

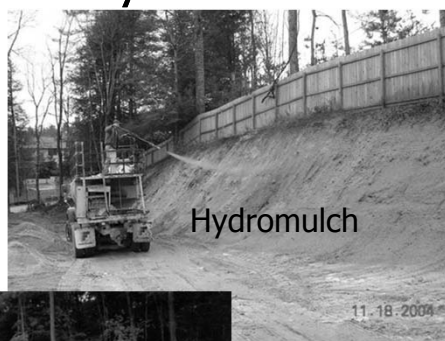
## Mulches for Controlling Erosion and Establishing Grass on Slopes: What Works



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## Ground Covers: Many Varieties



But can they be improved with polyacrylamide (PAM)?

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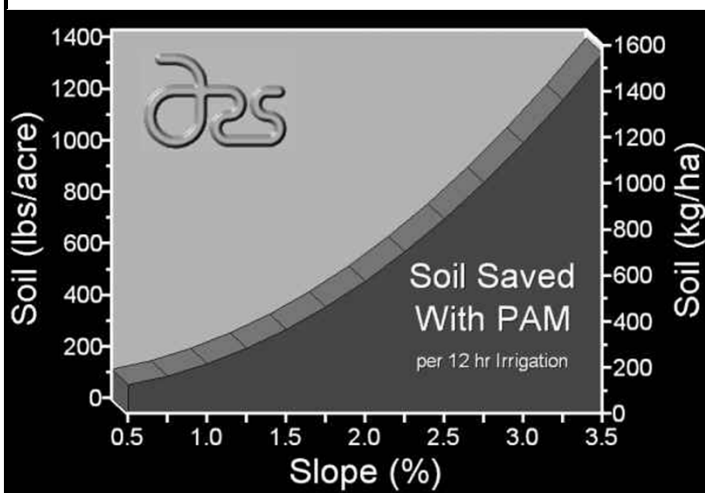
## USDA Promotes PAM



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## Furrow Irrigation Application



Up to 94%  
Reduction  
In Furrow  
Erosion!

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## PAM and Erosion: Published Results

- PAM usually reduced erosion, but there appeared to be a minimum application rate for reliable results.
- PAM also usually reduced runoff volume, but there is some evidence that surface sealing can occur.
  - Depends on rate, concentration, and soil

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## Mulch Effects

Authors	Year	Material	Slope (%)	Erosion Reduction (%)
Mannering et al.	1963	Wheat straw	5	$\geq 2,400$ kg/ha = 0 $\leq 1,100$ kg/ha = 75-90
Bautista et al.	1996	Straw		50-94
Dougherty et al.	2010	Blankets Hydromulch Straw	?	58 53 66
Hayes et al.	2005	Straw	50	83
Faucette et al.	2005	Compost, hydroseed	10	95-99
Sutherland & Zielger	2007	Coir blanket Coir mesh	9	>99 92-99

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- Insert splash video

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## Additional Mulch Benefits

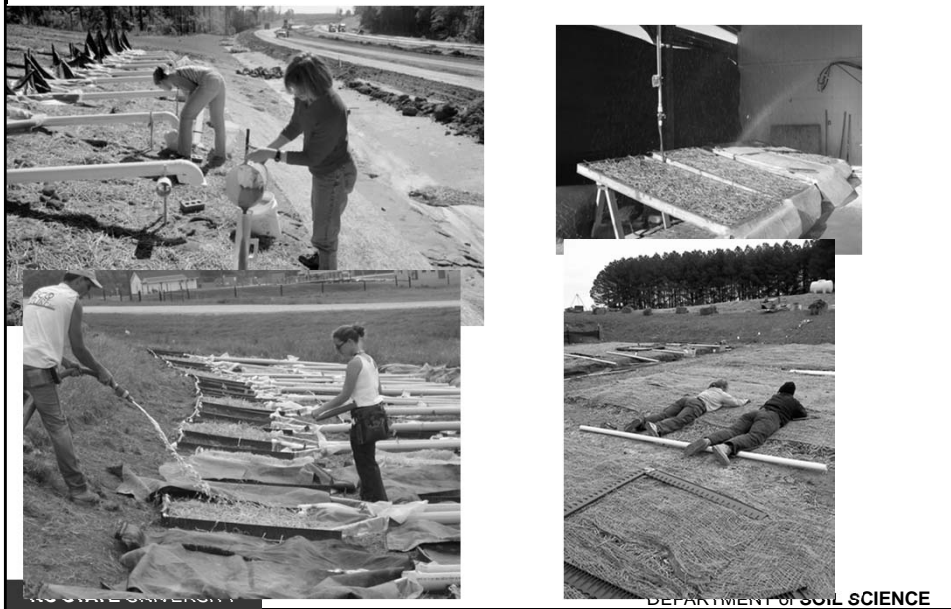
Cover (%)	Soil Loss	Clay (<2 $\mu\text{m}$ )	Silt (2-50 $\mu\text{m}$ )	Sand (>50 $\mu\text{m}$ )
	(% of 0 cover)	Particle Size Ratio: Eroded/Soil		
0	100	0.9	0.9	2
15	50	0.9	1	2.5
30	43	0.8	0.9	3.3
50	40	0.7	1	3.6
70	10	0.7	1	5
90	4	0.6	1	5.5

