Effects of

SWATHING BARLEY

On Rate of Drying, Yield, Seed Quality

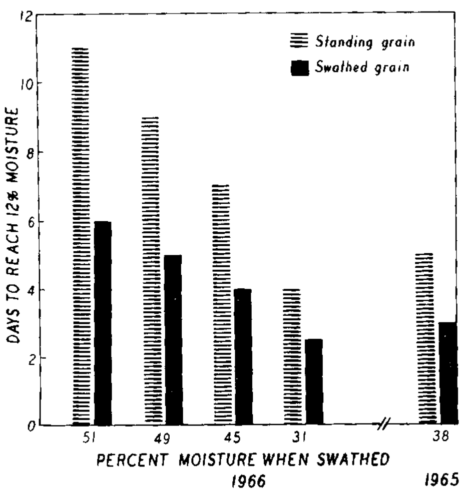
J. T. FEATHER · J. E. RUCKMAN · C. W. SCHALLER

Barley swathed within a moisture range of 51 to 31% was not significantly lower in protein content or germination potential, as compared with standing grain in these tests. However, yield reductions occurred at all cuttings within this range. Grain quality was related to the moisture content at which the crop was swathed. Results of moisture determinations based on whole-head samples agreed closely with results obtained on a kernel basis.

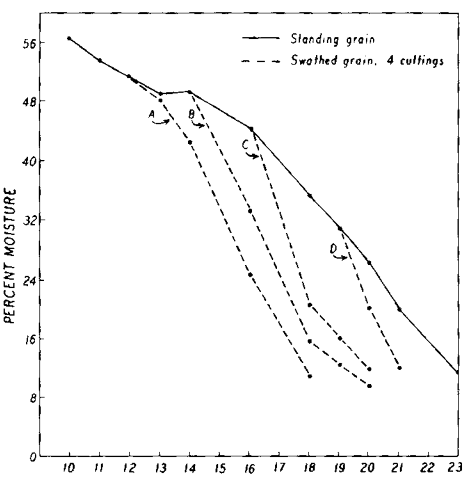
BARLEY IS OFTEN used in a double-cropping sequence in California and must be removed as soon as possible to facilitate early planting of the subsequent crop. This crop removal problem has stimulated interest in the effects of early cutting on yield and quality, and led to the study reported here. The studies (at Davis) were on the speed at which barley dries when harvested at high moisture levels, and the degree of moisture content at harvest possible without sacrificing significant loss in yield or grain quality.

The drying rate for barley swathed at various moisture levels, compared with adjacent standing grain, was determined in 1966 by using head samples as well as kernel samples for moisture determination. Barley swathed within a moisture range of 51 to 31% indicated no significant adverse effect on protein content or germination potential, as compared with standing grain. However, yield reductions occurred at all cuttings within this range. In general, quality of the grain was lowest when swathed at the highest moisture content, although the difference in quality of that swathed at 31% moisture was not significantly lower than that of the standing grain.

GRAPH 1. DAYS REQUIRED FOR CALIFORNIA MARIOUT BARLEY TO DRY IN THE SWATH WHEN CUT AT FOUR MOISTURE LEVELS COMPARED WITH ADJACENT STANDING GRAIN



GRAPH 2. RATE OF DRYING IN SWATHED AND STANDING BARLEY AT DAVIS IN 1966*



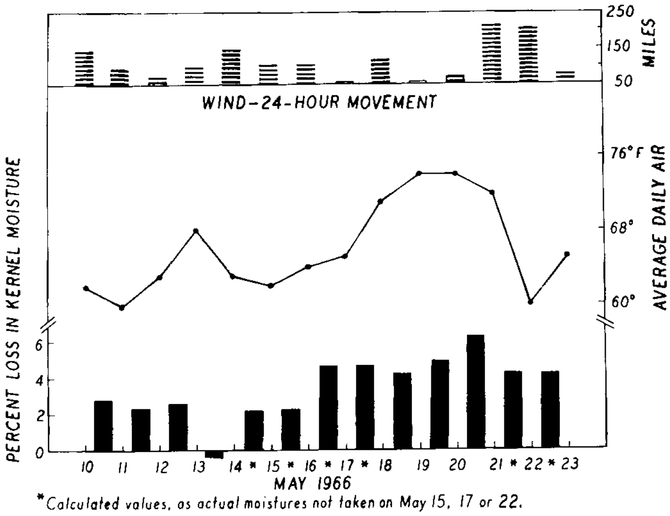
* No moisture samples taken on May 15 and 17, or in the swathed grain on May 19 and 21. Drying rate is estimated for these days.

