

**Moisture Levels for Safe Handling & Storage of Burley Bales
from Farm Through the Warehouse**



Industry Team:

Supported By: Council for Burley Tobacco
Burley Tobacco Growers Coop –
Brian Furnish

Producers, Co. Agents:

Rusty Thompson, Mike Duckworth-Versailles
Harold Harris, John Wilson-Richmond

Warehouses: Tattersalls/Fourth St./Gentry Whse-Lex., Ky
Madison Warehouse-Richmond, Ky.

Evaluators: Philip Morris USA
Universal Leaf/Southwestern
Vaughn Tobacco Co.
AMS, USDA

Objective:

- To evaluate the effect of moisture content at stripping time,
- various handling conditions and
- storage environments...
farm & warehouse...
- on market 'quality'...

Experimental Methods:

Three Moisture Contents:

"Med" ~ 20-22% m.c.w.b.

"Med-High" ~ 22-24% m.c.w.b.

"High" ~ 24-26% m.c.w.b.

Three Grades: *Lower, middle, Upper stalk*

Storage: *Farm - Indiv. Bales*

Whse - 'Unitized' stack 7 bales

Lab - Mid-Stalk Grade only, 'Unitized' stack 7 bales,

3 m.c. @ Room temp. ~ 68F, 30% RH

in Chambers ~ 50F, 75% RH

Period: *Late Oct. - Dec. 8,9*

Evaluated: *By Cored MC, Temp. Sensors, 'TobaccoChek' Meter,
Tobacco Co 'Experts' on Characteristics,
AMS Graders*

Introduction:

- 1990s - Increasing emphasis by Buyers on moisture content and effects on market quality...
- Various industry studies and moisture sampling...showed a wide range of tobacco moisture coming from the farm...
- 1997-98: TAUS/PMUSA, 50,000 tests= $\sim$ 22%
- 1999, Council for Burley Tobacco requested UK study...

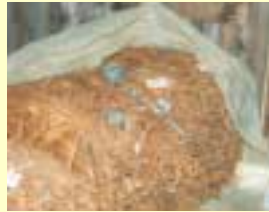
Methods:

- Tobacco bulked as best possible when in case to provide three moisture contents
- Tobacco stripped into 3 grades.
- Bales probed every 10-14 days with a 'TobaccoChek' Moisture Meter.



Methods:

- Certain bales cored, oven dry m.c.
- Several had temp. sensors in middle
- 3 bales of each grade and moisture were stored on the farm



Methods (Cont.):

- 7 bales each grade and moisture were stacked, banded and stored at the warehouse



Methods (Cont.):

- Seven-bale stacks of the middle grade to a lab.
3 at room conditions,
3 in Chambers
- Tobacco evaluation done
by selected "experts"
using a form with
various characteristics:
Color, Smell, Injury/Damage, Heat,
Mold, Feel/Moisture, Stems,
'Overall Quality'
Exec.=1, Good=2, Fair=3, Poor=4
- AMS grade for each sample bale at evaluation.



Results:

- Moisture Content, Weight Data
- Temp. data
- 'Quality' Eval. By 'Experts'

Following data are extractions from 43 page report for 1999 study

- and 26 page report for 2000 study.
- Try to highlight meaningful data with proper perspective...
- Copies available upon request...
- On web site soon...

Table 2. Comparison of oven and *TobaccoChk* moisture data for the Thompson Farm medium moisture test.

<u>Bale#</u>	<u>Oven MC</u>	<u>TobChK, 11-15</u>		<u>Diff. (TobCk - Oven)</u>		
				<u>1st Rdg.</u>	<u>2nd Rdg.</u>	<u>Both</u>
TM04	17.1	17.1	16.4	0.0	-0.7	-0.4
TM08	20.4	19.2	19.8	-1.2	-0.6	-0.9
TM09	17.9	19.1	19.1	1.2	1.2	1.2
TM11	18.8	19.4	19.2	0.6	0.4	0.5
TM12	19.8	20.6	18.2	0.8	-1.6	-0.4
TM13	18.1	19.1	18.5	1.0	0.4	0.7
TM35	18.1	18.6	18.4	0.5	0.3	0.4
TM36	19.1	17.5	19.5	-1.6	0.4	-0.6
TM37	<u>20.0</u>	<u>20.1</u>	<u>22.2</u>	<u>0.1</u>	<u>2.2</u>	<u>1.2</u>
Avg.	18.8	19.0	19.0	0.2	0.2	0.2

Table 6. Comparison of oven and *TobaccoChek* moisture data for the Thompson Farm “high” moisture test.