Shi et al., 2012: Effects of Mulch Cover Rate on Interrill Erosion Processes and the Size Selectivity of Eroded Sediment on Steep Slopes.  
doi:10.2136/sssaj2012.0273

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## Results of Our Tests



## NCSU Study

Site	Time	Bare	Straw	Reduction
	(month/date)	Soil Loss, kg/ha		%
Piedmont 1	6/24-7/25	7,300	390	95
Piedmont 2	9/24-12/17	11,700	1,200	90
Coastal Plain	12/17-2/8	10,500	500	95

Hayes et al., 2005. J. Soil Water Cons.



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## Small Plot, Low Slope Tests

### Averages First 5 Storms

Cover	Runoff		Turbidity (NTU)		Erosion (t/ha)	
	No PAM	PAM#	No PAM	PAM	No PAM	PAM
Bare	6.5a	5.2a	2,279a	1,950a	4.4a	2.3a
Blanket	3.2b	2.1b	1,350ab*	570b*	1.7ab	0.5b
Straw	1.7b	1.9b	763b	371b	0.8b	0.6b
Hydromulch	1.7b	1.4b	349b	142b	0.6b	1.4ab

#APS 705, 19 kg/ha

\*PAM significantly reduced turbidity for that mulch

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## Small Plot, Low Slope Tests

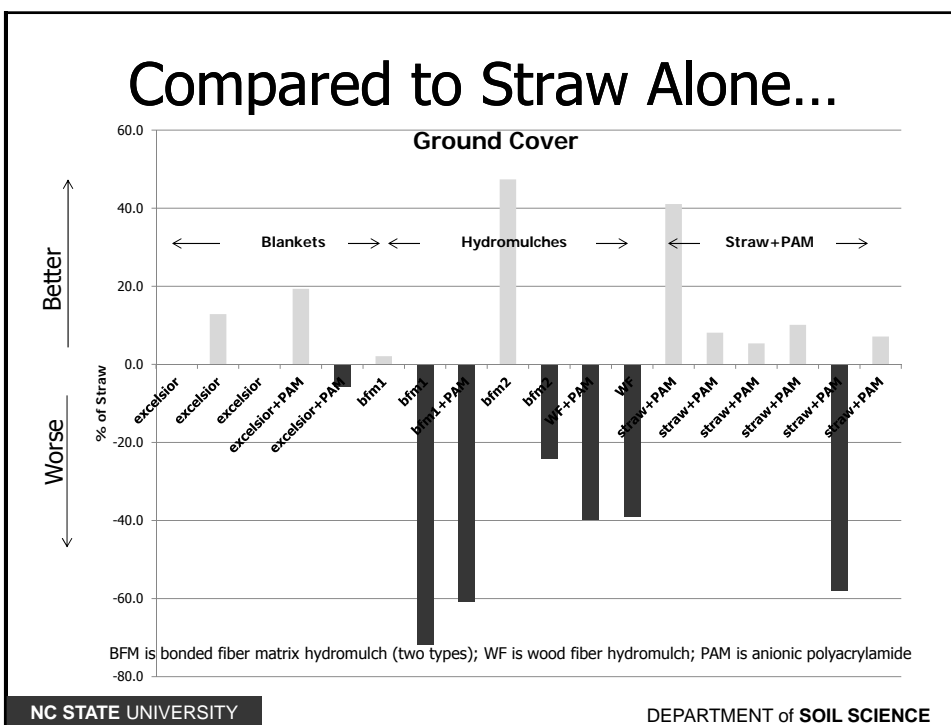
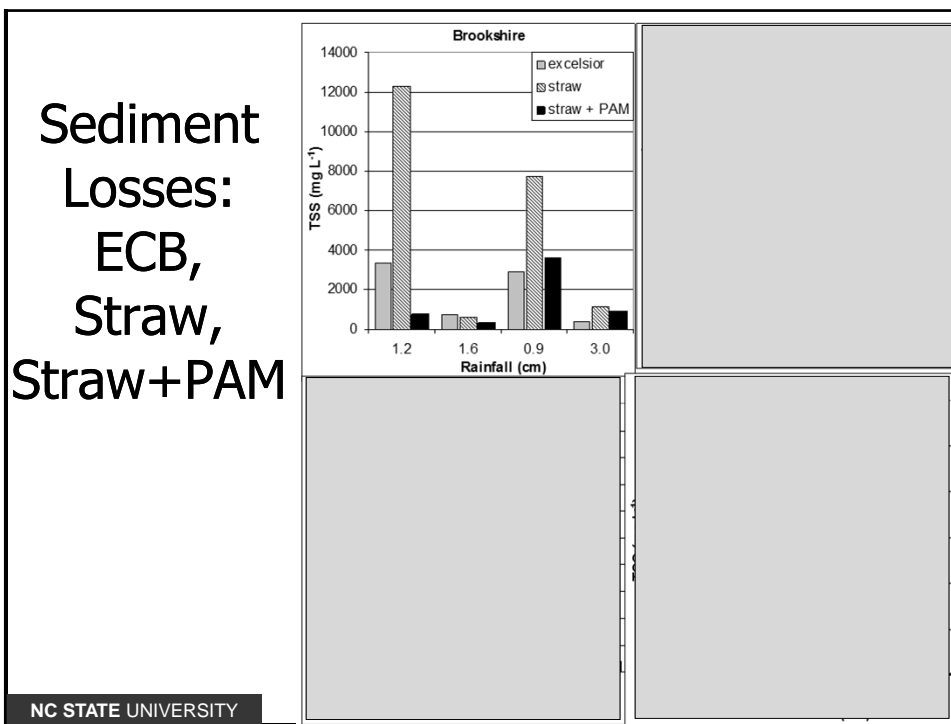
### Grass Cover (%)

