The relative ripening rate of the grain and straw of ten varieties of oats
by Frank C Petr

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Agronomy
Montana State University

Abstract:
Ten varieties of oats were compared for rapidity of dessication of the straw following maturity of the grain at Bozeman in 1951. Moisture content of the grain and straw was determined at nine consecutive 3-day intervals commencing 30 days after the heading date of each variety. The oat varieties were assigned maturity ratings of early, midearly, midseason, midlate, and late on the basis of heading date.

The moisture content of the straw decreased slowly at successive stages and remained relatively high for all varieties throughout the experiment. No significantr differences in straw moisture at the final harvest were evident between varieties. The moisture content of the grain receded rapidly in all the varieties during the first four 3-day intervals. During the 24 days between the first and final harvest of each variety the grain moisture decreased from an average of 43.2 percent to 17.0 percent. The developmental period of the kernel apparently was shorter in Maganski 044 than in the other varieties in the test as indicated by the tendency of the grain to start dessicating in a shorter time after heading.

Differential shattering resulting from hail was observed. Mission and Aberystwyth S84 were most resistant. Mission apparently derived its shatter resistance from its Markton parent, which was. observed to have such resistance by another investigator, Late tiller counts were made days after heading. Early Varieties produced significantly more tillers than the late varieties. However, varieties with a tendency to produce late tillers did not differ in straw moisture content. Significant differences in height of the varieties were also noted, but had no apparent effect on the ripening characteristics of the straw.

THE RELATIVE RIPENING RATE OF THE GRAIN
AND STRAW OF TEN VARIETIES OF OATS

by

FRANK C. PETR

A THESIS

Submitted to the Graduate Faculty

in

partial fulfillment of the requirements

for the degree of

Master of Science in Agronomy

at

Montana State College

Approved:

Head, Major Department

Chairman, Examining Committee

Dean, Graduate Division

Bozeman, Montana
September, 1952

ACKNOWLEDGEMENTS

The writer wishes to acknowledge the assistance given him by Mr. R. F. Eslick. His advice and encouragement throughout the course of the study are gratefully appreciated. The writer also wishes to thank Dr. A. H. Post, Dr. E. R. Hehn, and other persons who contributed time and advice.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX TABLES

ABSTRACT

Ten varieties of oats were compared for rapidity of dessication of the straw following maturity of the grain at Bozeman in 1951. Moisture content of the grain and straw was determined at nine consecutive 3-day intervals commencing 30 days after the heading date of each variety. The oat varieties were assigned maturity ratings of early, midearly, midseason, midlate, and late on the basis of heading date.

The moisture content of the straw decreased slowly at successive stages and remained relatively high for all varieties throughout the experiment. No significant differences in straw moisture at the final harvest were evident between varieties. The moisture content of the grain receded rapidly in all the varieties during the first four 3-day intervals. During the 24 days between the first and final harvest of each variety the grain moisture decreased from an average of 43.2 percent to 17.0 percent. The developmental period of the kernel apparently was shorter in Maganski 044 than in the other varieties in the test as indicated by the tendency of the grain to start dessicating in a shorter time after heading.

Differential shattering resulting from hail was observed. Mission and Aberystwyth S84 were most resistant. Mission apparently derived its shatter resistance from its Markton parent, which was observed to have such resistance by another investigator.

Late tiller counts were made 51 days after heading. Early varieties produced significantly more tillers than the late varieties. However, varieties with a tendency to produce late tillers did not differ in straw moisture content. Significant differences in height of the varieties were also noted, but had no apparent effect on the ripening characteristics of the straw.

INTRODUCTION

In the production of oats, as compared to wheat and barley, considerably greater losses result when the grain is left standing until it reaches a stage suitable for combine harvest. To a large extent, these losses can be attributed to shattering after the grain is mature and low enough in moisture content for satisfactory storage but with the straw too green for successful combining.

It has been observed that drying of the culms and leaves of wheat and barley generally proceeds simultaneously with the ripening of the grain while in oats, the grain and straw tend to react independently in this respect or, at least, the rate of dessication is much slower for the vegetative portions than for the grain.

Various environmental factors have been cited as affecting ripening of oats and other crops (9)[1/]. Therefore, it would appear desirable to develop varieties of oats that ripen due to some internal stimulus inherent in the plant and operating with little or no regard to external conditions. This property appears to be present to some extent in common wheat and certain other crops in which definite ripening occurs even during periods when climatic conditions are not considered favorable for ripening to take place.

The object of this investigation was to determine the relationship of grain and straw moisture as the grain approaches maturity, and to investi-

1/ Numbers in parenthesis refer to "Literature Cited", page 35.

gate possible varietal differences in straw dessication which could be utilized in the development of oats with the qualities necessary to overcome this harvest problem. Since resistance to shattering is also an important factor in combine harvesting, observations were made to determine varietal differences in this respect.

