DOUBLE HARVESTING GRAIN SORGHUM
IN OKLAHOMA

By

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CHAPTER I

INTRODUCTION

Since the development of hybrids in grain sorghum major increases in yields have been the result of altered cultural practices. The higher yields afforded by hybridization have encouraged farmers to grow the crop on more fertile soils with higher plant populations, more fertilizer, and increased use of irrigation.

A recent practice for further increasing annual yields is that of double harvesting. This involves harvesting two crops of grain in one year from a single planting with the use of additional fertilizer and irrigation. Farmers of Texas and Arizona were the first to attempt such a cropping system. The crop is planted as early in the season as possible to insure maximum utilization of the growing period. Upon harvest the stover is either shredded with a stalk cutter or left standing and additional fertilizer and irrigation is applied. The second crop is harvested late in the fall after the first frost.

The purpose of this study was to investigate some of the possibilities of double harvesting grain sorghum in Oklahoma. The shorter growing season in this state necessitates harvesting the grain while still wet and either drying it mechanically or storing it as wet grain.

Factors of concern in this study included: 1. the comparison of hybrids and a variety of different maturity groups as to their ability to produce a ratoon crop of grain, and 2. the comparison of yields, protein percentages, test weights, days to first bloom, and plant heights from two methods of double harvesting with single harvesting.

Throughout this discussion the terms "ratoon crop" and "recovery crop" will be used interchangeably in reference to the regrowth of sorghum plants after they have been clipped. The term "normal crop" will be used to mean a sorghum crop which is planted when the soil temperature is 65 to 70°F. and harvested when the grain is dry in the field. The term "chopped" will be used to refer to treatments in this experiment in which the plants were cut off four to six inches above the ground level after the heads were removed. The term "headed" will be used to refer to treatments in which the heads were removed and the plants were left standing.

CHAPTER II

REVIEW OF LITERATURE

It has long been known that some grain sorghums if clipped regularly will continue to grow and produce grain as long as environmental conditions are favorable. Clipping studies (29) with immature plants indicated, however, that grain yield from a recovery crop was inferior to one which had not been clipped. Singh et al. (29) reported that clipping the heads of the hybrid RS 610 in the dough stage resulted in an average of 3.9 side branches per plant. From those branches 3.7 secondary heads per plant were produced. The secondary heads were much smaller and gave a 40 percent yield reduction in comparison to check plants. Test weight was also reduced but forage yield was increased.

Stith (36), in Arizona, applied this recovery characteristic of sorghum in producing two crops of grain in one growing season from one planting. The hybrid grown, the planting date, the plant population and the method of harvest were considered critical points in the double harvesting procedure. The hybrids from the mid-season maturity group were found to be superior to others. These hybrids permitted ample time for two crops to mature in Arizona and yields were higher than from those of earlier maturity groups. The planting date was found optimum when the soil temperature had reached 65°F. Plant populations of 100,000 to 110,000 plants per acre in rows less than 40 inches wide were considered optimum. Irrigation and fertilization were considered essential.

Three harvesting methods were used: 1. combined and left the stubble, 2. combined and shredded the stubble, and 3. delayed combining until frost. The heads produced from the first method were from leaf nodes and were numerous but small. The heads produced from the second method were from crown nodes and larger. However, the second system required two weeks longer to mature and the expense of shredding the stalks was involved. In the third system more bird damage and weathering were considered problems. Favorable second-crop yields were reported from all systems but yields from the first harvesting method were slightly greater.

Other reports (30,31), from Texas, indicated results similar to that of Stith (36); however, these investigators found shredding the stalks a more favorable method of harvesting. Yields of 10,000 pounds per acre were reported from two crops. Further emphasis was placed on the necessity of early planting, high plant populations, and additional nitrogen fertilizer and irrigations.

The effects of early planting have been studied by several investigators (5,24,25,26,34,37). Most (5,25,26,37) agreed that the minimum soil temperatures for germination of sorghum seed is approximately 50°F., but temperatures of 65°F. are necessary for emergence. Quinby et al. (26) has further reported that the optimum mean temperature for growth is 80°F.

Stoffer et al. (37) obtained greater yields with later planting dates. This was attributed to a greater number of heads per unit area, higher carbohydrate accumulations in the seeds, and increased root growth. The hybrid RS 610, reportedly, gave significantly better performance than the variety Martin at earlier planting dates. Pinthus (25) reported comparable results. Other investigators (5,24) suggested that earlier planting tends to lengthen the time to anthesis and expand generally the total number of days from planting to physiologic maturity.