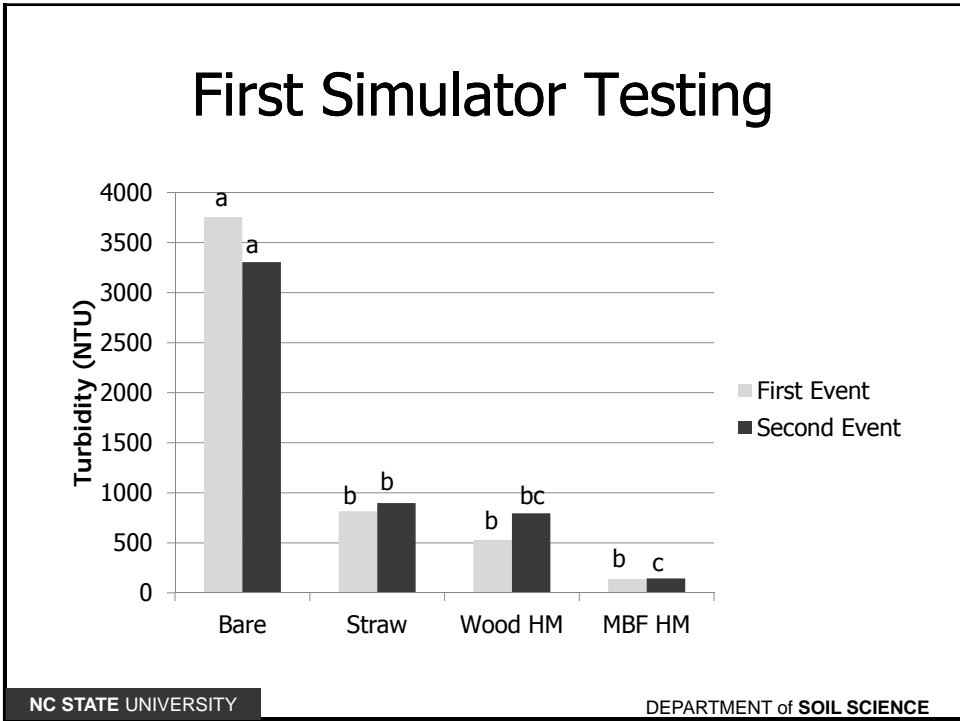
Cover	October 30		November 13	
	No PAM	PAM*	No PAM	PAM
Bare	24c	23c	38c	44b
Blanket	39b*	48a*	50ab	55ab
Straw	48a	50a	56a	65a
Hydromulch	25c*	30b*	39bc	51b