Late varieties as well as tall varieties of oats with a large amount of vegetative growth are sometimes thought to have a slower ripening process than varieties which head earlier in the season or short varieties that produce little foliage. A correlation between rapidity of straw dessication and such readily observable characteristics as height of straw or heading date, could likewise be of value to the plant breeder.

To avoid possible confusion, some of the terminology used in this paper will be explained at this point. "Maturity" will denote the time at which the maximum amount of dry matter has been accumulated in the plant or in a plant organ such as the caryopsis. "Ripening" will be used in reference to the dessication process commencing at maturity and possibly before maturity of either the seed or the foliage. The grain is considered ripe when its natural moisture content recedes to 16 percent, which is the maximum moisture percentage allowed in the four numerical market grades of cultivated oats (19). Since no general standard is available, 25 percent moisture, other than that absorbed from the atmosphere, is considered the upper limit for ripe straw.

LITERATURE REVIEW

To date there are but few papers published on harvesting problems encountered in the production of oats. An intensive search of the literature has disclosed none in which the moisture relationships of oat straw and grain have been studied. Much of the literature dealt with effects of varying degrees of maturity on such factors as germination, yield, frost resistance, and chemical composition with reference to feed value of the grain and straw. However, some of the findings are pertinent to this problem and will be reviewed accordingly.

Burnett and Bakke (7) studied the effects of delayed harvest on yield of grain in Iowa in 1930. Their results show that oats and barley are more susceptible to shattering losses resulting from delayed harvest than is wheat.

Rather (17) reported on studies of the effects of delayed harvest which were started by Wilsie and Brown at the Michigan Agricultural Experiment Station in 1931. Using the same crops, they obtained results similar to those of Burnett and Bakke. One phase of the Michigan experiment involved the comparison of Markton, Worthy, Wolverine, and Iogold oats. The results are best expressed in the summary by Rather in which he states, "Of the varieties tested, none appeared to have any special advantage for combine harvest as standing grain. Markton oats was the least susceptible to shattering but had the weakest straw." Bushel weights of oats decreased rapidly when harvest was delayed and such losses were greater in oats than in barley. The moisture content of the straw was not reported for this experiment or for the one by Burnett and Bakke cited previously.

Kedzie (13) compared the chemical composition with reference to feeding value of wheat straw and grain harvested on 46 consecutive days. Moisture content, however, was not determined for either the grain or the straw. He found that wheat straw deteriorated much more rapidly in nutritive value and composition than did the grain.

The moisture content of wheat foliage at flowering was studied by Hurd-Karrer and Taylor (12) to test the contention that the moisture content of the vegetative portions of the wheat plant drops suddenly after flowering. They found no evidence of a maximum water content at flowering nor of a sudden water loss after fertilization of the florets had occurred. In general, their results indicated that the water content of the leaves was decreasing from the time the experiment commenced. This was nine days prior to anthesis in Kanred winter wheat and four days before anthesis in Purplestraw No. 1 wheat. A decrease in moisture content of the foliage was usually more closely associated with hot dry days than with any particular stage of maturity.

Bakhuzen (1) measured the moisture content in various parts of wheat plants when grown under constant conditions. He found there was a definite increase in dry matter immediately after flowering. This was not in agreement with the findings of Hurd-Karrer and Taylor (12). However, the conditions of Bakhuzen's experiment apparently were not natural as each plant produced only one culm, and flowering commenced about thirty days after the plants emerged.

Percival (16) at Reading, England, observed that in wheat, the ripening process of the grain and straw proceeded at about the same rate. He found the time between "earing and ripening" to be usually from 55 to 63 days.

Numerous studies (2,3,4,5,6,10,11,20) on the development of the oat kernel as well as similar studies on wheat and barley have been published. There is quite general agreement on the ripening processes occurring from flowering to maturity of the grain.

Booth (4) made a detailed study of the daily growth of Gopher oat kernels from pollination to maturity. Flowering lasted for about eight days starting with the terminal florets and progressing downward. The kernels in the spikelets originating from the lowest whorl were in the late dough stage when the apical spikelets were ripe. The green weight increased rapidly for 13 days and after 15 days there was a marked decline in green weight. Dry weight increased more rapidly than green weight during this period indicating a decrease in moisture percentage.

According to Booth (4), the developmental period of the kernels continued for 15 days after pollination and was concluded when the glumes of the apical spikelet became straw colored. General ripening was completed in 4 days. During this time, the lemma and palea became a uniform straw color and moisture decreased from 41.47 to 21.00 percent. No observations on straw moisture were made as the primary interest was in the effect of immaturity and frost on the germination of the grain.