<u>Bale#</u>	<u>Oven MC</u>	<u>TobChK, 11-15</u>	<u>Diff. (TobCk - Oven)</u>		<u>Both</u>	
			<u>1st Rdg.</u>	<u>2nd Rdg.</u>		
TH01	19.6	20.6	20.9	1.0	1.3	1.2
TH02	20.4	23.0	21.2	2.6	0.8	1.7
TH03	20.5	21.0	20.1	0.5	-0.4	0.1
TH11	23.0	22.5	23.0	-0.5	0.0	-0.3
TH12	21.5	21.0	20.9	-0.5	-0.6	-0.6
TH13	20.8	21.5	21.9	0.7	1.1	0.9
TH35	20.8	21.6	21.8	0.8	1.0	0.9
TH36	21.7	21.1	20.5	-0.6	-1.2	-0.9
TH40	21.7	20.9	22.9	-0.8	1.2	0.2
Avg.	21.1	21.5	21.5	0.4	0.4	0.4

Table 14. Comparison of oven and *TobaccoChek* moisture data for the Thompson Farm “very high” moisture test.

<u>Bale#</u>	<u>Oven MC</u>	<u>TobChK,11-15</u>	<u>Diff. (TobCk - Oven)</u>			
			<u>1st Rdg.</u>	<u>2nd Rdg.</u>	<u>Both</u>	
TV02	21.8	22.0	24.5	0.2	2.7	1.5
TV08	31.5	23.0	HI	-8.5	HI	HI
TV09	24.1	24.8	23.6	0.7	-0.5	0.1
TV16	22.4	23.8	22.8	1.4	0.4	0.9
TV17	23.1	23.0	21.7	-0.1	-1.4	-0.8
TV18	23.7	24.9	23.3	1.2	-0.4	0.4
TV36	26.0	24.5	26.0	-1.5	0.0	-0.8
TV38	21.1	22.9	20.8	1.8	-0.3	0.8
TV39	23.2	23.5	22.8	0.3	-0.4	-0.1
Avg.	24.1	23.6	23.2	-0.5	-0.9	-0.7

**Table 3. Data for Thompson Farm “medium” moisture bales
and stacks stored in the warehouse.**

<u>Wt. 10-15</u>	<u>Wt. 12-07</u>	<u>Loss Lb</u>	<u>Loss%</u>
676	663	-13	-1.9%
680	664	-16	-2.4%
554	539	-15	-2.7%

8 Wks. In Whse

**Table 7. Weight loss of Thompson Farm “high moisture”
unitized stacks stored in the warehouse.**

<u>10-15</u>	<u>12-07</u>	<u>Loss Wt. lb</u>	<u>Loss%</u>
688	666	-22	-3.2%
626	601	-25	-4.0%
670	644	-26	-3.9%

8 wks. In Whse.

Table 17. Data for Thompson Farm “very high” moisture bales and stack stored in warm room.

<u>Bale#</u>	<u>TCK 11-15</u>	<u>Oven MC</u>	<u>TCK 12-01</u>	<u>MC Ch.</u>
TV17	23.0	21.7	24.3	24.1
TV21	23.6	25.4	26.9	26.9
TV22	23.8	24.9	26.7	26.0
TV24	24.1	23.0	26.0	26.8
TV25	22.9	22.5	25.2	25.6
TV29	25.3	25.1	HI	HI
Avg.		23.8		25.9
	<u>11-16</u>	<u>12-07</u>	<u>Loss Lb</u>	<u>Loss %</u>
Wt.	697	675	-22	-3.2%
			3 Wks, 70F, 20-25% RH	

Table 5. Data for bales and stack stored in an environmental chamber.

