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An Overview of the 1985 Corn, Cotton, Soybean, and Wheat Objective Yield Surveys

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AN OVERVIEW OF THE 1985 CORN, COTTON, SOYBEAN, AND WHEAT OBJECTIVE YIELD SURVEYS. By Ralph V. Matthews; Statistical Research Division; Statistical Reporting Service; U.S. Department of Agriculture; Washington, D.C. 20250; November 1985.

ABSTRACT

The Statistical Reporting Service (SRS), U.S. Department of Agriculture (USDA), conducts sample surveys to forecast crop yields during the growing season and to estimate yields after harvest. In the objective yield (OY) surveys, enumerators count and measure plants in two randomly located plots in randomly selected farmer's fields in the major producing states. Enumerator training is conducted so that procedures are followed uniformly in all states. Counts and measurements are chosen to be simple, objective, and repeatable. Plot location methods, plot sizes, and observed variables are presented for corn, cotton, soybean, and wheat. Yield forecasts are produced with current-year data as the inputs to regression models constructed with data from previous years. Net yield estimates equal the material hand harvested from the plots at maturity minus the material gleaned from additional plots after the farmer's harvest. The gleaning is done to estimate harvesting loss.

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SUMMARY

This report contains concise descriptions of the 1985 corn, cotton, soybean, and wheat objective yield (OY) surveys. The paper describes the data collection procedures including:

(1) The number of sample fields per state;

(2) Sample unit location procedures;

(3) Sample unit size and shape descriptions.

Three appendixes contain maturity stage descriptions, sample unit condition descriptions, and the timing and site details of the forecasting and estimating variables.

The report describes briefly the forecasting and estimating procedures for each crop. This publication serves as an introduction to the OY surveys and includes references to the Agency manuals which describe the procedures in detail.

AN OVERVIEW OF THE 1985 CORN, COTTON, SOYBEAN, AND WHEAT OBJECTIVE YIELD SURVEYS

By Ralph V. Matthews[1/]

INTRODUCTION

The Statistical Reporting Service (SRS) collects sample survey data and publishes official U.S. Department of Agriculture (USDA) statistics on crops, livestock, prices, and farm labor. Producers receive these statistics directly or through the farm media. Farm organizations, trade associations, agribusinesses, and commodity brokers are other data users. Crop statistics include planting intentions, acres harvested, production, and stocks. "Scope and Methods of the Statistical Reporting Service"[3][2/] describes the Agency's organization and procedures.

Forty-four field offices serve the 50 states and produce state estimates. Information is gathered through mail surveys, telephone and personal interviews, and field observations [2]. Crop production statistics rely on all three modes of data collection. Questionnaires are mailed to farmers to obtain expected yield and crop conditions in their locality. Personal interviews are conducted during the June Enumerative Survey (JES) [7] and the December Enumerative Survey (DES) [4]. These are surveys in which the sampling units are areas of land selected from an area frame. After crop acreages are known from the JES (or the DES for winter wheat), a sample of fields is selected for making field observations for the objective yield (OY) surveys.

OBJECTIVE YIELD SURVEYS

Data Collection Procedures

SRS collects data on crop acreage and yield in the OY surveys. The surveys began in 1961 for cotton and corn; crops added since then were winter, spring, and durum wheat, 1962; soybean, 1967; potato, 1971; rice, sorghum, and sunflower, 1984 [3]. The yield information is

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1/ The author is a survey statistician with the Statistical Reporting Service, U.S. Department of Agriculture.

2/ Numbers in brackets refer to literature cited at the end of this report.

"objective," because enumerators count and measure the growing crops to collect the data. Acreages are not determined by field measurement but by personal interviews of farmers while examining aerial photographs and thus are not totally "objective." Farmers also report yields in the sample fields during postharvest interviews to provide an additional yield indicator.

In the OY surveys, trained enumerators randomly locate two small plots in randomly selected farmer's fields in major producing states. Observations of crop development are made at monthly intervals during the growing season to forecast yield. The observed variables used to forecast yield change as the plants progress through the reproductive growth stage and then mature. The plots are harvested by hand at maturity to estimate gross yield. After the farmer harvests the field, new plots are located to measure harvest loss, and net yield is estimated.

In the 1985 winter wheat survey, the field work to collect data on crop development began on April 22. A national forecast was issued on May 10 which reflected the conditions of the crop as of May 1. For corn, cotton, and soybean, the field work began on July 22 for an August 12 forecast reflecting conditions as of August 1.