The average moisture loss in swathed barley from the earliest cuttings exceeded 8% per day, whereas daily moisture loss from standing grain over the same period averaged 3.5%.

Seed of Foundation California Mariout barley was planted January 29 at 100 lbs per acre to minimize tillering. Swathing was begun on May 12 at 51% moisture and subsequent cuttings were made at 49, 45, and 31%. Results were compared with adjacent strips left to mature normally in the field. Four replications were swathed at each cutting made at mid-morning with a 12-foot Heston swather. Grain was cut at one-third the total height of the standing plants, and the size of each plot was 1/100 of an acre.

Head samples were taken every other day for moisture determination of the swaths and adjacent standing grain. The complete depth of the swaths was sampled in a manner that did not appreciably disturb the windrows. The barley heads were placed immediately in plastic bags and transferred to the laboratory where samples were prepared and fresh weights taken within an hour after cutting. Moisture percentage was determined by oven-drying at 130°C to constant weight. For example, two days after each swathing, 100 heads were collected at random from each of these windrows. Awns were clipped to the terminal spikelet on 40 heads to make up one moisture sample. For comparison, moisture was determined on samples of kernels taken from

GRAPH. 3. DAILY LOSS OF KERNEL MOISTURE FROM STANDING GRAIN OF CALIFORNIA MARIOUT BARLEY PLUS AVERAGE DAILY AIR TEMPERATURE AND WIND MOVEMENT DURING RIPENING.



*Calculated values, as actual moistures not taken on May 15, 17 or 22.

Swathing barley on Agronomy Department test plots, U.C., Davis.

the remaining 60 heads. Preparation of these samples included clipping the awns close to the seed from two rows the full length of each head. These seeds were removed and composited, and the moisture level determined concurrently with the head sample.

The two methods of moisture determinations correlated closely as shown in table 1. Head and kernel moisture technique records also agreed closely in comparisons with each sample from windows.

From this experience, the technique recommended for following moisture changes in barley grain is to clip main heads and tiller heads at random and follow the procedure outlined for moisture analyses on whole heads. This method proved especially helpful when the grain moisture content was high.

TABLE 1. KERNEL MOISTURE PERCENTAGE OF SWATHED BARLEY CUT AT VARIOUS STAGES OF MATURITY COMPARED WITH KERNEL AND HEAD MOISTURE CONTENT OF ADJACENT STANDING GRAIN

	Standing grain		Swathed grain			
	Head moisture	Kernel moisture	Date cut 5/12	5/14	5/16	5/19
Date	%	%	Moisture %			
5/10	56.3	56.5				
5/11	54.3	53.6				
5/12	50.9	51.3	51.3			
5/13	50.1	48.7	48.6			
5/14	49.7	49.1	42.6	49.1		
5/15	...	...	...	...		
5/16	45.3	44.7	24.8	33.4	44.7	
5/17	...	...	...	...	...	
5/18	34.9	35.4	11.0	15.8	20.8	
5/19	31.2	...	...	...	...	31.2
5/20	28.8	26.3	...	9.8	12.1	20.4
5/21	20.9	20.0	...	...	...	...
5/22	...	...	...	...	...	...
5/23	12.4	11.6	...	...	...	...

Results indicate that barley swathed at 31% moisture reached 12% only two days ahead of the adjacent standing grain (graph 1). Similar results were obtained in a preliminary trial in 1965, when only a two-day difference was obtained between barley swathed at 38% moisture versus standing grain. A maximum difference of only five days was obtained when swathed at 51% moisture, primarily because a few days of dry, north winds combined with high temperatures produced favorable drying conditions for the standing grain (graph 3).

Curves indicating the change of moisture loss in swathed and standing grain are shown in graph 2, based on data presented in table 1. They are similar, with curves for the swathed barley indicating a slightly greater rate of drying than that of the standing grain.

Swathing at the higher moisture levels had the most effect on drying rate. This is readily apparent when comparing the change of moisture of the standing grain between May 12 and 16 with that swathed on May 12 at 51% moisture. During this period, moisture of the standing grain was reduced by 6.6% in contrast to 26.5% for the swathed grain—a fourfold increase. Grain swathed at 44.7% moisture lost 32.6% in four days, compared with a reduction of 22.4% for the standing grain. However, when swathed at 31.2%, moisture reduction was only slightly greater than that for the standing grain. From these data it would appear that swathing had its greatest effect at the higher moisture levels, and during periods of cool, cloudy weather when the moisture reduction in the standing grain is minimal. Therefore, during seasons of relatively cool weather, the benefits obtained from swathing may be greater than the period of two to three days as indicated in this study. High daily temperatures (as experienced from May 18 through May 20) caused an increased rate of desiccation in the standing grain. A moisture sampling on May 20 at the regular morning time of 10:30 indicated a 26.3% moisture content, whereas a sampling in the afternoon, five hours later, showed a further drop to 22.3%.