<u>TCK 10-04</u>	<u>TCK 10-15</u>	<u>TCK 11-05</u>	<u>TCK 12-01</u>	<u>MC Ch</u>
19.8	19.2	19.6	19.3	19.6
21.4	21.1	20.9	21.3	21.6
20.6	19.5	20.3	19.6	19.4
20.2	20.2	20.6	20.2	20.8
20.5	20.2	20.1	20.3	20.6
20.7	19.7	20.5	19.8	19.5
Avg.	20.3	20.2	20.3	19.7
	<u>10-15</u>	<u>10-27</u>	<u>12-07</u>	<u>Loss Lb</u>
				<u>Loss%</u>
Wt.	678	669	669	-9
				-1.3%
				2 Wks Whse, 6 Wks Chamber
				50F, 75-80%RH (No Loss for
				6 wks in Chamber)

Table 23. Comparison of oven and *TobaccoChek* moisture data for the Harris Farm medium moisture test.

<u>Bale#</u>	<u>Oven MC</u>	<u>TobChK,</u>	Diff. (TobChK - Oven)			
			<u>1st Rdg.</u>	<u>2nd Rdg.</u>	<u>Both</u>	
HM01	19.3	18.7	18.0	-0.6	-1.3	-0.9
HM12	20.5	19.5	20.1	-1.0	-0.4	-0.7
HM14	19.4	18.7	20.2	-0.7	0.8	0.1
HM35	20.3	20.1	19.1	-0.2	-1.2	-0.7
Avg.	19.9	19.3	19.4	-0.6	-0.5	-0.6

Table 27. Comparison of oven and *TobaccoChek* moisture data for the Harris Farm high moisture test.

<u>Bale#</u>	<u>Oven MC</u>	<u>TobChK,11-13</u>	<u>1st Rdg.</u>	<u>2nd Rdg.</u>	<u>Both</u>	
HH03	20.5	22.5	21.6	2.0	1.1	1.6
HH11	22.6	22.1	21.6	-0.5	-1.0	-0.8
HH12	22.8	21.5	22.6	-1.3	-0.2	-0.8
HH39	25.2	21.9	23.3	-3.3	-1.9	-2.6
Avg.	22.8	22.0	22.3	-0.8	-0.5	-0.6

Table 31. Comparison of oven and *TobaccoChk* moisture data for the Harris Farm “very high” moisture test.

<u>Bale#</u>	<u>Oven MC</u>	<u>TobChK,11-13</u>		<u>1st Rdg.</u>	<u>2nd Rdg.</u>	<u>Both</u>
HV04	26.5	23.1	25.8	-3.4	-0.7	-2.1
HV11	23.4	22.9	23.4	-0.5	0.0	-0.3
HV15	33.2	24.9	HI	-8.3		-8.3
HV39	28.2	23.5	24.9	-4.7	-3.3	-4.0
Avg.	27.8	23.6	24.7	-4.2	-3.1	-3.7

Table 24. Data for Harris Farm medium moisture bales and stacks stored in the warehouse.

