. These counties on the stern edge of the state's ybean belt have just recently come soybean producers, thus using the large percentage creases.

The increased popularity of ybeans in the state has reduced ats, sunflower, and flax creages and stabilized corn creages.

SUMMARY

Historical planting and yield ecords (1961 to 1986) for South akota soybean production were nalyzed to determine if significant changes/trends in and use and yield had occurred on a statewide and/or county basis. The computer files created by this study contain yield, acres planted, and acres harvested data and will be updated as new data becomes available.

The major state trends observed in this study were:

1. growing season precipitation, the number of days with temperatures >90°F, the average fall date of 28°F temperatures, and the maturity grouping map were useful in delineating the major soybean producing regions;

2. average annual soybean yields have increased at a rate of 0.53 bu/a/yr, from 16 bu/a in 1964 to 32 bu/a in 1985;

3. the average number of acres planted to soybeans has increased at a rate of 48,000 acres/yr, from 0.13 million acres planted in 1961 to 1.35 million planted acres in 1986;

4. the percentage of planted acres harvested for grain has increased from 92 to 99%;

5. the total annual soybean production has increased at a rate of 1.5 million bu/yr, from

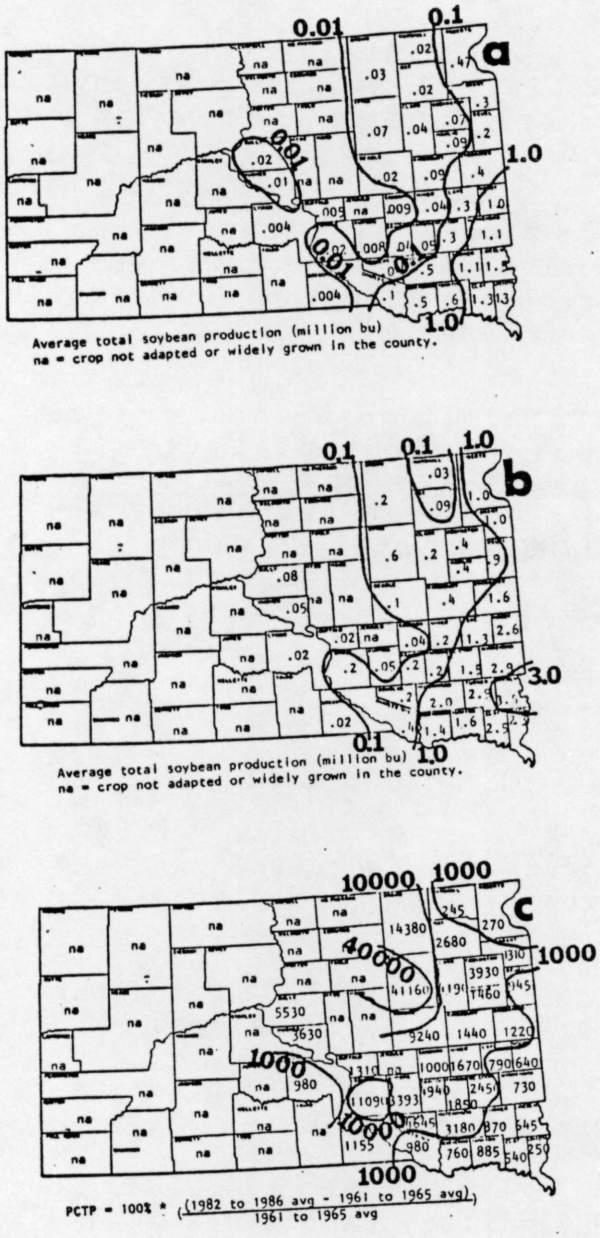


Fig 12. County total production trends. a = average total production for 1961–1986, b = average total production for 1982–1986, and c = percent change in total production (PCTP) – 1982–1986 average compared to 1961–1965 average.

2.3 million bu/yr in 1961 to 41.2 million bu/yr in 1986; and

6. the major production, yield and acreage changes have taken place during the 1980's.

The major county (regional) trends observed in this study were:

1. highest dryland soybean yields (26-year avg) were found in southeastern South Dakota;

2. highest yield increases (1982 to 1986 avg compared to 1961 to 1965 avg) were found west and north of a line from Moody to Bon Homme Counties;

3. planted soybean acreage has increased throughout all regions of the state with the greatest percentage present in the southeast corner where 18% (26-yr avg) or 30% (5-yr avg) is planted yearly to soybeans;

4. the greatest acreage increase in soybeans has occurred in the southeast (1982 to 1986 avg compared to 1961 to 1965 avg) while the greatest percentage increases occurred in the James River Valley;

5. the percentage of planted acreage harvested declines as one moves from the southeast corner of the state north and west (26-yr avg);

6. the percentage of planted acreage harvested has increased (1961 to 1965 avg compared to 1982 to 1986 avg) in the western and northern parts of the soybean belt of South Dakota while above normal precipitation in the southeastern and east-central regions increased flooding and late planting resulting in increased acres not being harvested; and

7. the greatest soybean production areas were the southeastern and east-central regions of South Dakota.