Wilson and Raleigh (22) studied the changes occurring in Victory oats as it approaches maturity. They found that dry matter percentages of all parts of the oat plant increased with approaching maturity. This is similar to their results with wheat, although the moisture content of the oat plant averaged considerably higher from milk stage to maturity than was true for wheat. Twelve days prior to maturity, the kernels and glumes contained about 39.5 percent dry matter. This increased to 81.3 percent dry matter when the oats was considered mature. The vegetative parts at the same stages of maturity averaged 25.9 percent and 66.9 percent dry matter respectively. The experiment was carried on in a severe rust season. Therefore, the dessication of the leaves may have been more pronounced than under normal conditions.

Harland and Pope (11) studied the moisture level of the barley kernel from flowering to maturity. They report that no further increase in dry matter occurs when the moisture content of the kernel falls below 42 percent. They likewise considered this the end of the developmental period and noted that dessication proceeded rapidly after that moisture level occurred. Volume of the kernel began to decrease at the end of the developmental period and continued to decrease throughout the ripening process.

The effect of certain mineral nutrients was studied by Noll (15) and McClelland (14). Several nutrients apparently induced earlier ripening of oats when applied to areas deficient in those nutrients. Noll reported phosphorus was outstanding in this respect. However, earliness could not be forced by applications greater than the amount needed to obtain maximum yields. At the Ohio Experiment Station (14), acid phosphate had more effect on promoting earliness than rock phosphate or basic slag even where yield response was the same. Further investigations showed that the influence on earliness varied with yield response when low and moderate applications were used. The effect of phosphorus on the moisture content of the straw was not investigated in any of several papers dealing with the effect of phosphorus on maturity.

Describing the difficulties in determining maturity of cereal crops, Caporn (8) states, "The ripening of cereal crops is a characteristic which is very difficult to study from either a physiological standpoint or from a genetic point of view. Observations are usually made by 'eye' and are usually not based on any type of exact test. Probably the greatest obstacles confronted in any of several types of experiments on ripening of cereal crops are the influence of climate and soil."

According to Graber and Ahlgren (9), cool weather encourages the development of basal buds, whereas hot and dry weather reduces and sometimes eliminates all tillering. Delayed harvest due to uneven ripening is usually attributed to the development of additional tillers shortly before or after the emergence of floral heads.

Burnett and Bakke (7) states that physiological properties have an important role in ripening and that sugars and proteins determine the water relations of cells. Amino acids and glutenin found in wheat have great moisture retention properties which extend the ripening period of the grain.

In 1917, Caporn (8) studied the heredity of early and late ripening in a cross of Mesdag and Hopetown. The two varieties differed in ripening time by approximately 18 days. The progeny of the cross ranged in ripening time from that of the earlier variety to the later. His analysis of the data indicated that inheritance was based on three factors. Color of the palea was used as a criteria of ripening. Moisture content of the kernels was not determined and the condition of the straw at the time the kernels were considered ripe was not mentioned.

MATERIALS AND METHODS

Six varieties and four unnamed selections of oats were used in this experiment. These were divided arbitrarily into groups according to heading dates. Table I gives the heading date, source, and other pertinent information on each of the oats included in this experiment. In this paper future references to varieties will be by name and unnamed selections will be referred to by number as indicated by an asterisk in Table I.

The oat varieties used in this experiment were grown on the Agronomy and Soils Department farm located near Bozeman. The soil, classified as Huffine silt loam, was of good fertility and received no fertilizer treatment. The plots received only one light irrigation during the season applied on July 16 after all the varieties were headed out. Although precipitation was below normal for June and July, the plants did not at any time show symptoms of moisture deficiency. Climatic data is shown in Appendix Table I.

The oats were grown in four-row plots ten feet long with one-foot spacing between rows to permit hand cultivation for weed control. The seeding rate used for all varieties was 80 pounds per acre. A single-row push-type belt drill was used for seeding the plots. The experimental design was a randomized complete block replicated six times. This provided sufficient material for harvesting samples at nine stages of ripening. Duplicate samples each consisting of plant material from two feet of row were harvested from each plot at three-day intervals.

Table I. Source, maturity rating and principle area of production or development of the varieties and selections included in the oat ripening experiment at Bozeman, 1951.

Name of Variety	C.I. 1/ or Selection Number	Principle Area of Production or Development	Varieties Involved in Parentage	Maturity Rating	Date Headed
Reselect Clinton*	C.I. 4969	Iowa	Bond, Richland, Green Russian	Early	7-3
Gopher*	C.I. 2027	Minnesota	Sixty Day	Midearly	7-6
Mission*	C.I. 2588	Montana	Markton, Victory	Midseason	7-9
(Unnamed)	C.I. 4283*	Idaho	Victoria, Richland, Markton, Victory	Midseason	7-9
(Unnamed)	2795-11-5*	Canada	Alaska, Golden Rain, Hajira, Banner	Midseason	7-9
(Unnamed)	C.I. 6611*	Montana	Bond, Green Russian, Victoria, Richland, Markton, Victory	Midlate	7-12
(Unnamed)	AB5989*	Idaho	"	Midlate	7-12
Bridger*	C.I. 2611	Montana	Markton, Victory	Late	7-15
Maganski 044*	C.I. 4514	Russia	Unknown	Late	7-14
Aberystwyth S84*	C.I. 3549	England	Unknown	Late	7-16

*Denotes name or number used in this paper when referring to the variety.