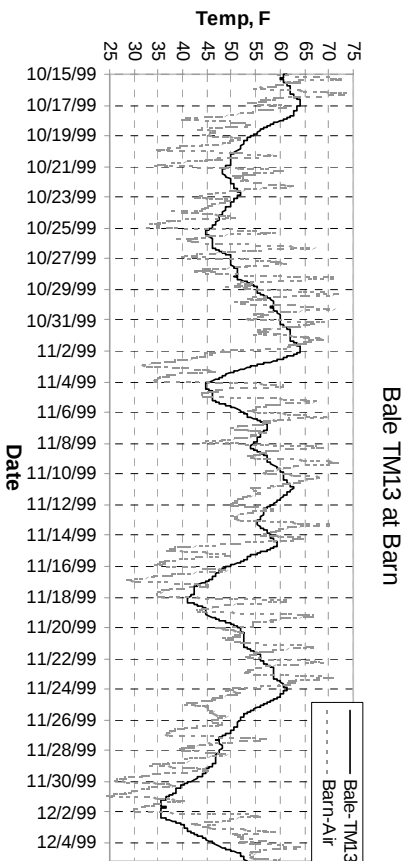
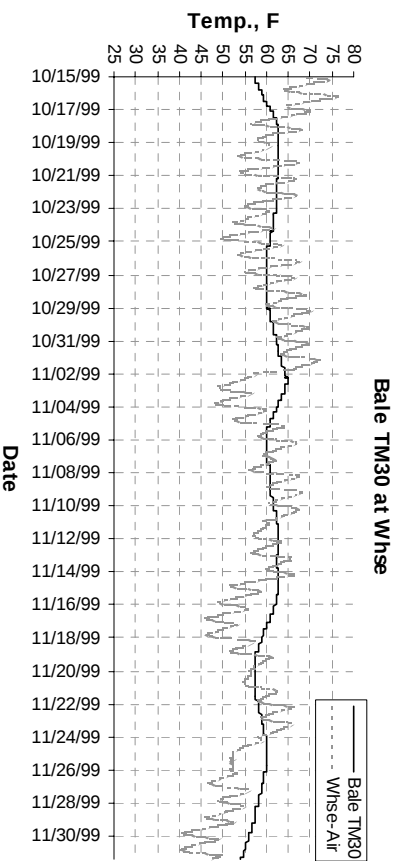
Location	Wt. 11-13	Wt. 12-09	Loss lb	Loss%	
400-45,W	382	374	-8.0	-2.1	3 wks. at Whse.
400-48,W	568	555	-13.0	-2.3	3 wks. at Whse.
400-49,W	546	537	-9.0	-1.7	3 wks. at Whse.

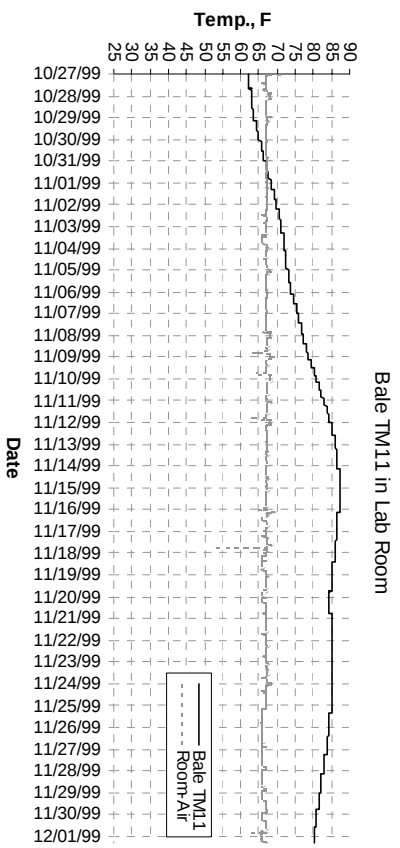
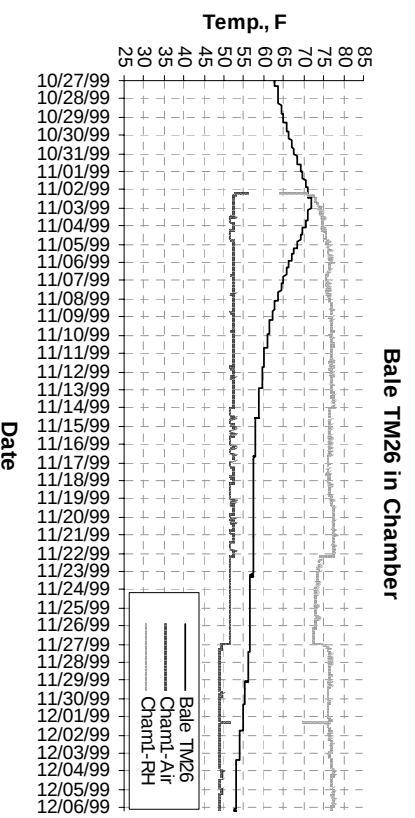
Table 28. Data for Harris Farm high moisture bales and stacks stored in the warehouse.