The number of sample fields for each crop is shown by state in table 1. The total sample is distributed among the states to achieve a desired level of precision in each state. Although the number of sample fields is large, the total plot area of any crop is very small. For example, 1,920 sample soybean fields with two sample units per field planted with 30-inch rows equal a total plot area of 1.54 acres.

Manuals of survey procedures [5,6] and data collection forms are produced at the Washington, D.C. headquarters to help insure consistency in all the states. A field office statistician coordinates an OY crop survey in each state. These statisticians attend a national training school to obtain training in survey procedures or to learn of any changes in the program. Each statistician then transmits the information to the field supervisors and enumerators in a state training school, so that procedures are as consistent as possible in all states. The state training schools cover all aspects of data collection including actual field practice. Generally, the enumerators have agricultural backgrounds and live in the areas they serve.

TABLE 1 -- Number of sample fields selected in each state for the 1985 corn, cotton, soybean, and winter wheat objective yield surveys

State	Crop			
	Corn	Cotton	Soybean	Winter wheat
Alabama			100	
Arizona		115		
Arkansas		110	150	100
California		275		100
Colorado				120
Georgia			100	
Idaho				110
Illinois	260		200	90
Indiana	210		130	70
Iowa	240		170	
Kansas				310
Kentucky			100	
Louisiana		100	120	
Michigan	110			
Minnesota	210		120	
Mississippi		165	120	
Missouri	150		170	100
Montana				130
Nebraska	240		100	130
North Carolina			100	
Ohio	190		140	90
Oklahoma				200
Oregon				120
South Dakota	140			
Tennessee			100	
Texas		580		220
Washington				200
Wisconsin	170			
TOTAL	1,920	1,345	1,920	2,090

An enumerator starts from the first corner encountered when approaching the sample field and locates two sample units to collect data for each sample field. Random number tables for different-sized fields are used to determine the numbers of rows and paces to locate the sample units. In corn, cotton, and soybean, a measured buffer area is inserted between the enumerator's last pace and the sample unit to help eliminate personal judgement about the exact starting point of each sample unit. The buffer was tested in the 1985 wheat survey with a split-sample test using the growing crop sample units. The sample unit location procedures are shown for each crop in table 2. A sample unit which appears unrepresentative of the field must nevertheless be enumerated because the sample is drawn to make estimates for the state and not for one particular field.

TABLE 2 -- Sample unit location method and length of buffer for growing crop (GC) and harvest loss (HL) observations in the 1985 corn, cotton, soybean, and winter wheat objective yield surveys

Crop	Location method				Buffer	
	Row planted crop		Broadcast crop		--ft--	
	Unit 1	Unit 2	Unit 1	Unit 2	GC	HL
Corn	RP	RP	NA	NA	5	5
Cotton 1/	RP	RP	NA	NA	5	5
Soybean	RP	RP	PP	PP	5	5
Winter wheat 1/	PP	FP	PP	FP	5 2/	5

RP = Rows and paces; a random number of rows from the starting corner and a random number of paces into the field along that row.

PP = Paces and paces; a random number of paces from the starting corner along the longer edge of the field and a random number of paces into the field perpendicular to the first direction of pacing.

FP = Fixed paces; 30 paces in each direction farther into the field from Unit 1.

NA = Not applicable.

NOTE: Harvest loss units are located 5 additional rows or paces in each direction.

1/ Harvest loss observations in one-half of the sample fields.

2/ 5-ft buffer in split-sample test on sample units.

Table 3 shows the size and shape of the sample units, the measurement device used when staking the boundaries, and the number of rowspaces measured. In row-planted crops, the size varies from three 21.6-in rows in wheat to two 15-ft rows in corn. In soybean or wheat fields without distinct drill rows, the sample unit is a square plot 3 ft (soybean) or 21.6 in (wheat) on a side.

The crop and planting method determine whether a tape measure or a C-shaped steel frame is used to mark off the sample unit beyond the buffer. Florist stakes are used to mark the sample unit boundaries for the return visits.

The enumerator measures the distance between specified rows in and adjacent to the sample unit. The rowspace measurements are used to convert the counts made in the sample unit to a per acre basis. In corn,

cotton, and soybean, one and four row spaces are measured. The 4-row to 1-row ratio is an edit check on the accuracy of the 4-row measurement. The 1985 wheat survey was a transition year for row space measurement. Five row spaces were measured prior to 1985. Four and five row spaces were measured in 1985, and it is expected that four row spaces will be measured in 1986. Measuring one and four row spaces in 1986 would allow the edit check used currently in the other crops.