1/ "Cereal Investigations" number assigned by U.S.D.A.

The first harvest was made thirty days after the heading date of each variety with subsequent harvest at three-intervals as shown in Appendix Table II. Previous observations on Gopher and Bridger oats indicated that at this stage the apical florets had turned from a green to a yellow color and the glumes subtending the apical florets showed only faint traces of green.

Samples were harvested at 9 A.M. except on two dates when showers made it necessary to postpone sampling until mid-afternoon to permit drying of the foliage. According to Willard (19) rain or dew have little immediate effect on the moisture content of foliage providing that the surface moisture adhering to the leaves had been allowed to evaporate.

A hand sickle was used to harvest the oats leaving less than one inch of stubble. This was done in preference to using the normal height of harvest to avoid possible error. Otherwise it would have been necessary to leave stubble of a height proportional to the height of the variety in order to obtain a comparable estimate of straw moisture. Harvesting at a height of twelve inches would have resulted in a lower moisture content for the short varieties as the oats appeared to be greenest near the base.

Three of the six replications were harvested at one time and processed immediately to prevent excessive dessication between harvest and weighing. The material was tied in bundles and marked with the plot number and stage of harvest for future reference. A Fairbanks-Morris spring scale was used for all weight determinations. One sample, which had been marked with "A" at harvest, was weighed green and again after oven-drying. The duplicate sample, marked "B", was weighed green and threshed with a Vogel head thresher. Even at the earliest harvest date no difficulty was encountered in threshing the oats. The rachis and pedicels generally remained intact and the glumes were easily separated from the kernels by the air blast. The threshed seed was weighed immediately and put in the drying oven until a constant weight was attained. Drying was accomplished with an electric oven equipped with a fan.

The total moisture and the grain moisture percentages were determined from the decrease in weight of the respective samples. From this data the straw moisture was readily calculated. A random check on several samples indicated that the calculated straw moisture percentage varied only slightly from the figure obtained when actual green and oven dry straw weights were used to determine the percentage of moisture in the straw.

Late tiller counts were made at the eighth stage of harvest for each variety. At this stage the panicles on the main culms and early tillers were completely lacking in chlorophyll while the late tillers were entirely green and the kernels were still in the early stages of formation. Late tillers occurring in sections of row four feet long were counted in each of the six replications.

Test weights of each variety were determined for each stage of maturity. These were originally intended to serve as a criteria of maturity of the grain. In order to have sufficient material for test weight determinations, it was necessary to bulk the grain obtained from the six replications harvested at a given stage. A standard test weight apparatus was used in determining the bushel weights.

EXPERIMENTAL RESULTS

The moisture content of the grain and straw at nine successive stages of ripening is given in Tables II and III respectively. Grain moisture dropped rapidly to a low level by the fourth stage of harvest and then remained relatively stable during the remainder of the experiment. At the first stage of ripening (30 days after heading), the average moisture content ranged from 36.4 percent for Maganski 044 to 48.1 percent for Reselect Clinton oats. The straw moisture receded more slowly and somewhat more uniformly than the moisture content of the grain. The lowest straw moisture at the first stage of ripening was 68.8 percent for AB5989 while Aberystwyth S84 had a high moisture percentage of 75.7.

At the fourth stage of ripening (39 days after heading), Aberystwyth S84 still showed the highest straw moisture content of 73.1 percent while Maganski 044 was lowest in this respect with a moisture percentage of 65.2. Maganski 044 likewise had the lowest grain moisture content of 16.8 percent while Reselect Clinton was highest with a moisture percentage of 28.6 percent.

At the ninth and final harvest, occurring 54 days after heading, the percentage of moisture in the straw varied from 61.4 percent for C.I. 4283 to 66.0 percent for AB5989. At the final harvest the grain showed a considerably wider variation between varieties, perhaps due to the climatic conditions on September 1, the last harvest date for the three varieties in the midseason group.

An upward trend in grain moisture was noted for all varieties harvested on August 29 and September 1. It is interesting to note that a similar increase in moisture content of the straw was not evident for the same dates. The last stage of harvest for Reselect Clinton occurred on August 26; consequently, this variety does not show the upward trend in grain moisture noted for the varieties harvested after that date.

Table II. Moisture content of the grain of ten varieties of oats at nine successive 3-day intervals at Bozeman, 1951.