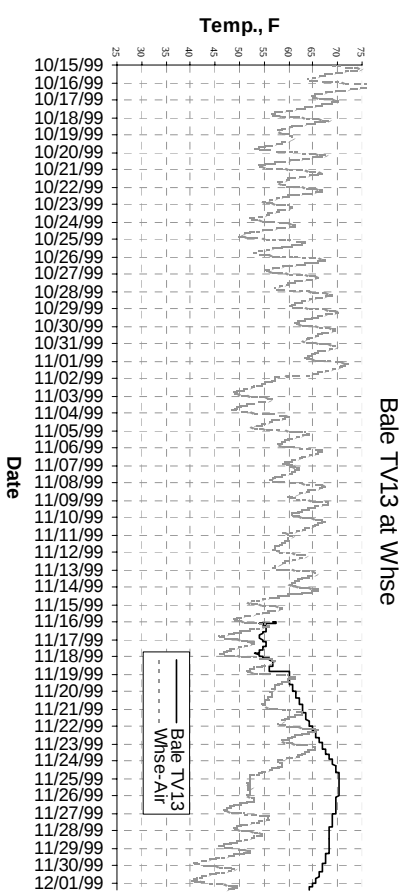
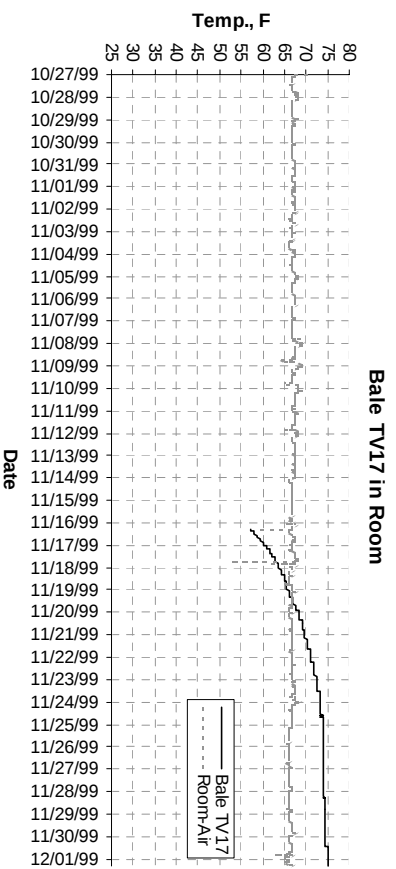
Location	Wt. 11-13	Wt. 12-09	Loss lb	Loss%	
400-44,W	530	520	-10.0	-1.9	3 wks. at Whse.
400-46,W	590	569	-21.0	-3.7	3 wks. at Whse

Table 32. Data for Harris Farm very high moisture bales and stacks stored in the warehouse.

Location	Wt. 11-13	Wt. 12-09	Loss lb	Loss%	
400-47,W	498	477	-21.0	-4.2	2 wks. at Whse.
400-51,W	518	505	-13.0	-2.5	2 wks. at Whse
400-50,W	582	560	-22.0	-3.8	2 wks. at Whse