TABLE 3 -- Size of growing crop (GC) and harvest loss (HL) sample units, device used to locate sample unit boundaries, and number of rowspaces measured for per-acre conversions in the 1985 corn, cotton, soybean, and winter wheat objective yield surveys.

	Sample unit size				
	Row planted crop		Broadcast crop		
Crop	No. of rows	Row length	Size of square	Boundary location device	No. of rowspaces measured
Corn					
GC & HL	2	15 ft	NA	tape	1 & 4
Cotton 1/					
GC & HL	2	10 ft	NA	tape	1 & 4
Soybean					
GC	2	3.5 ft	3 ft 2/	frame	1 & 4
HL	2	3 ft	3 ft	frame	1 & 4
Winter wheat 1/					
GC	3	21.6 in	21.6 in	frame	4 & 5
HL	3	21.6 in	21.6 in	frame	5

Tape = Tape measure.

Frame = Rigid steel frame.

NA = Not applicable.

1/ Harvest loss observations in one-half of the sample fields.

2/ 3 ft X 0.5 ft area also observed.

An enumerator determines the maturity stage of corn, soybean, and wheat; the stage indicates which data to collect during each visit to the sample field. The maturity stage of cotton is not determined in the

field but by a computer edit of the data. Appendix 1 contains the maturity stage descriptions for corn, soybeans, and wheat from the enumerator's manuals [5,6].

Variables called condition codes are collected to quantify the physical conditions causing sample units to differ within a sample field. They are used for edit checks in the state office. The condition code variables for corn are in appendix 2; similar variables exist for soybean and wheat.

Three distinct phases of determining the yield are 1) forecasting the yield before the hand harvest at maturity; 2) estimating the yield after the hand harvest; 3) estimating the harvest loss after the farmer's harvest [1]. In addition to counts or weights taken in the field, plant material may be collected and mailed to a designated state office for further counting, threshing, or weighing under laboratory conditions. For estimating harvest loss, no counts are made in the field, and all the plant material collected is mailed to a state office.

Observations are made either within the boundaries of the sample unit or on pre-defined plants outside the sample unit. For most data items, both sample units in a sample field are enumerated, but in some cases only one sample unit is surveyed. All or part of one or more of the rows in the sample unit is counted or clipped. Appendix 3 contains the data collection site for each variable. Forecasts and estimates are made with the variables in appendix 3. Early-season measurements and final harvest data from previous years are used to construct regression models to forecast yield per acre.

Forecasting and Estimating Procedures

Corn

In corn, the number of ears, grain weight per ear, and harvest loss are the three components used to forecast or estimate net yield. To make a state forecast, five years of previous data are used to construct regression models. Two models are used to forecast number of ears through the milk stage. In one model, the number of stalks is the independent variable. In the other model, the number of stalks, the number of stalks with ears or silked ear shoots, and the number of ears and silked ear shoots are the independent variables. From the dough stage through maturity, the actual number of ears with kernel formation is counted, and regression models are not used.

Prior to any kernel development, the average grain weight per ear from five previous years in the state is used in forecasting. Between the time kernels develop and the hand harvest occurs, regression models are constructed using five years of previous data; current ear length measurements are used to forecast grain weight per ear. After the hand harvest at maturity, the average grain weight per ear for each sample field is known from the laboratory data, and an estimate is made.

When net yield forecasts are made prior to harvest, the harvest loss is estimated by using the 5-year state average. After the farmer's harvest, harvest loss is estimated by gleaning the sample field plots.

Cotton

The three components of cotton yield are number of large bolls (burrs, open bolls, partially open bolls, and large unopen bolls), average boll weight, and harvest loss. Maturity stages are not determined by an enumerator, but maturity categories are assigned in a computer edit of the data using the presence of fruiting structures and the ratio between the number of large bolls and the number of plants.

Five years of previous data are used to construct two models for each maturity category and state. One model is a survival model, and the other is a regression model. The survival model is based on survival to maturity of tagged fruiting structures in a 3-ft section of row adjacent to one sample unit in each field. The regression model uses the fruiting structure counts from both sample units and the 3-ft sections of row adjacent to each one.