Results from row spacing and plant population experiments (13,26, 32,33,35) also, agreed with the findings of Stith (36). Most reports (13,32,33,35) suggested that 20-inch rows were superior in production to 40-inch rows and that significant row spacing X plant population interactions were usually present. In all cases cited, except one (26), the yield increases in narrower rows were attributed more to plant population than row spacing. Other effects attributed to narrower rows included: increased tillering (35), decreased panicle moisture (26), taller plants (32), and better weed control (32).

Irrigation and fertilization studies with high plant populations indicated that yields as great as 8,000 pounds per acre could be obtained from a single crop (23). Musick et al. (23) and Stone et al. (38) reported that the critical moisture period of sorghum was prior to and during the boot stage of growth. Musick (38) also found that significant yield responses on Kansas soils could be obtained from amounts of nitrogen fertilizer up to 120 pounds per acre. Protein percentage was found to increase, along with yield, with increasing increments of nitrogen. Lamke (19), Miller (22), and Tucker (39) found similar results. However, others (1,3,11,12,20,28) suggested that protein decreased with increas- yields. Schoeff (27) attributed this to unsound agronomic practices.

In areas where shorter growing seasons exist, double harvesting would depend on growing earlier maturing hybrids or harvesting later maturing ones at an earlier date. The harvesting of wet grain has been investigated by several experimenters (2,4,15,16,21). Hogg (15) reported that sorghum grain reached maximum dry weight at 40 to 45 percent moisture and that, theoretically, physiologic maturity was attained at that level. Kersting (18) found that protein and carbohydrate content decreased after physiologic maturity. This suggested that maximum yield could be obtained some days in advance of usual harvest dates. Pauli (24) indicated that physiologic maturity was reached approximately 30 days after anthesis and Warnes (41) reported that moisture loss after that stage was one percent per day. The total time from planting to harvest could be decreased by 10 to 15 days by combining at 30 percent moisture. Cardon (4) reported that grain sorghum can be combined at 30 percent moisture if the combine ground speed is reduced and the cylinder speed increased. The report further suggested that the grain can be satisfactorily stored in air tight silos and that feeding value is equal to dry grain.

CHAPTER III

MATERIALS AND METHODS

Perkins Research Station, Perkins, Oklahoma, 1964:

Nine grain sorghum hybrids and one variety were used in this study. The variety and four of the hybrids were experiment station releases. The remaining five hybrids were of commercial origin. These materials were selected on the basis of maturity dates and previous performance in hybrid and variety tests (6,7,8,9,10). Three high-yielding hybrids were selected from each of the three general maturity date groups; namely, early, medium, and late. The variety was of the medium maturity group. Descriptions of the entries are given in Appendix A.

These materials were grown on a Vanoss loam soil at Perkins, Oklahoma, in 1964 and screened on their ability to produce a second crop of grain. The purpose of the screening was to select desirable materials to be double harvested in a later study. The criterion for selection was primarily grain yield of the second crop. The early and medium entries were treated as follows:

1. Planted April 18 and harvested when the grain was dried to 18 to 23% moisture. One treatment consisted of only heading the plants while in another the stalks were cut off four to six inches above the ground level. The recovery crops were harvested as dry grain after frost.

2. Planted May 28 and harvested when the grain was dry in the field.

The late maturing entries were treated only as indicated in 2 above because they were not expected to produce two crops in Oklahoma.

The entries were planted in 40-inch rows with four-row plots in a completely randomized design with four replications. The rate of planting was in excess to insure a proper stand. The stand was thinned approximately two weeks after emergence leaving an estimated two-inch spacing between plants (approximately 75,000 plants per acre).

Cultural data are shown in Table 1, Appendix B. Sixty-four pounds per acre of nitrogen was applied to the early and normal planted crops, while 100 pounds was applied to the stubble of all double-harvest entries after the first harvest. Flood irrigation was used. Two of the four irrigations were applied to the first-crop material. The third and fourth irrigations were utilized by the second-crop material, making a total of 10-acre inches of additional water for the second crop of grain. The first fertilizer application was drilled into the plowed layer with an ordinary grain drill prior to planting. The second was a side-dress application with a conventional "Allis Chalmers" cultivator and fertilizer applicator. This method was inefficient due to the variable stages of plant growth in the field. Several plants of the taller entries were broken. The third treatment of fertilizer was manually applied with a calibrated push-type "Planet Junior" plot planter. This application was made on all double-harvest treatments just after the first harvest. The "Planet Junior" was a satisfactory method for applying fertilizer to the individual four-row plots.