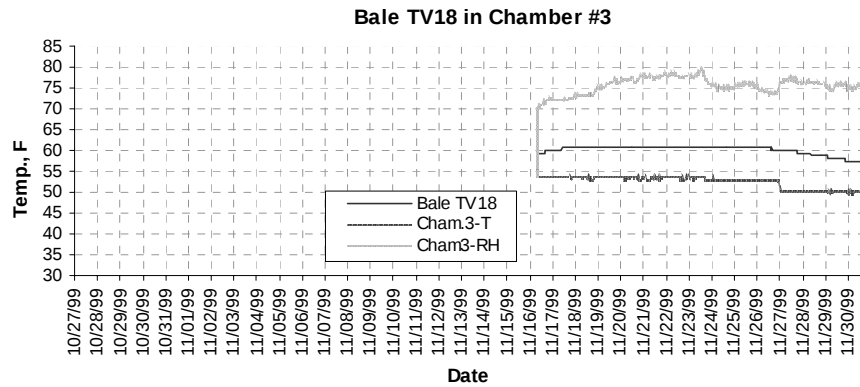


Table 20. Lexington Bale Evaluation Data for Thompson Farm Tobacco

Lot ID	Color #	Smell #	Inj/Dam #	Heat #	Mold #	Feel/M #	Stem #	Quality #	Ov Rat	AMS Grd	Avg M.C
0409-23	Ex 1	Ex 1	Ex 1	Ex	Ex 1	Ex	Ex 1	Ex 1			
TM11	Go	Go 1	Go 2	Go 2	Go 2	Go 1	Go 3	Go 1			
	Fa 2	Fa 1	Fa	Fa 2	Fa 1	Fa 2	Fa	Fa 1			
	Po 1	Po 1	Po	Po	Po	Po	Po	Po 1			
0409-23	11	10	5	10	8	8	7	10	8.6	B3K	18.8
	%	%	%5	%	%	%	%	%			
0409-23 Unit has a little warmth-good shape for now-but after period of time could be a problem.											

Table 21. Lexington Bale Evaluation Summary for Thompson Farm Tobacco Ranked by Overall Rating

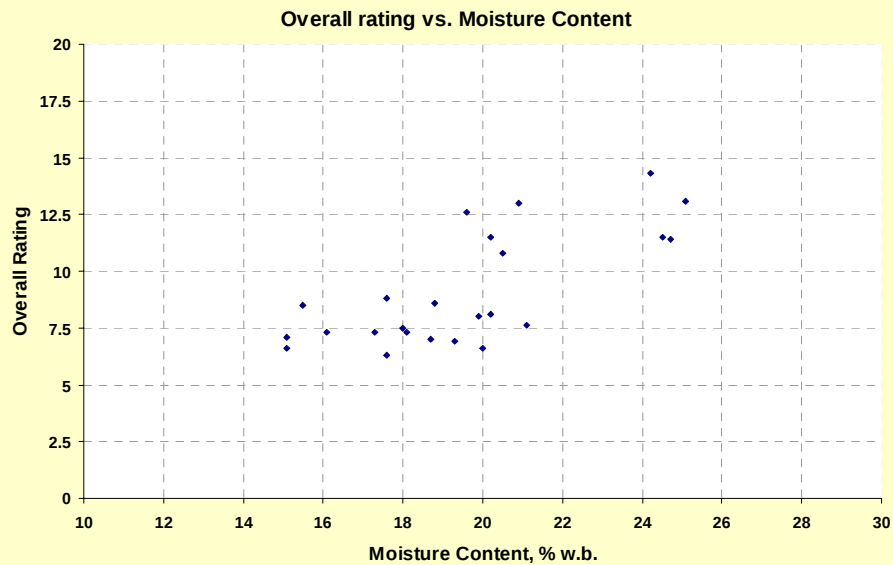
<u>Lot ID</u>	<u>Bale#</u>	<u>Overall Rating</u>	<u>AMS Grade</u>	<u>Avg. M.C.</u>
0454-18	TM08	6.3	C4K	17.6
0409-26	TM04	6.6	X4L	15.1
0454-21	TH03	6.6	C4F	20.0
0454-24	TV02	6.9	C4F	19.3
0409-30	TH27	7.0	B4F	18.7
0454-20	TM35	7.1	T3F	15.1
0409-22	TM30	7.3	C4K	18.1
0454-19	TM13	7.3	B3K	16.1
0409-27	TH12	7.3	B3F	17.3
0454-22	TH13	7.5	B3K	18.0
0454-25	TV16	7.6	B4F	21.1
0409-28	TH02	8.0	X3F	19.9
0409-24	TM26	8.1	C3F	20.2
0409-25	TM36	8.5	T4F	15.5
0409-23	TM11	8.6	B3K	18.8
0454-23	TH35	8.8	T4FR	17.6
0437-75	TV39	10.8	T4FR	20.5
0440-00	TV23	11.4	B3F-W	24.7
0435-44	TV18	11.5	C3F	24.5
0409-31	TH17	11.5	T4K	20.2
0454-26	TV38	12.6	T4FR	19.6
0409-29	TH36	13.0	T4FR	20.9
0439-99	TV09	13.1	C4F-W	25.1
0454-98	TV17	14.3	B3F-W	24.2

•It is interesting to note the comments made by the Evaluators on the inspection forms.