A yield forecast uses the 5-year average boll weight until 20 percent of the forecasted number of large bolls are weighed. Between the time that 20 and 85 percent are weighed, a regression equation is used to predict average boll weight. After 85 percent are weighed, the actual average boll weight enters the forecasts.

The 5-year average harvest loss is used as the yield forecast component until the farmer harvest. The harvest loss estimate from the subsample of fields is then used as an adjustment in estimating net yield.

Soybean

Number of plants, number of pods with beans per plant, weight of beans per pod with beans, and harvest loss are the four components used to forecast or estimate soybean net yield. The variables used for forecasting and estimating number of plants and number of pods with beans per plant depend on the maturity stage and whether the soybean variety is determinate or indeterminate.

Maturity stages 1 and 2 (in appendix 1) are divided into eight maturity categories for forecasting. The eight maturity categories are defined by the presence or absence of pods with beans and by two different ratios. If no pods with beans are present, the ratio is between the number of blooms, dry flowers, and pods and the number of main stem nodes. When pods with beans are present, the ratio is between the number of pods with beans and the number of blooms, dry flowers, and pods. Five years of previous data are used to construct regression models to forecast number of plants and number of pods with beans per plant.

The forecasting components for weight of beans per pod with beans and for harvest loss are the 5-year state averages for each variable. For yield estimates, the current-year weight of beans per pod with beans replaces the 5-year average when the lab data are available. The 5-year average for harvest loss is replaced by current data after the sample fields are checked for harvest loss.

Wheat

Wheat has three components in its forecasts or estimates: number of heads, weight of grain per head, and harvest loss. The regression models for predicting number of heads use only the number of stalks prior to head development. If present, heads are counted both before and during the hand harvest.

The weight of grain per head is represented by the 5-year state average prior to kernel development. After kernel development begins, the independent variables for two different regression models change in the following order as development progresses: fertile spikelets per head, grains per head, and unthreshed weight per head. Appendix table 5 contains the forecasting variables for each maturity stage. After the hand harvest, an estimate is made using actual threshed grain weight per head.

The harvest loss component is predicted by the 5-year average until the farmer harvest and by the current estimate after the data is collected from the subsample of sample fields.

CONCLUSION

This overview of the 1985 corn, cotton, soybean, and wheat OY surveys showed how the data are collected in the field and which variables are used to forecast and estimate yields. Readers who want more information on a specific crop should consult the Agency manuals listed in the reference section.

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APPENDIX 1 — Maturity stage descriptions for the 1985 corn, soybean, and wheat objective yield surveys.

CORN

EAR SHOOTS WITHOUT EVIDENCE OF KERNEL FORMATION

Code 2 - Pre-blister — Shoot has some silks showing. Little or no watery, clear liquid present in "spikelets." Blister stage has not been reached.

EARS WITH EVIDENCE OF KERNEL FORMATION

Code 3 - Blister — Most "spikelets" liquid. Most silks protruding from husks are beginning to turn color.

Code 4 - Milk — Plant or shuck is green. Ears are erect. Little or no denting. Most kernels are full of milk-like substance, but kernels not fully grown. Silks protruding from husks have turned brown and dry.

Code 5 - Dough — About one-half of kernels showing dent with some milk or dough-like substance in all kernels. Kernels full grown. Maturity line has not moved halfway to cob on majority of kernels. Shucks taking on a light rust-colored appearance. Ears beginning to lean away from stalks.

Code 6 - Dent — Ears are firm and solid. Kernels fully dented with no milk present in most kernels. Shucks about dry but not beginning to open up. Kernels may be hard to scratch at surface, but still soft near the cob. Maturity line on the kernels has not reached the cob.

Maturity Line. To differentiate between Code 6-Dent, and Code 7-Mature ears, it will be necessary to break the ears, observe the maturity line of the exposed kernels on the top half of the ear and test for milk on top of kernels next to cob. To be in Code 7, the maturity line of the exposed kernels on the top half must be down to the cob. This indicates that the corn is mature and reasonably represents actual harvest conditions. If there is doubt as to whether or not the maturity line has reached the cob, test for milk in the tops of the kernels next to the cob with your thumbnail.

Code 7- Mature — Corn is about ready or ready for harvest. Maturity line on the kernels extends inward to the cob. No milk can be squeezed from the tip of the kernels next to the cob when punctured with thumbnail. Kernels shell off cob fairly easily. Shucks dry and beginning to open up. No green foliage present.