Variety	Number of Days after Heading								
	30	33	36	39	42	45	58	51	54
Bridger	44.8	40.2	34.0	24.3	19.7	22.2	21.4	17.1	13.0
Aberystwyth S84	45.1	40.0	32.8	26.8	23.6	25.9	23.2	16.9	12.8
Maganski O44	39.4	28.9	19.7	16.8	14.5	19.8	20.8	15.0	10.7
C.I. 6611	44.3	39.1	31.1	24.2	19.5	17.9	22.1	22.3	18.1
AB5989	43.5	37.9	29.6	22.3	19.7	17.6	23.3	22.4	16.5
Mission	44.2	42.6	37.8	27.8	19.5	17.6	16.2	20.3	21.6
2795-11-5	42.6	40.9	36.3	22.7	17.3	17.6	16.3	19.3	21.5
C.I. 4283	40.8	40.2	33.7	23.8	18.9	17.4	16.7	19.6	22.5
Gopher	39.6	36.0	33.4	24.2	18.2	15.1	17.1	14.6	19.7
Reselect Clinton	48.1	40.9	30.8	28.6	21.1	13.3	12.8	16.2	13.1
Average	43.2	38.7	31.9	24.1	19.2	18.4	19.0	18.4	17.0

Table III. Moisture content of the straw of ten varieties of oats at nine successive 3-day intervals at Bozeman, 1951.

Variety	Number of Days after Heading								
	30	33	36	39	42	45	48	51	54
Bridger	73.1	71.8	68.6	68.9	69.0	66.1	65.5	64.8	63.3
Aberystwyth S84	75.7	69.4	68.6	73.1	69.5	67.6	62.9	66.1	63.8
Maganski O44	71.4	69.1	62.6	65.2	65.2	61.9	60.8	63.8	62.9
C.I. 6611	70.7	72.9	71.0	67.8	68.6	65.6	67.7	63.0	64.6
AB5989	68.8	73.1	69.7	66.5	68.1	66.8	68.0	64.1	66.0
Mission	72.6	70.8	71.2	68.7	68.0	68.9	64.6	64.8	61.8
2795-11-5	70.0	72.8	72.5	68.8	69.2	68.3	66.5	66.2	63.1
C.I. 4283	71.9	71.1	71.4	67.8	65.8	67.3	65.2	65.3	61.4
Gopher	71.8	71.4	71.7	70.0	68.0	65.8	67.0	63.5	64.6
Reselect Clinton	70.5	68.1	71.4	67.9	67.5	67.3	66.8	62.8	64.2
Average	71.7	71.1	69.9	68.5	67.9	66.6	65.5	64.4	63.6

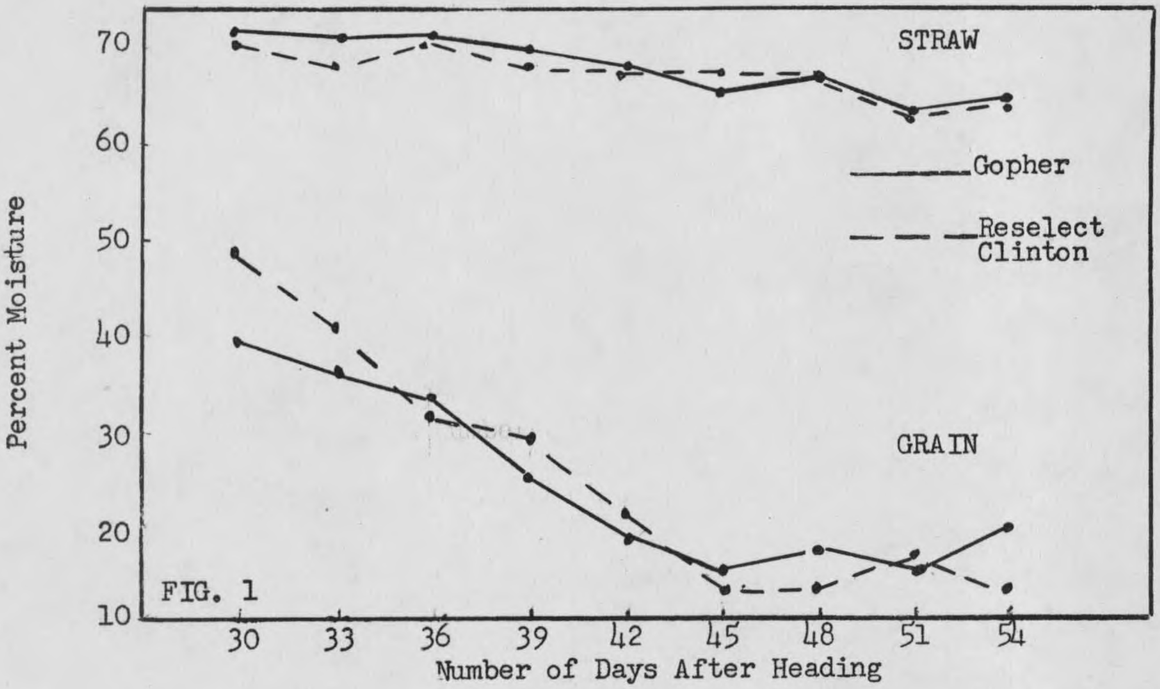
An analysis of variance of the straw moisture percentage at the final harvest is given in Table IV. No significant difference was indicated between varieties or replications when the "F" test was applied. Statistical analysis of the grain moisture data for the final harvest was not attempted because of the apparent effect of environmental conditions on a portion of the data.