- A 24.5% bale (TV18) was noted as having ‘..too much moisture..’
- whereas a 15.5% bale (TM36) had ‘mold’ showing,
- an 18.8% bale (TM11) had ‘warmth’,
- and three other bales with moisture contents of 15.1%, 19.9% and 20.9% had ‘moisture problem potential’ notations.
- Several others in the 20-25% range passed the scrutiny without any notations made.

**Table 35. Richmond Bale Evaluation Summary
for Harris Farm Tobacco Ranked by Overall Rating**

<u>Lot ID</u>	<u>Overall Rating</u>	<u>AMS Grade</u>	<u>M.C.</u>	<u>Auction Grade</u>
0439-74	5.5	T4GF	16.9	T4F
0400-43	5.8	X5L	18.8	X4F
0400-48	5.8	B4K	17.7	B4F
0400-45	5.8	X5L	14.7	X4F
0439-65	6.0	N1L	---	X4L
0439-72	6.3	X5L	---	X4L
0439-70	6.4	X5L	---	X4L
0400-44	6.4	C4V	---	B4F
0439-69	6.8	B4VF	16.5	B4F
0439-73	6.9	B4GF	20.3	T4F
0439-67	7.4	C4K	22.7	C4F
0439-66	7.5	C4K	19.0	C4F
0400-49	8.8	T4VF	19.3	T4F
0400-50	9.5	T4VF	24.8	T4F
0400-47	9.5	X5L	24.9	X4F
0400-51	10.1	C4K	22.2	B4F
0400-46	10.8	T4GF-W	23.6	T4FR-W
0439-68	11.8	T4GF-W	HI	T4FR-W