SOYBEAN

Code 1 - Pods Still Forming or Earlier	The unit will be classified as "1" until the plant has progressed through the bloom stage. Any pods formed will still be green and there should be little or no seed development in the pods. Most units are expected to be in this stage in late July in the northern states and in late August in southeast Missouri and other southern areas.
Code 2 - Pods Set, Leaves Still Green	In general, there should be no blooms on the plants except possibly for a late plant in the unit which may have an occassional bloom or two on the top node of the main stem or near the end of a lateral branch. Most of the pods will still be filling and all leaves will still be green.
Code 3 - Pods Filled, Leaves Turning Yellow	Leaves will be yellowing on nearly all plants, but green leaves may still be more numerous on the plants than yellow or partially yellow leaves. Almost all the pods will be filled and some will be ripening.
Code 4 - Pods Turning Color, Leaves Shedding	All leaves will have turned yellow and some will have fallen. The pods will have their full size. Pods will be changing color from green to brown, but some pods may still be green. The beans are not firm and they have not completely shrunk inside the pods.
Code 5 - Pods Brown, Almost Mature	The pods will be brown and easily opened so the beans can be removed. The beans are brown and have shrunk inside the pod. Most of the leaves have been shed by the plants.
Code 6 - Mature	The pods will be brown and ready to combine. All leaves will have fallen from the plants, except for an occasional late plant in the unit. The beans are very hard and will not scratch.

Code 1 - Pre-Flag

This is a general category in which you will record all units where tillers are only an inch or two high, up to units where stalks are large or mature enough to be in the "Boot" stage. The stalks do not indicate any swelling and DO NOT HAVE the definite flag leaf or other evidence of a partly developed head inside the leaf sheath.

Code 2 - Flag or Early Boot

Stalks are starting to joint and joints can be seen easily. The plant has four or five leaves and the "Flag Leaf" is identifiable and its collar is visible above the top foliage leaf. A partly developed head may be detected by noting that the stem has started swelling below the foliage leaf. This swelling may also be felt inside the sheath. Be careful not to damage the partly developed head by squeezing the stem or sheath.

In most cases the presence of heads enclosed in the leaf sheath could be verified by going outside the unit and examining stalks that are similar in appearance to the doubtful ones before classifying the unit in the FLAG or EARLY BOOT stage. Clip a few stalks, unroll the leaf sheath and see whether or not there is a small, partially developed head encased in the sheath.

Code 3 - Late Boot or Flower (Head Emerged) Includes Watery Kernels

The head has moved up the stem and swelling has occurred above the base of the top foliage leaf. The sheath will split and head will partially or wholly emerge. The flower stage occurs soon after the head emerges and small blooms or flowers begin to open at the middle of the head and blooming progresses toward each end. For our purpose, consider the unit to be in the late boot or flower stage from the time swelling can be seen or felt above the top foliage leaf until the head emerges and the watery clear liquid in the kernel has begun to turn milky.

Code 4 - Milk

Kernels are formed in heads. Kernels of grain are soft, moist and milky. When the grain is squeezed, a milky liquid can be observed. The plant is still generally green. One or two of the lower leaves may be dead, but the blades of the three upper leaves and the head are green. Signs of ripening (yellow spots or stripes) are visible only on the edges or tips of the leaves.

Code 5 - Soft Dough

The grains can be crushed between the thumb and fingernail; the contents of most of the GRAINS are SOFT and can be kneaded LIKE DOUGH with ONLY A FEW GRAINS PER HEAD containing any milky liquid. The plant has changed to a golden tint (except in the purple-strawed forms which are a pinkish purple color); the stalk is smooth and shiny, tough and pliable. Only the upper-most leaves are swollen and green, the lower leaves being shrunken and brownish.

Code 6 - Hard Dough

The GRAINS READILY PART FROM THE HEAD and are likely to shake out of the glumes. The grain is FIRM and though it may be dented by pressure of the thumbnail, it is NOT EASILY CRUSHED. The characteristic color has become distinct. The yellow grains are paler,

the red grains somewhat darker and flinty or mealy in character. The leaves are dry and shrunken. Wheat in this category may be swathed in some areas.

Code 7 - Ripe

Straw is dull and brittle at this stage; the GRAIN is HARD and BREAKS IN FRAGMENTS when crushed. Harvest may be expected at this time.

APPENDIX 2 Sample unit condition codes for the 1985 corn objective yield survey.