Populations of sorghum midge [Contarinia sorghicola (Coq.)]

occurred in the recovery growth. Two applications with "Diazanon" at the rate of one-half pound per acre were necessary to reduce the populations to a tolerable level. The insecticide was applied with a three-wheeled "highboy" tractor equipped with a pressure pump sprayer. Bird populations also became a problem later in the season. These were kept from the field by carbide guns. Weeds were controlled by cultivation as was necessary.

Harvesting was done by hand and the chopped forage was removed from the field. The area harvested was 1/500 acre taken from the two inner rows of the four-row plots. The heads were cut one-half inch below the base with hand pruning shears and placed in burlap bags. The wet grain was dried in the heads. All heads were then threshed on the same day with an "Almaco" portable nursery thresher.

The following measurements were made on all plots: 1. days to first bloom, 2. plant height, 3. grain yield, 4. test weight of grain, and 5. protein percentage of grain. Date of first bloom was considered when three heads in the row began shedding pollen. This measurement was taken on recovery growth of double-harvest material as well. Plant height was measured to the nearest inch and grain yield in bushels per acre. The test weight was measured with a quart-size test weight apparatus. Percent nitrogen was analyzed by the Kjeldahl method and percent protein calculated by multiplying % N by the factor 6.25.

From the 1964 material five hybrids were selected for further observation during the 1965 growing season. The hybrids consisted of two early (NK 125 and NB 505), two medium (RS 610 and OK 612), and one late (OK 632). OK 612 did not produce a second crop in 1964; however, it was retained since the future experiment was planned for Tipton as well as Perkins. The growing season at Tipton is generally longer than at Perkins. The 1965 experiment was conducted in a manner similar to that of the previous year, except that the late maturing hybrid was double harvested and the nitrogen rate was increased to 100 pounds per acre for each crop.

Perkins Research Station, Perkins, Oklahoma, 1965:

The Perkins experiment was planted April 23 on the same soil as that of the previous year. Forty-inch rows were again used since this was suitable for the available machinery. Soil moisture conditions at planting time were excellent. Seed was planted in excess and the stand was thinned to approximately one plant per 1.5 inches of row length (100,000 plants per acre). The normal-cropped entries were planted June 7 in their respective plot positions in the field design.

Fertilizer and water applications are shown in Table 2, Appendix B. An additional 200 pounds per acre of 12-24-12 was applied pre-plant to this experiment and side-dress applications of nitrogen were increased 30 pounds. The "Planet Junior" seeder was used for all side-dress applications. Four irrigations were needed for the 1965 crop.

The double-harvest material was harvested at 25 percent moisture. The threshing percentage of the grain from the heads at that level was not lower than 65 for any entry. RS 610 exhibited threshing percentages greater than 70 at moisture levels higher than 25 percent.

Sorghum midge populations were greater in the recovery growth than in the previous year. Four applications of "Diazanon" were necessary to control the insects. The chemical was applied with a knapsack sprayer at the recommended rate of one-half pound per acre. Some damage due to birds occurred but the use of carbide guns was beneficial in their control. All other methods at Perkins were performed the same as in 1964.

The date of the first freeze was later in the year than normal which allowed all double-harvest entries to produce a second crop. The recovery crop of headed treatments and one chopped treatment, NK 125, reached maturity before the other four chopped entries. These were harvested October 28. The other treatments could have been harvested as wet grain yet it seemed necessary to leave them until the first freeze which occurred November 27. By mistake these entries were bulk harvested with a combine; therefore, yield data is lacking. Estimates of yield were made on those plots and will be discussed later.

Southwest Cotton Substation, Tipton, Oklahoma, 1965:

The Tipton experiment was planted April 29 in 28-inch rows on a Tipton silt loam soil. The plant spacing was three inches (approximately 78,000 plants per acre). The normal crop was planted June 10.

The first side-dress fertilizer application was made as anhydrous ammonia while that on the stubble was applied with the "Planet Junior" as prilled ammonium nitrate. Six irrigations were necessary at the rate of 2.5 inches per application. The cultural data are shown in Table 3 of Appendix B.

Sorghum midge damage to the second crop of all entries was extreme. The population build-up was so unexpected that the damage was severe before control measures could be enacted. Data from the Tipton test therefore is lacking.

Statistical analyses were not made on any of the data from these experiments. Injury to plants of the preliminary experiment at Perkins was not uniform on all plots. Those plots with taller plants received severe injury from the cultivator while some plots with shorter plants received no injury at all. The hail storm which occurred June 28 injured plants of the early-planted crop more than those of the normal crop. The early-planted crop had passed the bloom stage of growth while the normal crop had only reached the six-inch stage. Much of the yield data from the second crops of 1965 experiments was lost.