REFERENCES

1. Caldwell, B.E.(ed.). 1976. Soybeans: Improvement, Production, and Uses. Agronomy Number 16. American Society of Agronomy, Inc., Madison, WI. 53711.

2. Chilcott, E.C. 1897. Forage Plants for South Dakota. Bull. 51. Agricultural Experiment Station, South Dakota State College, Brookings.

3. FAO. 1985. 1984 FAO Production Yearbook. FAO - United Nations, Rome, Italy.

4. Hall, R.G., J.J. Bonnemann, P.D. Evenson. 1987. 1987 Variety Recommendations - Soybeans. EC 775. South Dakota Cooperative Extension Service. South Dakota State University, Brookings 57007.

5. Hartwig, E.E. 1976. Varietal Development. In Soybeans: Improvement, Production, and Uses. Caldwell, B.E.(ed.). Agronomy Number 16. American Society of Agronomy, Inc., Madison, WI. 53711.

6. Janick, J., R.W. Schery, F.W. Woods, and V.W. Ruttan. 1981. Plant Science: An Introduction to World Crops. W.H. Freeman and Co., San Francisco, CA.

7. Kibler, W.E. and J.C. Ranek. 1978. South Dakota Historic Crop and Livestock Estimates 1970-1975. South Dakota Crop and Livestock Reporting Service, Sioux Falls 57117.

8. Kenefick, D.G., J.C. Harlan, K.K. Weischedel, P.D. Evenson. 1984. Historical Crop/Climate Relationships in South Dakota. Plant Science Department, South Dakota State University, Brookings 57007. p. 21-33.

9. Kost, W.E. and C.L. Jabara. 1985. Agricultural Trade is Vital. In U.S. Agriculture in a Global Economy 1985 Yearbook of Agriculture. L.B. Marton (ed.). Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

10. Malo, D.D. 1984. South Dakota Oat Production - Yield and Land Use Trends 1961-1982. Tech. Bull. 69. South Dakota Agricultural Experiment Station, South Dakota State University, Brookings 57007.

11. _____ 1979. Our Best Release. South Dakota Farm and Home Research. Vol. 30(4):18-22.

12. Martin, J.H., W.H. Leonard, D.L. Stamp. 1976. Principles of Field Crop Production. Macmillan Publishing Co. Inc., NY.

13. McQuigg, J.D. and N.D. Strommen. 1976. Development of LACIE Weather-Wheat Yield Models. American Society of Agronomy Annual Meetings, Houston, TX. Nov. 28-Dec. 2.

14. Pearson, R. and J.C. Ranek. 1981. South Dakota Historic Crop and Livestock Estimates 1976-1980. South Dakota Crop and Livestock Reporting Service, Sioux Falls 57117.

15. Potas, R., H.C. Trelogan, and E. Johnson. 1966. South Dakota Historic Agricultural Statistics 1961-1965. South Dakota Crop and Livestock Reporting Service, Sioux Falls 57117.

16. Probst, A.H. and R.W. Judd. 1976. Origin, U.S. History and Development, and World Distribution. In Soybeans: Improvement Production, and Uses. Caldwell, B.E.(ed.). Agronomy Number 16. American Society of Agronomy, Madison, WI 53711.

17. Ranek, J.C. 1987. South Dakota Agricultural Statistics 1986-1987. South Dakota Agricultural Statistics Service, Sioux Falls 57117.

18. _____ 1986. South Dakota Agricultural Statistics 1985-1986. South Dakota Agricultural Statistics Service, Sioux Falls 57117.

19. _____ 1985. South Dakota Historic Agricultural Statistics 1979-1985. South Dakota Crop and Livestock Reporting Service, Sioux Falls 57117.

20. _____, H.C. Trelogan, and W.H. Schroeder. 1973. South Dakota Historic Crop and Livestock Estimates 1965-1970. South Dakota Crop and Livestock Reporting Service, Sioux Falls 57117.

21. SAS Institute Inc. 1982. SAS User's Guide: Basics, 1982 Edition. SAS Institute Inc., Cary, NC.

22. Scott, W.O. and S. R. Aldrich. 1970. Modern Soybean Production. SA Publications, Champaign, Illinois. 61820.

23. Spuhler, W., W.F. Lytle, and D. Moe. 1971. Climate of South Dakota. Bull. 582. South Dakota Agricultural Experiment Station, South Dakota State University, Brookings 57007.

24. Statistical Reporting Service-USDA. 1981-1987. South Dakota's Rank in Agriculture. USDA-Statistical Reporting Service, Washington, D.C. (yearly summaries).

25. _____ 1986. Frost Hazard Map and Table. Statistical Reporting Service, Sioux Falls 57117.

26. Westin, F.C. and D.D. Malo. 1978. Soils of South Dakota. Bull. 656. Plant Science Department. South Dakota Agricultural Experiment Station, South Dakota State University. Brookings 57007.

Published in accordance with an Act passed in 1881 by the 14th Legislative Assembly, Dakota Territory, establishing the Dakota Agricultural College and with the Act of re-organization passed in 1887 by the 17th Legislative Assembly, which established the Agricultural Experiment Station at South Dakota State University.