SAMPLE UNIT CONDITION OBSERVATIONS

14. Observe unit and enter code for each unit that best represents each of the different field conditions. Specific instructions for each code are covered in enumerator's manual.

MOISTURE	WEEDINESS	FROST/FREEZE	DISEASE/INSECT ANIMAL	HAIL	LODGING
Dry ..... 1 Moist ..... 2 Wet ..... 3 Saturated ..... 4 Standing Water. 5 Unknown 6	None to Slight..1 Light ..... 2 Moderate ..... 3 Heavy ..... 4 Severe ..... 5 Unknown 6	None To Slight.1 Light ..... 2 Moderate ..... 3 Heavy ..... 4 Severe ..... 5 Unknown 6	None To Slight.1 Light ..... 2 Moderate ..... 3 Heavy ..... 4 Severe ..... 5 Unknown 6	None To Slight.1 Light ..... 2 Moderate ..... 3 Heavy ..... 4 Severe ..... 5 Unknown 6	None to Slight..1 Light ..... 2 Moderate ..... 3 Heavy ..... 4 Severe ..... 5 Unknown 6
U1 365 U2 366	U1 367 U2 368	U1 373 U2 374	U1 375 U2 376	U1 377 U2 378	U1 383 U2 384

General

The sample unit condition observations will be made each time the sample unit is visited and the Form B completed. Observations should reflect only the count area of each unit. The condition observations are subjective, however, guidelines are covered in the following pages.

Surface Moisture:

Three rows beyond row 1 of the sample unit (row 4 middle) feel the texture of the upper three inches of the soil surface. Rate moisture content for each unit according to code below that best describes the moisture condition.

CODE	CONDITION	DESCRIPTION
1	Dry	Soil contains little moisture, can be broken with some difficulty between thumb and forefinger, breaks into powder or individual grains.
2	Moist	Soil contain some moisture, crushes easily under gentle pressure between thumb and forefinger and can be pushed together into a lump.
3	Wet	Soil contains considerable moisture, readily deformed by moderate pressure and can be pushed into a lump, will form a wire between thumb and forefinger, tends to stretch rather than pull free from other particles.
4	Saturated	Soil has water drippings, forms mud, does not form a lump when pressed, will not form a wire when rolled between thumb and forefinger.
5	Standing Water	Water standing on surface of soil.
6	Unknown	Not Observed.

WEEDINESS

For this evaluation, weeds are all plants (vegetation) other than the planted crop, for example, cocklebur and sorghum are both weeds in a corn field. Estimate the percent of major weeds present in the unit and record the appropriate code on Form B.

CODE	CONDITION	DESCRIPTION
1	None to Slight	Excellent weed control; weeds are not a problem in this field.
2	Light	Good weed control; weeds make up less than 1/4 of the plants in the unit.
3	Moderate	Weeds make up 1/4 to 1/2 of the plants in the unit.
4	Heavy	Weeds make up 1/2 to 3/4 of the plants in the unit.
5	Severe	Very weedy; more than 3/4 of the plants in the field are weeds. Severe crop loss expected.
6	Unknown	Not Observed.

FROST AND FREEZE

Use the codes below to best describe the amount of frost or damage withing the count unit.

CODE	CONDITION	DESCRIPTION
1	None to slight	No damage, or not more than 5% of leaves are damaged.
2	Light	Less than 1/4 of leaves or other plant parts are damaged.
3	Moderate	1/4 to 1/2 of leaves or other plant parts are damaged.
4	Heavy	1/2 to 3/4 of all leaves or other plant parts are damaged.
5	Severe	More than 3/4 of leaves or other plant parts are damaged.
6	Unknown	Not Observed.

DISEASE, INSECT, ANIMAL DAMAGE

Rate the amount of disease, insect, and animal damage on the crop within the unit according to the scale below which is based on defoliation and record the code that best describes the condition on Form B. For animal damage code the unit based on the extent of damage and make a note on the questionnaire.

CODE	CONDITION	DESCRIPTION
1	None to Slight	0 to 5% of the leaves or other plant parts affected.
2	Light	Less than 1/4 but more than 5% of the leaves or other plant parts affected.
3	Moderate	1/4 to 1/2 of the leaves or other plant parts affected.
4	Heavy	1/2 to 3/4 of the leaves or other plant parts affected.
5	Severe	More than 3/4 of the leaves or other plant parts affected. Pre-mature plant death.
6	Unknown	Not Observed.