CHAPTER IV

RESULTS AND DISCUSSION

Perkins, 1964:

Results of the 1964 preliminary experiment are shown in Tables I, II, III, IV, and V on the following pages. The grain yields were generally low due to a hail storm and mechanical injury which decreased the plant population. Sorghum midge damage further contributed to the yield reduction of late maturing hybrids and the recovery crops of most entries.

Large populations of the insect occurred before their presence was realized; otherwise, control measures could have been enacted at an earlier date. According to Harding (14) and Walter (40) the life cycle of the midge is from 15 to 19 days and the maximum life of the adult is 36 hours. Maximum oviposition must occur soon after the adult emerges, thus providing rapid build-up of populations and subsequent loss of grain. Midge damage was not noted, however, in entries which reached full bloom early in the season. These included all of the first crop of early-planted material and the early and medium maturing entries of the normal crop. Damage was only slight in the ratoon crops of NB 505 and NK 125.

The early planting resulted in a general reduction of yield compared to the normal crop for most entries (Table I). The reduced yield could have been the result of increased mechanical injury from applying the fertilizer or the hail storm. The plants of the early seeding were at more advanced stages of growth than the normal crop when the injuries occurred. Low temperatures soon after emergence of the early-planted crop did, however, slow the growth of the plants. The variety, Combine 7078, appeared to be affected more by the cold than any of the hybrids.

TABLE I

AVERAGE GRAIN YIELD IN BUSHELS PER ACRE FOR THREE MATURITY GROUPS OF GRAIN SORGHUM, PLANTED ON TWO DATES WITH DIFFERENT HARVESTING TREATMENTS, PERKINS, 1964

Entry*	Normal	Headed			Chopped		
		1st Crop	2nd Crop	Total	1st Crop	2nd Crop	Total
NB 505 E	66.5	45.5	23.5	69.0	47.3	41.6	88.9
NK 125 E	51.8	41.1	27.9	69.0	40.2	46.8	87.0
Dek. S. 33E	62.0	42.8	7.0	49.8	44.6	26.2	70.8
RS 610 M	66.0	56.2	20.4	76.6	55.4	10.2	65.6
OK 612 M	68.8	64.3	9.1	73.4	61.0	00.0	61.0
G.G. R103 M	63.2	55.4	15.8	71.2	57.1	12.3	69.4
Comb. 7078 M	57.8	54.2	00.0	54.2	59.2	00.0	59.2
NK 310 L	69.2						
Lind. 788 L	75.2						
OK 632 L	73.6						

*E denotes early, M denotes medium, and L denotes late.

The ratoon crop of medium maturing, chopped entries was hindered in yield by frost. Perhaps most of these entries could have escaped the frost damge had the first crop been harvested at 25 percent moisture rather than at 18 to 23 percent. The variety, Combine 7078, did not produce a second crop and OK 612 failed to produce grain in the chopped treatment. Second-crop yields were greatest in early maturing hybrids but the total of two crops exceeded the highest single crop only slightly.

Recovery growth was much more uniform from chopped than from headed treatments. Side branches from leaf nodes arose on the headed treatments and exserted to variable heights. The heads of these branches were quite small, whereas those of the chopped treatments were comparable in size to those of the parent culms. The secondary culms in the latter case arose from crown nodes.

More days to bloom were required for the early than the normal planted crop (Table II). This may have been the result of the slowed growth due to cooler temperatures shortly after emergence, yet it seems reasonable to assume that the injury due to the hail storm contributed as well. The variety, Combine 7078, appeared to have been affected most by the early planting and injury.

In the recovery crops more days to bloom were required for chopped than headed treatments. Within the headed group differences were not great among entries. Combine 7078 required the most days to bloom of all in that group. Among chopped treatments 2 to 21 more days to bloom were required for medium and early entries.

Plant heights of each entry remained about the same except for the ratoon crop of the chopped treatments (Table III). These plants grew an additional 2 to 15 inches as compared to the normal treatments. The reason for the increase in height is not known; however, the weather just prior to the boot stage of growth was abnormal. Temperatures were 10 to 12 degrees below normal and heavy overcast skies with intermittent rain occurred for several days. Although the plants were taller, heights

TABLE II

AVERAGE DAYS FROM PLANTING TO FIRST BLOOM FOR THREE MATURITY GROUPS OF GRAIN SORGHUM, PLANTED ON TWO DATES WITH DIFFERENT HARVESTING TREATMENTS, PERKINS, 1964

Entry*	Normal	Early Plant	Headed	Chopped
NB 505 E	53	60	24	29
NK 125 E	49	58	23	30
Dek. S. 33E	53	61	23	31
RS 610 M	58	65	23	45
OK 612 M	58	66	26	45
G.G. R103M	58	65	24	45
Comb. 7078 M	58	70	37	39
NK 310 L	72			
Lind. 788 L	60			
OK 632 L	59			

*E denotes early, M denotes medium, and L denotes late.

were not such that combining would be hindered.