Table IV. Analysis of variance of straw moisture percentages at the ninth harvest of the ripening experiment.

Variation due to:	d.f.	M.S.	"F" ratio
Replications	5	81.67	1.076 N.S.
Varieties	9	113.76	1.499 N.S.
Error	45	75.88	
Total	59		

Graphs in Figures 1 - 4 show the trend of the moisture content of the grain and straw at successive stages of harvest for each maturity group. It is evident that the moisture content of the grain receded at a much faster rate than the decline of moisture in the culms and leaves.

Except for 0.99 of an inch of rain occurring on August 4 (two days after the experiment was started), environmental conditions during the first 20 days of the experiment were ideal for ripening. No high winds occurred during this period and the temperature was moderately warm but not sufficiently hot to cause premature dessication of the grain or the foliage. However, prior to the fifth harvest for the three late varieties and before the final harvest for the earliest variety (Reselect Clinton),



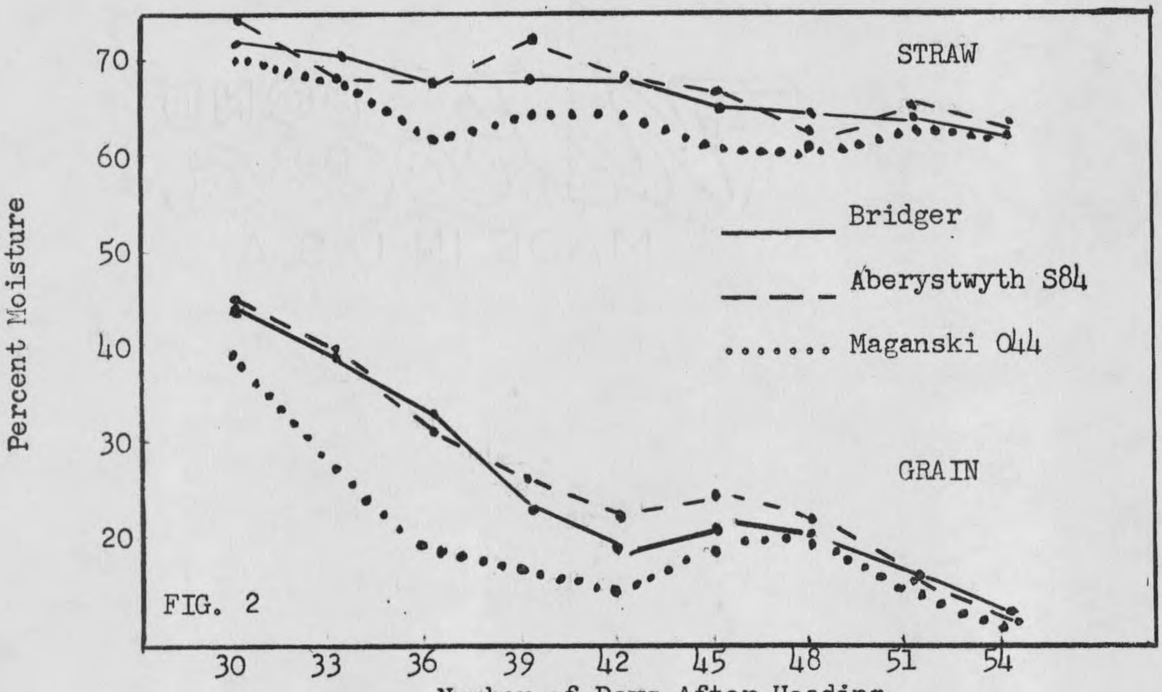
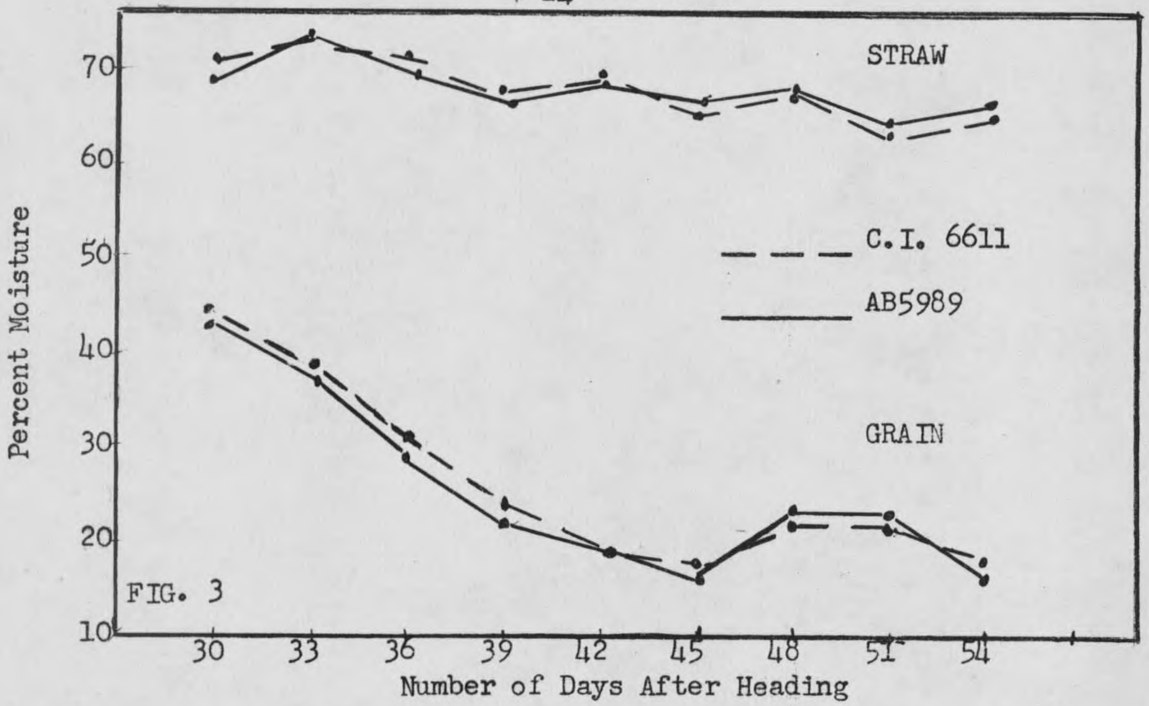