HAIL DAMAGE

Hail damage usually results in defoliation and destruction of stems. Use the codes below to describe the amount of hail damage within the unit on the Form B.

CODE	CONDITION	DESCRIPTION
1	None to Slight	No damage or not more than 5% of leaves are damaged.
2	Light	Less than 1/4 but more than 5% of leaves are missing; few main stems are broken.
3	Moderate	1/4 to 1/2 of leaves are missing; less than 1/4 of main stems are broken.
4	Heavy	1/2 to 3/4 of leaves are missing; 1/4 to 1/2 of main stems are broken.
5	Severe	More than 3/4 of leaves are missing; more than 1/2 of stems are broken. Severe crop loss is anticipated.
6	Unknown	Not Observed.

LODGING DAMAGE

Crop lodging is a condition when plants bend at or near the soil surface and lie more or less on the ground. Lodging is rated according to the angle formed by the main stem of the plant and vertical. Select the appropriate code below which best describes the amount of lodging within the unit and record on the Form B.

CODE	CONDITION	DESCRIPTION
1	None to Slight	Most plants are nearly vertical, 0 degrees.
2	Light	Most plants are nearly 22 degrees from vertical.
3	Moderate	Most plants are halfway between vertical and flat on the ground, 45 degrees.
4	Heavy	Most plants are nearly 70 degrees from vertical.
5	Severe	Most plants are flat on the ground, 90 degrees.
6	Unknown	Not Observed.

APPENDIX 3

Data collection phase, site, and portion of the sample units observed for the variables in the 1985 corn, cotton, soybean and wheat objective yield surveys.

Key to Codes in appendix tables 1, 2, 3, and 4.

NA = Not applicable

Phase

F = Forecast
E = Estimate
H = Harvest loss

Collection Site

F = Field
L = Laboratory

Position (Pos.)

I = Inside the sample units
O = Outside the sample units

Portions of Rows (Part)

A = All
P = Part

APPENDIX TABLE 1 -- Data collection phase, site, and portion of the sample units observed for the variables in the 1985 corn objective yield survey

Variable	Phase	Site	Portion of sample units			
			Pos.	Units	Rows	Part
Maturity stage 1/	F,E	F	O	1	1	NA
	F,E	F	I	2	2	A
No. of stalks	F	F	I	2	2	A
No. of stalks w/ears or silked ear shoots	F	F	I	2	2	A
No. of ears & silked ear shoots	F	F	I	2	2	A
No. of ears w/kernel formation	F	F	I	2	2	A
Length of kernel rows of 5 ears	F	F	O	1	1	NA
Length of cobs	F	F	I	1	1	A
No. of ears w/grain	E	F	I	2	1	A
Wt. of ears w/grain	E	F	I	2	1	A
Wt. of 4 (or less) ears	E	L	I	2	1	P
Wt. of grain on 4 (or less) ears	E	L	I	2	1	P
Moist. content of grain on 4 (or less) ears	E	L	I	2	1	P
Ears & pieces gleaned	H	F	I	2	2	A
Loose grain gleaned	H	F	I	2	1	A
Wt. of grain from ears & pieces	H	L	I	2	2	A
Wt. of loose grain	H	L	I	2	1	A
Moist. content of grain	H	L	I	2	1,2	A

1/ Two methods used experimentally in 1985.

APPENDIX TABLE 2 -- Data collection phase, site, and portion of the sample units observed for the variables in the 1985 cotton objective yield survey

Variable	Phase	Site	Portion of sample units			
			Pos.	Units	Rows	Part
No. of plants	F	F	I	2	2	A
No. of burrs	F,E	F	I	2	2	A
1st 10 (or less) open bolls	F,E	F	I	2	2	P
Wt. of seed cotton from 1st 10 (or less) open bolls	F	F	I	2	2	P
No. of remaining open bolls	F,E	F	I	2	2	P
Wt. of seed cotton from remainig open bolls	F	F	I	2	2	P
No. of partially open bolls w/cotton visible	F,E	F	I	2	2	A
No. of large unopen bolls (at least 1-in diameter)	F,E	F	I	2	2	A
No. of plants	F	F	O	2	1	NA
No. of burrs, open bolls, & partially open bolls	F,E	F	O	2	1	NA
No. of large unopen bolls	F,E	F	O	2	1	NA
No. of small bolls & blooms	F	F	O	2	1	NA
No. of squares	F	F	O	2	1	NA
Wt. of oven-dried seed cotton from 1st 10 (or less) open bolls	F,E	L	I	2	2	P
Large unopen bolls & partially open bolls gleaned	H	F	I[1/]	2	2	A
Seed cotton on plants gleaned	H	F	I	2	2	A
Seed cotton on soil gleaned	H	F	I	2	2	A
Wt. of oven-dried seed cotton on plants	H	L	I	2	2	A
Wt. of oven-dried seed cotton on soil	H	L	I	2	2	A

1/ In growing crop or harvest loss sample unit.