TABLE 2. YIELD AND TEST WEIGHT OF CALIFORNIA MARIOUT BARLEY SWATHED AT FOUR MOISTURE LEVELS COMPARED WITH STANDING GRAIN AT DAVIS, 1966

Yield		
Treatment	Yield	Duncan's multiple range test*
	(lbs/A)	(5% level)
Standing grain	4435	A
Swathed 45%	3915	B
Swathed 31%	3823	BC
Swathed 51%	3520	BC
Swathed 49%	3390	C
C.V. = 6.89%		

Test Weight		
Treatment	Weight	Duncan's multiple range test
	(lbs/bu)	(5% level)
Standing grain	49.4	A
Swathed 31%	48.4	B
Swathed 45%	47.5	C
Swathed 49%	46.9	C
Swathed 51%	45.7	D
C.V. = 1.09%		

* Values followed by the same letter are not significantly different.

Effect on yield, quality

All swathing treatments at the moisture levels used in this experiment resulted in reduced weights per plot, with yields at three general levels: standing grain, swathed at 31 to 45% moisture; and swathed at 49 to 51% (table 2). Comparable results were obtained in 1965 when swathing at 38% also caused considerable yield reduction. Quality, as measured by test weight, kernel weight, and kernel assortment was also adversely affected in direct relationship with moisture content at time of swathing (table 3). By these measurements, barley swathed at 51% moisture was significantly lower in quality than all other treatments. However, cutting at this high moisture level had no effect on protein content for germination of the seed, although no attempt was made to evaluate seedling vigor. Quality of the grain from the treatment windrowed at 31% moisture appeared to be equal to that from standing grain, as measured by kernel assortment and kernel weight. However, these criteria may be biased upward by the removal of the lighter, undeveloped kernels during the threshing process. Quality was somewhat affected with respect to these two characteristics, as indicated by the significant reduction in test weight.

Data considered

When these data are considered collectively, it is apparent that all the swathing treatments adversely affected yield and quality, and in a linear order, according to moisture content at time of swathing. Although nonsignificant reversals between treatments occurred with respect to yield, measurements of sufficient precision to distinguish between small differences are difficult to obtain. However, since one of the yield components, kernel development, showed significant differences between all treatments in one or more of the three measurements for quality, this difference should be reflected in true differences between treatments in yield.

Measurable differences in kernel weight could account for 20 to 30% of the yield reductions obtained with certain of the treatments. The magnitude of this component may have been minimized in this experiment by the removal of the smaller, undeveloped kernels during the harvesting process. Reduction in kernel number between treatments, resulting from premature cessation of kernel development of late flowers and late tillers would also contribute to lower yields. Likewise, undeveloped spikes are difficult to thresh and may be expelled along with the straw.

TABLE 3. STANDING BARLEY VS. FOUR CUTTINGS MADE AT DIFFERENT MOISTURE LEVELS, COMPARED ON THE BASIS OF KERNEL WEIGHT AND ASSORTMENT

Treatment	Kernel weight	Duncan's multiple range test*
	(gms/100)	(5% level)
Swathed 31%	4.72	A
Standing grain	4.50	AB
Swathed 45%	4.50	B
Swathed 49%	4.31	C
Swathed 51%	4.12	D
C.V. = 2.07%		

Kernel assortment	Duncan's multiple range test*
(% over 6/64)	(5% level)
79.9	A
78.2	A
75.1	A
70.2	B
59.2	C
C.V. = 4.11%	

* Values followed by the same letter are not significantly different.

The measured reductions in yield resulting from the various swathing treatments may have been exaggerated slightly by experimental procedure. No adjustments were made on the harvester after the threshing process was begun. The initial setting was determined on border plots that had been swathed at about 45% moisture. However, physical differences between treatments may have resulted in differential combine losses, not only of the undeveloped kernels but of the fully developed kernels as well. Maximum salvage of all kernels might have been realized through differential combine adjustments during threshing. Additional studies are under way to more precisely evaluate the effects of moisture content at swathing time on grain yield.

Through earlier cutting of a crop like barley in the double cropping sequence, growers could reduce risks from shatter losses, broken stems, and late lodging, especially under adverse weather conditions. Furthermore, an earlier planting of the second crop, grain sorghum for example, could increase the yield potential —and possible net income per acre.

J. T. Feather is Assistant Specialist; J. E. Ruckman is Associate Specialist; and C. W. Schaller is Professor of Agronomy, Department of Agronomy, University of California, Davis.

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