Test weights of the grain from ratoon crops were generally lower than those of the first crop (Table IV). The weights were, however, comparable with normal treatments. Those recovery-crop entries which were hindered by frost were typically lower in test weight than others. This was expected since the grain was immature and shriveled. Test weights were higher from the early planted material than from the normal crop, but an explanation for this is unavailable at this time. The missing data for the recovery crops of OK 612 and Combine 7078 were due to the lack of grain yield.

TABLE III

AVERAGE PLANT HEIGHT IN INCHES FOR THREE MATURITY GROUPS OF GRAIN SORGHUM, PLANTED ON TWO DATES WITH DIFFERENT HARVESTING TREATMENTS, PERKINS, 1964

Entry*	Normal	Early Plant	Headed	Chopped
NB 505 E	48	49	53	59
NK 125 E	48	48	52	57
Dek. S. 33 E	46	45	47	56
RS 610 M	54	52	54	63
G.G. R103 M	45	45	47	60
OK 612 M	47	45	45	49
Comb. 7078 M	39	38	38	47
OK 632 L	53			
Lind. 788 L	50			
NK 310 L	52			

*E denotes early, M denotes medium, and L denotes late.

Protein percentage was consistently higher than expected (Table V). Grain from early-planted material was generally lower in protein than for the normal crop while the ratoon percentages were generally higher than either the early-planted or normal crops. The high rates of nitrogen, along with irrigation, on established root systems may have accounted for this occurrence. Differences in protein percentage among maturity groups for particular cropping systems were not great.

TABLE IV

AVERAGE TEST WEIGHT IN POUNDS PER BUSHEL FOR THREE MATURITY GROUPS OF GRAIN SORGHUM, PLANTED ON TWO DATES WITH DIFFERENT HARVESTING TREATMENTS, PERKINS, 1964

Entry*	Normal	Headed		Chopped	
		1st Crop	2nd Crop	1st Crop	2nd Crop
NB 505 E	57.5	59.5	55.5	60.0	56.5
NK 125 E	52.0	55.5	53.0	55.5	52.5
Dek. S. 33 E	56.0	58.0	54.0	58.0	53.0
G. G. R103 M	52.0	57.5	49.0	57.5	47.0
RS 610 M	51.0	58.0	48.5	58.0	49.0
OK 612 M	51.5	58.5	52.0	58.0	--
Comb. 7078 M	50.0	57.0	--	57.0	--
OK 632 L	53.0				
Lind. 788 L	54.0				
NK 310 L	57.0				

*E denotes early, M denotes medium, and L denotes late.

Perkins, 1965:

Favorable grain yields were obtained from the 1965 crop at Perkins (Table VI). Little difference was noted in performance of early-planted and normal crops and only NK 125 exhibited a reduction in yield due to early planting. Hybrids of later maturity groups produced more grain than those of the earlier group in single-crop systems -- a common characteristic of sorghum maturity groups.

Two crops were produced by all entries with both harvesting methods. Differences among entries were not great in the second crop of headed treatments with 30.4 and 44.0 bushels per acre the lowest and highest, respectively. However, total yields of two crops under the headed system did tend to reflect differences in maturity groups. Early and medium maturing entries exhibited the highest second-crop yields. In comparison of two-crop yields of headed treatments with the highest single-crop yield, an additional 40 bushels per acre was obtained from the two-crop system.

TABLE V

AVERAGE PROTEIN PERCENTAGE FOR THREE MATURITY GROUPS OF GRAIN SORGHUM, PLANTED ON TWO DATES WITH DIFFERENT HARVESTING TREATMENTS, PERKINS, 1964

Entry*	Normal	Headed		Chopped	
		1st Crop	2nd Crop	1st Crop	2nd Crop
NB 505 E	12.5	12.5	14.4	12.5	13.8
NK 125 E	13.8	12.5	13.8	12.5	13.1
Dek. S. 33 E	13.8	11.9	14.4	11.9	14.4
G.G. R103 M	12.5	11.9	13.1	11.9	14.4
RS 610 M	11.9	11.2	11.2	11.2	13.8
OK 612 M	12.5	11.2	13.8	11.2	--
Comb. 7078 M	14.4	11.9	--	12.5	--
OK 632 L	12.5				
Lind. 788 L	13.8				
NK 310 L	13.8				

*E denotes early, M denotes medium, and L denotes late.