APPENDIX TABLE 3 -- Data collection phase, site, and portion of the sample units observed for the variables in the 1985 soybean objective yield survey

Variable	Phase	Site	Portion of sample units			
			Pos.	Units	Rows	Part
Maturity stage	F,E	F	I	2	2	A
No. of plants	F	F	I	2	2	A
No. of main stem nodes	F	F	I	2	2	P
No. of laterals w/blooms, dry flowers, & pods	F	F	I	2	2	P
No. of blooms, dry flowers, & pods	F	F	I	2	2	P
No. of pods w/beans	F,E	F	I	2	2	P
No. of pods	E	L	I	1	1	P
No. of pods w/developed beans	E	L	I	1	1	P
Wt. of pods & beans	E	L	I	2	1	P
Wt. of threshed beans	E	L	I	2	1	P
Moist. content of threshed beans	E	L	I	2	1	P
Pods gleaned	H	F	I	2	2	A
Whole beans & pieces gleaned	H	F	I	2	2	A
Wt. of threshed beans from pods	H	L	I	2	2	A
Wt. of whole beans & pieces	H	L	I	2	2	A
Wt. of threshed beans, whole beans & pieces	H	L	I	2	2	A
Moist. content of beans	H	L	I	2	2	A

APPENDIX TABLE 4 -- Data collection phase, site, and portion of the sample units observed for the variables in the 1985 wheat objective yield survey

Variable	Phase	Site	Portion of sample units			
			Pos.	Units	Rows	Part
Maturity stage	F,E	F	I	2	3	A
No. of stalks	F	F	I	2	3	A
No. of late boot heads	F,E	F	I	2	3	A
No. of emerged heads	F,E	F	I	2	3	A
No. of emerged heads	F	L	O	2	1	NA
Wt. of emerged heads	F	L	O	2	1	NA
No. of late boot heads	F	L	O	2	1	NA
Wt. of late boot heads	F	L	O	2	1	NA
No. of fertile spikelets on 10 (or less) heads	F	L	O	2	1	NA
No. of sterile spikelets on 10 (or less) heads	F	L	O	2	1	NA
No. of kernels on 10 (or less) heads	F	L	O	2	1	NA
No. of detached heads	E	F	I	2	3	A
Wt. of heads	E	L	I	2	3	A
Wt. of threshed grain	E	L	I	2	3	A
Moist. content of threshed grain	E	L	I	2	3	A
Unthreshed whole heads gleaned	H	F	I	2	3	A
Partly threshed heads gleaned	H	F	I	2	3	A
Loose grain gleaned	H	F	I	2	3	A
Wt. of heads, loose grain & chaff	H	L	I	2	3	A
Wt. of threshed grain	H	L	I	2	3	A
Moist. content of grain	H	L	I	2	3	A

APPENDIX 4 Forecasting variables of the 1985 wheat objective yield surveys.

APPENDIX TABLE 5 — Variables used to forecast two yield components of each maturity stage in the 1985 wheat objective yield survey

Maturity stage	Forecast variables	
	Number of heads	Grain weight per head
Pre-flag	No. of stalks	5-year avg.
Flag or early boot	No. of stalks	5-year avg.
Late boot or flower	No. of late boot and emerged heads	5-year avg. and no. of fertile spiklets on 10 (or less) heads
Milk	No. of late boot and emerged heads	No. of kernels on 10 (or less) heads and unthreshed wt. per head
Soft dough	No. of late boot and emerged heads	No. of kernels on 10 (or less) heads and unthreshed wt. per head
Hard dough 1/	No. of late boot, emerged, and detached heads	Wt. of threshed grain per head
Ripe 1/	No. of late boot, emerged, and detached heads	Wt. of threshed grain per head

1/ Components are estimated by counts and threshed weight, not forecasted by regression.