Figure 1. Moisture content of the grain and straw of Reselect Clinton and Gopher oats.

Figure 2. Moisture content of the grain and straw of the three late varieties of oats.



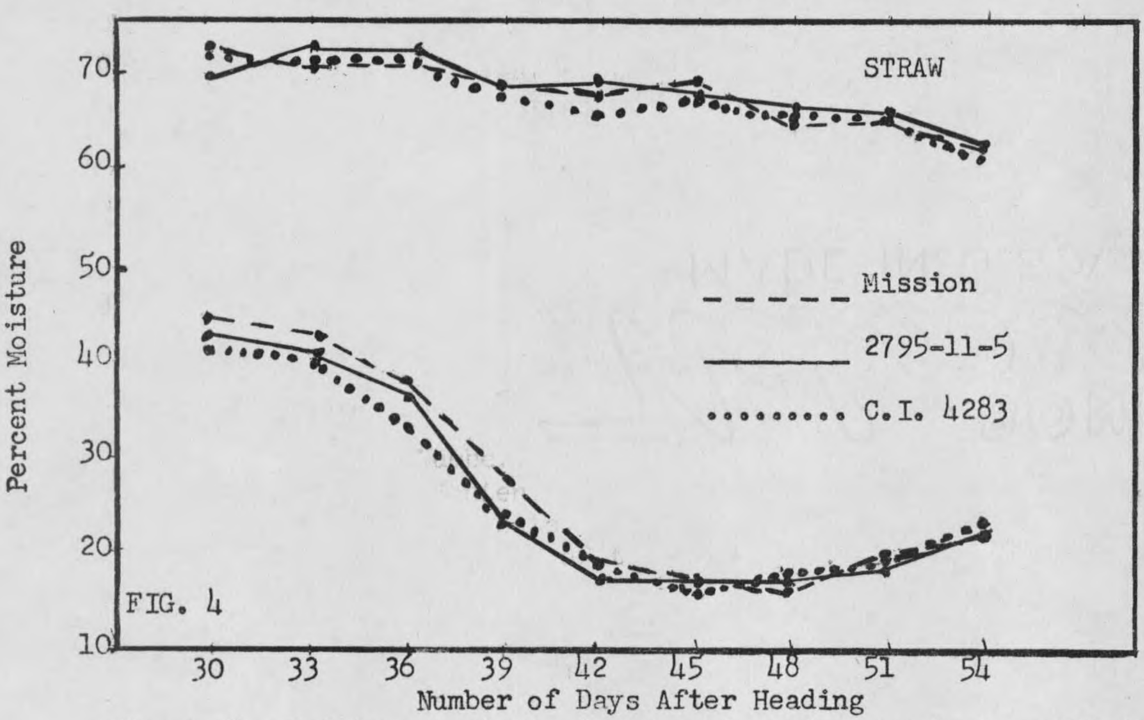


Figure 3. Moisture content of the grain and straw in two midlate varieties of oats.