Second-crop yield measurements of chopped treatments were made only on NK 125 but estimates were made for those that were harvested by mistake. The estimates were made by general observation and on the

TABLE VI

AVERAGE GRAIN YIELD IN BUSHELS PER ACRE FOR THREE MATURITY GROUPS OF GRAIN SORGHUM PLANTED ON TWO DATES WITH DIFFERENT HARVESTING TREATMENTS, PERKINS, 1965

Entry*	Normal	Headed			Chopped		
		1st Crop	2nd Crop	Total	1st Crop	2nd Crop	Total
NK 125 E	83.5	69.2	44.0	113.2	71.0	60.3	131.3
NB 505 E	73.2	72.3	42.8	115.1	71.6	59.0**	132.1
RS 610 M	101.3	97.8	43.1	140.9	97.1	77.7**	174.8
OK 612 M	99.1	96.0	30.4	126.4	93.5	65.4**	159.0
OK 632 L	98.4	99.4	38.4	138.8	96.0	57.6**	153.6

*E denotes early, M denotes medium, and L denotes late.
**Estimates of yield.

basis of the yield of NK 125. "It is recognized that these figures are not accurate but allowances have been made so that over-estimates is improbable." The yields were scaled according to maturity. The second crop of NK 125 was 85 percent that of the first. Entries, NB 505, RS 610, OK 612, and OK 632, were calculated as 83, 80, 70, and 60 percent of the first crop of each, respectively. The later maturing ones were scaled lower because of frost damage and general appearance of reduced yield. The first killing freeze was later than normal which allowed OK 612 and 632 to produce the second crop. It is doubtful that these entries could produce grain every year. RS 610 was not hindered by frost but under normal conditions the timing would be close. It is probable, however, that a second crop of wet grain could be obtained from RS 610 in most years. Two-crop yields with RS 610 were approximately 75 bushels greater than that of the single crop. Two-crop yields of early entries were increased only by about 30 bushels over the yield of the highest normal entry.

The cost of producing the second crop is shown in Table VII. Fixed costs were not included since these were necessary regardless if the second crop was produced. The irrigation cost figure represents fuel, repairs, and labor. Other costs figures were taken as custom rates for the Perkins area (17).

TABLE VII

COST ANALYSIS OF A RATOON CROP OF GRAIN PRODUCED
FROM THE GRAIN SORGHUM HYBRID RS 610
PERKINS, 1965

Item		Cost ($/Acre)
1. Irrigation; 7.8 in. @ $2.50/Ac-In.		19.50
2. Fertilizer; 100 lbs. N @ $.10/lb.		10.00
3. Fertilizer application		1.50
4. Cultivation; 1 time		1.50
5. Spraying; 4 times @ $3.00/Acre		12.00
6. Combining		4.50
7. Hauling; 78 bu. @ $.05 per Bu.		3.90
8. Grain drying; 78 Bu. @ $.02 per Bu.		1.56
9. Stalk cutting		1.50
	Total	$55.96
Chopped Method; RS 610 78 Bu. grain @ $1.75 cwt.		76.44
	Net gain	20.48
Headed Method; RS 610 Total cost less 2 sprayings, stalk cutting, and grain drying.		46.40
40 Bu. grain @ $1.75 cwt.		39.20
	Net Loss	$-5.36

RS 610 was used in cost comparisons since it produced the greatest amount of grain in both harvesting methods. The net gain for the chopped treatment was $20.48 per acre but a loss of $5.36 was incurred with the headed treatment. The costs of stalk cutting, grain drying and two sprayings were not included in the headed treatment since these were only necessary for the chopping method of harvest. Greater losses were incurred with the early maturing hybrids.

Second-crop test weight and protein percentage results generally agree with that of 1964 (Tables IV and VIII and V and IX). The second-crop test weights were slightly lower than first-crop weights and protein percentage was equal to or slightly higher. First and normal-crop test weights, however, were different from those of the previous year. In 1964 test weights from the grain of the early-planted crop were higher than those of the normal crop. The reverse was generally true for the 1965 crops.

TABLE VIII

AVERAGE TEST WEIGHT IN POUNDS PER BUSHEL FOR THREE MATURITY GROUPS OF GRAIN SORGHUM, PLANTED ON TWO DATES WITH DIFFERENT HARVESTING TREATMENTS, PERKINS, 1965

Entry*	Normal	Headed		Chopped	
		1st Crop	2nd Crop	1st Crop	2nd Crop
NK 125 E	56.0	53.0	53.0	53.5	53.5
NB 505 E	58.5	58.0	57.0	58.0	--
RS 610 M	57.0	56.0	51.5	57.0	--
OK 612 M	57.5	58.0	55.0	58.0	--
OK 632 L	57.5	57.0	55.0	57.0	--

*E denotes early, M denotes medium, and L denotes late.