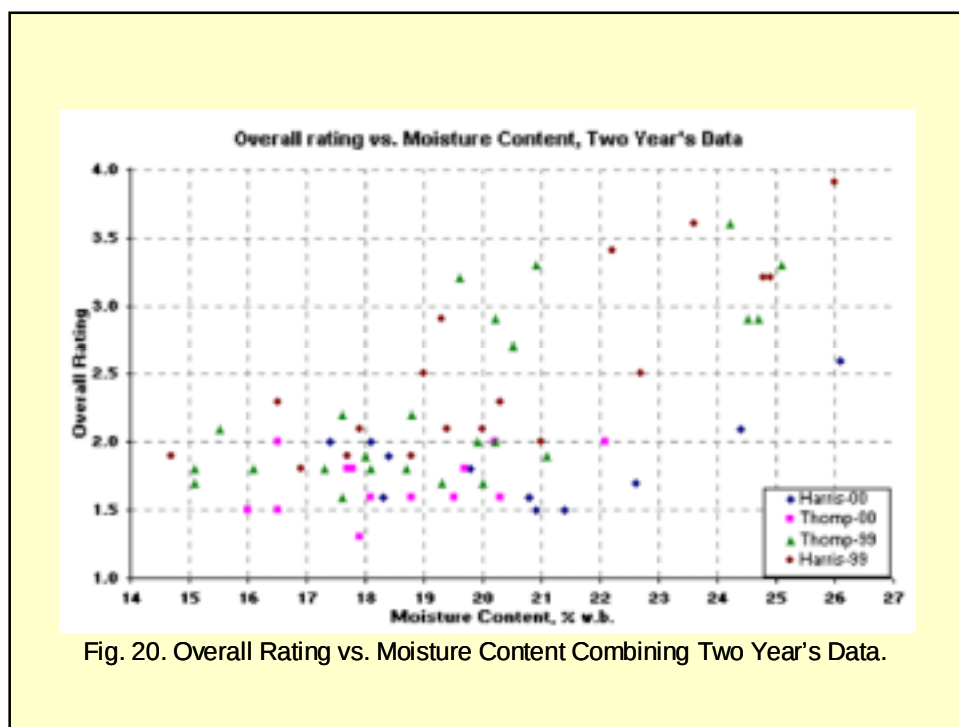
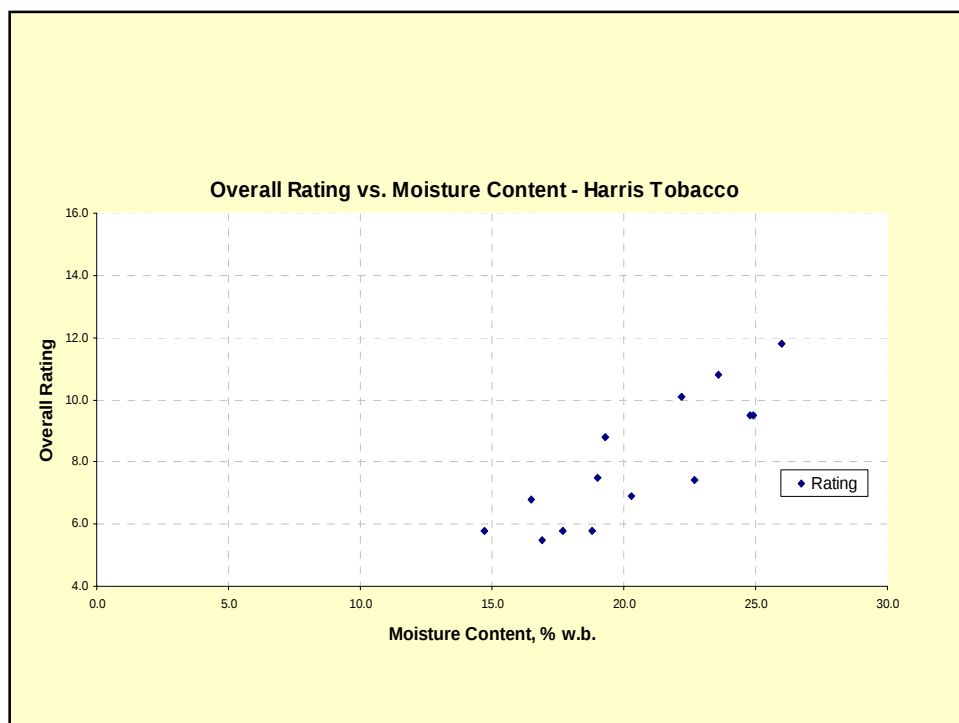
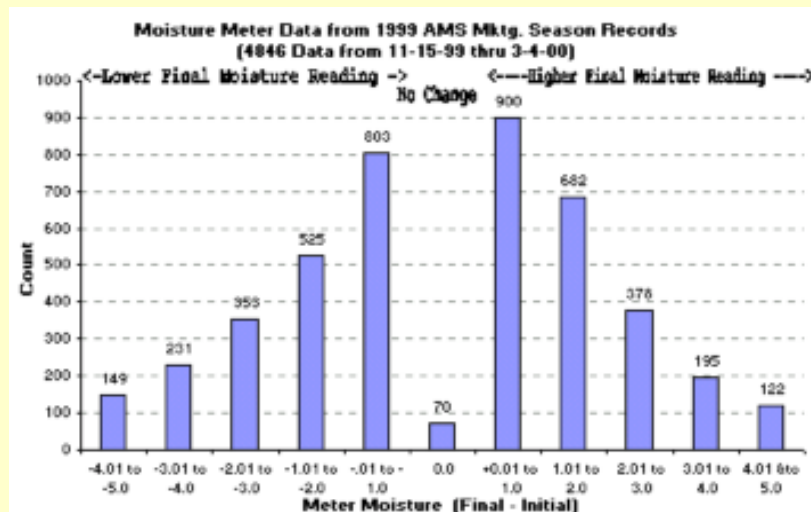


Fig. 20. Overall Rating vs. Moisture Content Combining Two Year's Data.



Summary Comments:

- Data show a large majority of ratings with the 1.5 to 2.5 values (excellent-good to good-fair) for the moisture contents ranging between 14% and 23%.
- Five of the ten bales with a moisture content above 23.0% had a 'W' applied to the grade indicative of the high moisture bales in 1999.
- Several of the 1999 bales in the 19% to 23% range had ratings above 2.5 indicative of some characteristics found suspect by the evaluators.
- Even below 19% moisture content several bales had evaluations above a 2.0 rating indicating worse than a 'good' condition.

Any Conclusion?

- Thus, what is a 'safe' farm moisture level to maintain 'quality' during the handling, marketing and temporary storage of burley?
- Is there a farm moisture level agreeable to all segments of the industry?
- Lights, Please...