\*PAM significantly improved grass cover for that mulch

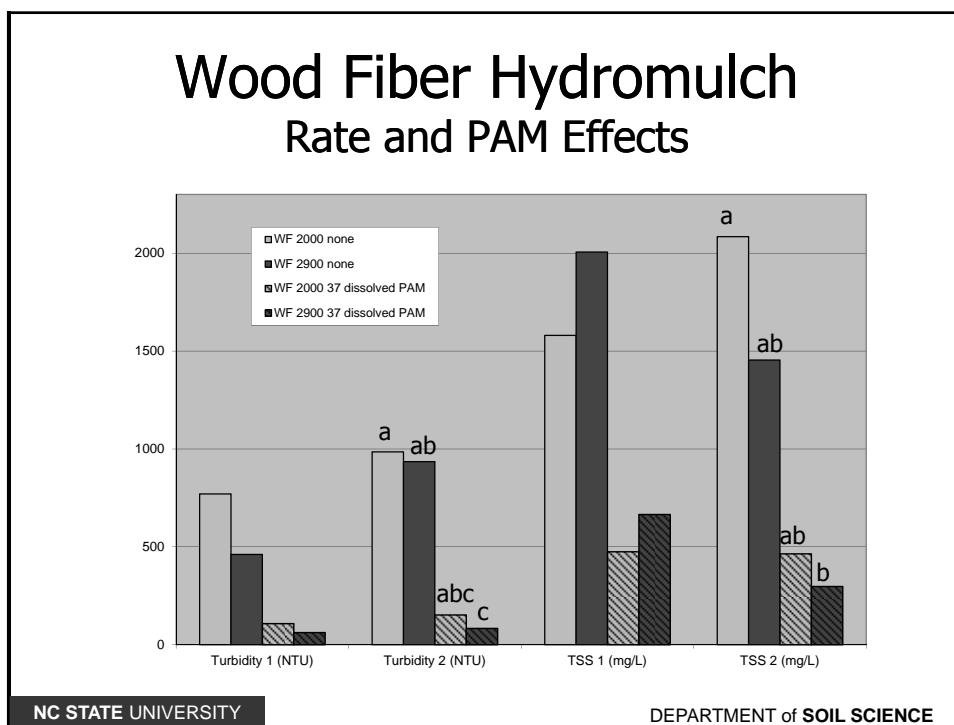
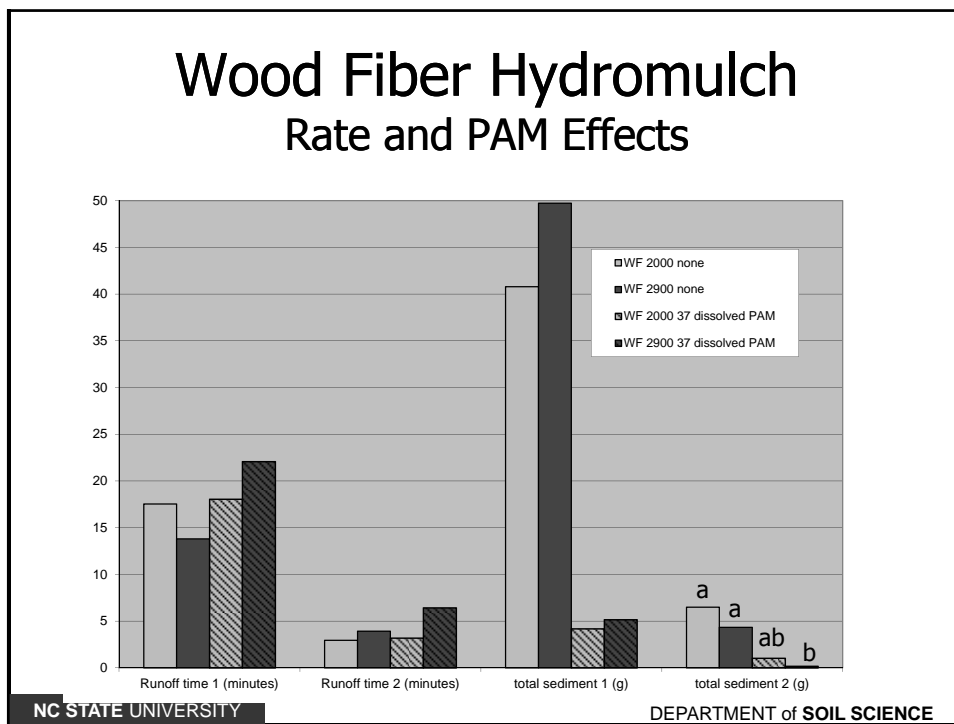
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