Figure 4. Moisture content of the grain and straw in three midseason varieties of oats.

rain and hail occurred causing considerable shattering of the grain. Mission and Aberystwyth S84 showed the highest degree of resistance to shattering while Reselect Clinton and Maganski O44 were most severely damaged. Reductions in yield attributed to the hail are shown in Table V. Actually the hail was rather mild because damage to wheat and barley in neighboring plots was slight. At the time the hail occurred, the moisture content of the grain of all the oat varieties was down to 20 percent or less except for Bridger and Aberystwyth S84, which may account for the severity of the damage.

Table V. Reductions in oat yields resulting from hail on August 23, 1951 at Bozeman.

Variety	Number of Days After Heading	Grain Moisture at Harvest Prior to Hail	Percent Reduction in Yield
Bridger	39	24.3	41.3
Aberystwyth S84	39	26.8	32.1
Maganski O44	39	16.8	50.1
C.I. 6611	42	19.5	40.5
AB5989	42	19.7	45.8
Mission	45	17.6	33.9
2795-11-5	45	17.6	44.8
C.I. 4283	45	17.4	41.2
Gopher	48	15.1	44.5
Reselect Clinton	51	12.8	51.4

Late tiller counts made at the eighth stage of ripening (51 days after heading) for all varieties are given in Table VI. The analysis of variance in Table VII indicates that Reselect Clinton produced significantly more late tillers than other varieties in the test except Gopher, C.I. 4283, and 2795-11-5. The late group of oats produced significantly less tillers than

Reselect Clinton, Gopher, and C.I. 4283. As already mentioned in the experimental procedure, the late tillers were readily distinguished from the early tillers by their over-all green color. Visual observation about three weeks after the original tiller counts revealed that no change in the tendency to produce late tillers had occurred in any of the ten varieties in the test. Second growth or aftermath was much more prevalent on the plots occupied by the varieties which produced the greatest number of late tillers. Intervarietal variation in tendency to produce late tillers is evident from the tiller counts for different replications as shown in Table VI. This was probably due to soil heterogeneity.

Table VI. Number of late tillers in four feet of row in 10 varieties of oats 51 days after heading.

	Number of Late Tillers in Replication						
Variety	I	II	III	IV	V	VI	Average
Bridger	0	0	0	0	0	0	0.0
Aberystwyth S84	0	0	3	0	0	0	0.5
Maganski 044	2	4	2	3	0	0	1.8
C.I. 6611	7	3	5	11	4	4	5.7
AB5989	8	3	8	4	5	8	6.0
Mission	10	2	4	5	5	5	5.2
2795-11-5	6	4	7	9	9	9	7.3
C.I. 4283	5	8	6	15	7	7	8.0
Gopher	5	9	19	16	8	0	9.5
Reselect Clinton	8	25	14	15	18	0	13.3
$\bar{X}$							5.7
L.S.D. (1%)							6.2

Table VII. Analysis of variance of number of late tillers in four feet of row in 10 varieties of oats 51 days after heading.

Variation due to:	d.f.	M.S.	"F" ratio
Replications	5	23.51	1.50
Varieties	9	103.67	6.62**
Error	45	15.67	
Total	59		

**Significant at 1% level.

Bushel weights, reported in Table VIII, increased until the fourth or fifth harvest, then levelled off, and in most instances, decreased at the later stages. Seven of the ten varieties attained their maximum test weight at the fourth stage of harvest. At the fourth harvest, Maganski 044, Mission, and Aberystwyth S84 had test weights of 39 pounds per bushel, the highest attained during the experiment. C.I. 4283 attained a test weight of 39 pounds at the fifth harvest. Bridger and Gopher also showed an increase in test weight through the fifth harvest with 38.4 and 37.8 pounds per bushel respectively.

Table VIII. Test weights of ten varieties of oats at nine consecutive 3-day intervals commencing 30 days after heading.

	Number of Days after Heading								
Variety	30	33	36	39	42	45	48	51	54
Bridger	34.0	36.0	38.0	38.0	38.4	38.2	38.0	38.0	37.8
Aberystwyth S84	35.0	37.0	38.0	39.0	39.0	38.1	38.0	38.5	38.0
Maganski 044	35.5	38.0	38.7	39.0	37.0	37.0	37.1	36.7	37.2
C.I. 6611	35.0	35.5	37.0	38.0	38.0	37.9	37.3	37.9	37.9
AB5989	35.0	36.5	38.0	38.5	38.1	37.3	37.2	37.2	37.2
Mission	34.2	35.5	36.0	39.0	38.5	38.0	37.3	38.0	38.1
2795-11-5	35.5	36.0	36.0	38.3	38.0	37.8	37.0	37.3	37.0
C.I. 4283	35.5	35.5	37.0	38.0	39.0	37.2	36.8	36.5	36.5
Gopher	34.8	36.0	36.0	37.2	37.8	37.6	37.8	36.0	36.8
Reselect Clinton	34.0	36.0	37.5	38.0	38.0	37.5	37.5	36.9	37.2
Average	34.9	36.2	37.2	38.3	38.2	37.7	37.4	37.3	37.4