TABLE IX

AVERAGE PROTEIN PERCENTAGE FOR THREE MATURITY GROUPS OF GRAIN SORGHUM, PLANTED ON TWO DATES WITH DIFFERENT HARVESTING TREATMENTS, PERKINS, 1965

Entry*	Normal	Headed		Chopped	
		1st Crop	2nd Crop	1st Crop	2nd Crop
NK 125 E	12.5	13.1	13.7	13.1	13.7
NB 505 E	12.5	10.6	13.1	11.9	--
RS 610 M	10.6	10.6	11.9	10.0	--
OK 612 M	10.0	10.0	12.5	10.0	--
OK 632 L	10.6	10.6	12.5	10.6	--

*E denotes early, M denotes medium, and L denotes late.

Plant height comparisons showed a reverse trend to those of 1964. The recovery growth of the chopped treatments was little different from that of the first or normal crops as contrasted to the 2- to 15-inch increase in the past year. Climatic conditions did not deviate far from normal during the growth of these plants. This further indicated that the reduced temperature and cloudy skies during the growth of the previous crop may have caused the increased height (Table X).

More days to bloom were again required for the early planted material than the normal (Tables II and XI). Recovery growth data from the two years were also comparable but normal crops appeared different. The previous year's normal crop required approximately 6 to 11 more days to bloom. The increased days to bloom in 1964 may have been due to the earlier planting date. The 1965 crop was planted 10 days later.

TABLE X

AVERAGE PLANT HEIGHT IN INCHES FOR THREE MATURITY GROUPS OF GRAIN SORGHUM, PLANTED ON TWO DATES WITH DIFFERENT HARVESTING TREATMENTS, PERKINS, 1965

Entry*	Normal	Early Plant	Headed	Chopped
NK 125 E	53	49	48	52
NB 505 E	53	49	49	51
RS 610 M	57	53	54	54
OK 612 M	48	47	46	48
OK 632 L	57	56	55	58

*E denotes early, M denotes medium, and L denotes late.

TABLE XI

AVERAGE DAYS FROM PLANTING TO FIRST BLOOM FOR THREE MATURITY GROUPS OF GRAIN SORGHUM, PLANTED ON TWO DATES WITH DIFFERENT HARVESTING TREATMENTS, PERKINS, 1965

Entry*	Normal	Early Plant	Headed	Chopped
NK 125 E	43	54	25	35
NB 505 E	44	56	28	38
RS 610 M	47	60	29	40
OK 612 M	49	63	30	41
OK 632 L	52	67	32	44

*E denotes early, M denotes medium, and L denotes late.

CHAPTER V

SUMMARY AND CONCLUSIONS

The possibilities of double harvesting grain sorghum in Oklahoma were investigated at Perkins in 1964 and at Perkins and Tipton in 1965. All experiments were conducted under irrigation and high rates of fertilization. The factors of concern in this study were: 1. the comparison of hybrids and a variety of different maturity groups as to their ability to produce a ratoon crop of grain, and 2. the comparison of yields, protein percentages, test weights, days to first bloom, and plant heights from two methods of double harvesting with single harvesting.

Nine hybrids and one variety from three different maturity groups were selected and screened in a preliminary test in 1964. Five hybrids, two early (NK 125 and NB 505), two medium (RS 610 and OK 612), and one late (OK 632), were retained for the 1965 experiment.

Grain yields were low in 1964 due to cultural and climatological factors. Two crops were produced from all entries of the headed treatments but the second-crop yields were low. Only the early maturing entries escaped frost under the chopping method of harvest. The second crop of the chopped treatment required approximately ten days longer to bloom than that of the headed treatment but was higher in yield and more uniform in height. Second-crop grain was generally lower in test weight but higher in protein percentage than the first or normal crop. Two-crop yields exceeded the highest single crop only slightly.

Grain yields were favorable in 1965 and two crops were produced by all entries at Perkins. The Tipton experiment was abandoned due to heavy infestations of sorghum midge. Yields were higher in the chopped than headed treatments at Perkins. An increase above the normal crop of approximately 75 bushels with RS 610 was obtained in the first case while only 40 bushels in the latter. Cost analyses indicated that a net gain of $20.48 per acre was obtained with the second crop with the chopped method of harvest, but a loss of $5.36 was obtained with the headed method. Greater loss was incurred with early hybrids in both methods.

Double harvesting of grain sorghum was found possible at Perkins, Oklahoma, yet the risk involved was great. There was chance of loss from early planting and an even greater chance of loss from sorghum midge. The system required close observation with accurate timing in harvesting and insect control. Also, a hybrid with yield potential such as RS 610 was necessary for profit. In light of this it would be impractical to advocate such a system without further investigation.