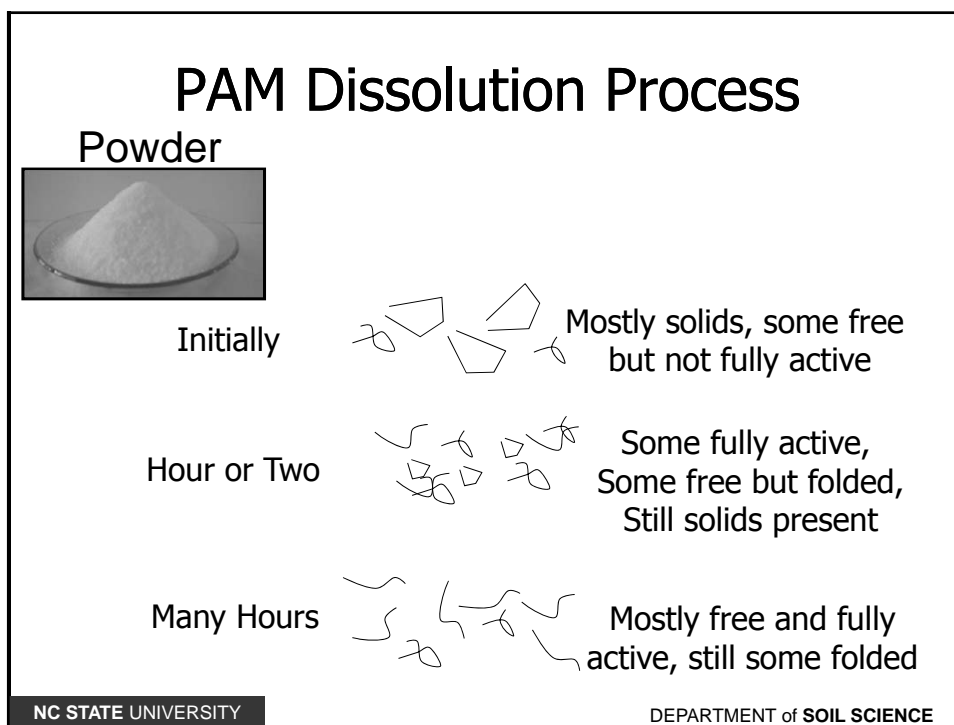
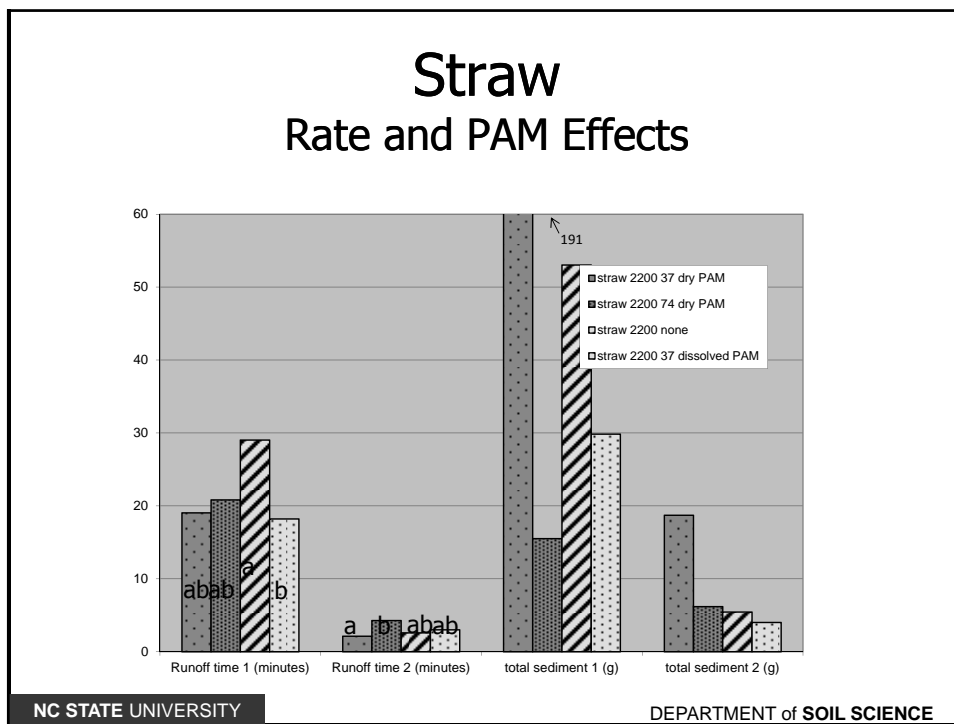
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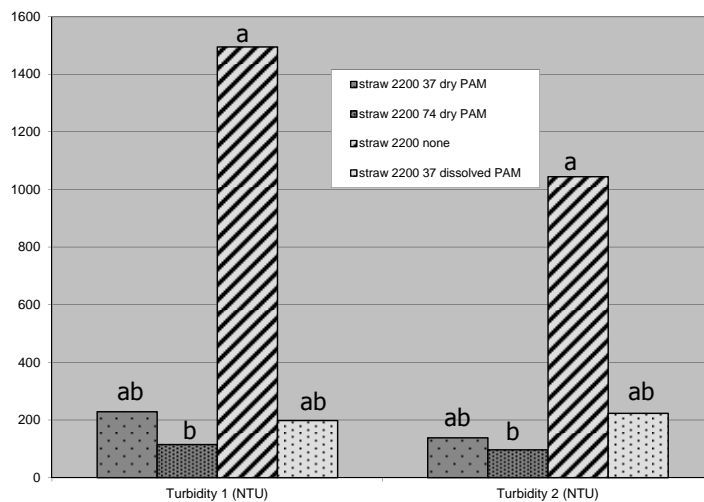