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APPENDICES

APPENDIX A

DESCRIPTIONS OF THE SORGHUM ENTRIES

NK 125, a hybrid developed by Northup King and company of Lubbock, Texas. The parentage of this and other commercial hybrids is not known since commercial companies maintain a closed pedigree system. In Oklahoma NK 125 attains an approximate height of 47 inches and reaches the mid-bloom period in about 50 days (10).

NB 505, a hybrid developed by the Nebraska Agriculture Experiment Station. It will reach mid-bloom about five days earlier than RS 610 and attain a height of about 47 inches (8,9,10).

Dekalb Shorty 33, a hybrid developed by the DeKalb Agricultural Associations, Incorporated of Lubbock, Texas. This is an early maturing hybrid as are NK 125 and NB 505. It reaches mid-bloom in about 52 days in Oklahoma and attains a height of 48 inches.

RS 610 is a regional hybrid from Combine Kafir-60 x Combine 7078. In Oklahoma it attains an approximate height of 46 inches and reaches the mid-bloom date in about 58 days (7,8,9,10).

Genetic Giant R103, a hybrid developed by the Steckley Hybrid Corn Company of Lincoln, Nebraska. Its height and bloom date are comparable to RS 610 (7).

OK 612 is a hybrid from Wheatland x OK RY8. It is a hetro-yellow endosperm type released by Oklahoma. It will reach an approximate height of 43 inches and reach the mid-bloom period in about 60 days

(7,8,9,10).

Combine 7078, a milo-type variety from Texas which reaches mid-bloom in about 58 days in Oklahoma. It will grow to an approximate height of 40 inches.

OK 632, a hybrid from Redlan x OK RY8, is a hetero-yellow endosperm type released by Oklahoma. It will reach an approximate height of 48 inches with a mid-bloom date of 62 days (7,8,9,10).

Lindsey 788 is a hybrid developed by the Lindsey Seed Company of Lubbock, Texas. In Oklahoma Lindsey 788 attains an approximate height of 47 inches and reaches the mid-bloom period in about 65 days (6,7,8).

NK 310, a hybrid developed by Northup King and Company. It reaches mid-bloom in about 67 days and attains an approximate height of 50 inches (6,7,8).

APPENDIX B

1964 and 1965 CULTURAL DATA

FOR PERKINS AND TIPTON

Table 1

Cultural Data

Perkins, Oklahoma, 1964

Pre-plant fertilization;	
200 lbs. 12-24-12/acre	April 1
Planting;	
Double-harvest crop	April 18
Normal crop	May 28
Side-dress fertilization;	
40 lbs. nitrogen/acre	Boot stage
Corrugation and irrigation; 4 inches	June 24
Irrigation; 3.5 inches	July 8
Irrigation, 3.5 inches	July 23
First harvest;	
Early entries	July 27-28
Medium entries	August 5-10
Side-dress fertilization to stubble;	
100 lbs. nitrogen/acre	August 10
Irrigation; 3.5 inches	August 10
Normal-crop harvest	September 20
Frost; 29°F.	October 20
Recovery-crop harvest	November 12

Table 2

Cultural Data

Perkins, Oklahoma, 1965

Pre-plant fertilization; 400 lbs. 12-24-12/acre	March 23
Planting;	
Double-harvest crop	April 23
Normal crop	June 7
Side-dress fertilization; 69 lbs. nitrogen/acre	
Double-harvest crop	June 16
Normal crop	July 12
Corrugation and irrigation; 4.2 inches	July 1
Irrigation; 4.0 inches	July 16
First harvest;	
Early entries	July 23
Medium entries	July 30
Late entries	August 6
Irrigation; 4.0 inches	August 10
Irrigation; 3.8 inches	September 12
Normal-crop harvest	September 25
Recovery-crop harvest	October 28
Frost 24°F.	November 27

Table 3

Cultural Data

Tipton, Oklahoma, 1965

Pre-plant fertilization	
400 lbs. 12-24-12/acre	March 15
Planting;	
Double-harvest crop	April 29
Normal crop	June 10
Irrigation; 2.5 inches	June 10
Side-dress fertilization; 75 lb. nitrogen/acre	
Double-harvest crop	June 14
Normal crop	June 29
Irrigation; 2.5 inches	June 30
First harvest	
Early entries	July 21
Medium entries	July 25
Late entries	August 1
Irrigation; 2.5 inches	July 22
Irrigation; 2.5 inches each	August 3 and 26
Irrigation; 2.5 inches	September 14
Normal-crop harvest	September 28

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