## Straw Rate and PAM Effects



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## Rainfall Simulator: PAM effects

Mulch Type	Mulch Rate (kg/ha)	% Reduction in Turbidity 1	% Reduction in TSS 1
C	2000	80.5	63.2
C	3000	52.9	28.1
WF	2000	86.0	70.0
WF	3000	86.5	66.8
S	2200	86.8	81.5

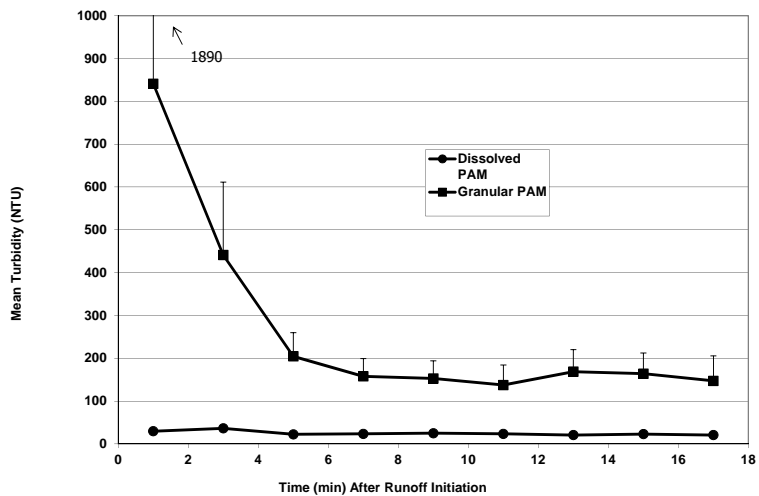
C = Cotton Prototype Hydromulch; WF = Wood Fiber Hydromulch; S = Straw

Adding 37 kg/ha dissolved PAM reduced turbidity and TSS, but differences were not always significant.

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## Rainfall Simulator Tests: Granular vs Dissolved PAM



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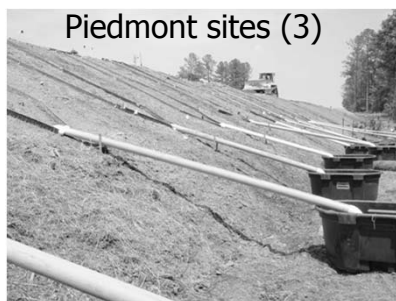
## Recent Study Results



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### Recent Project to Evaluate Hydromulches and PAM



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### 6<sup>th</sup> Site: Catastrophe!



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## Final Results: Erosion

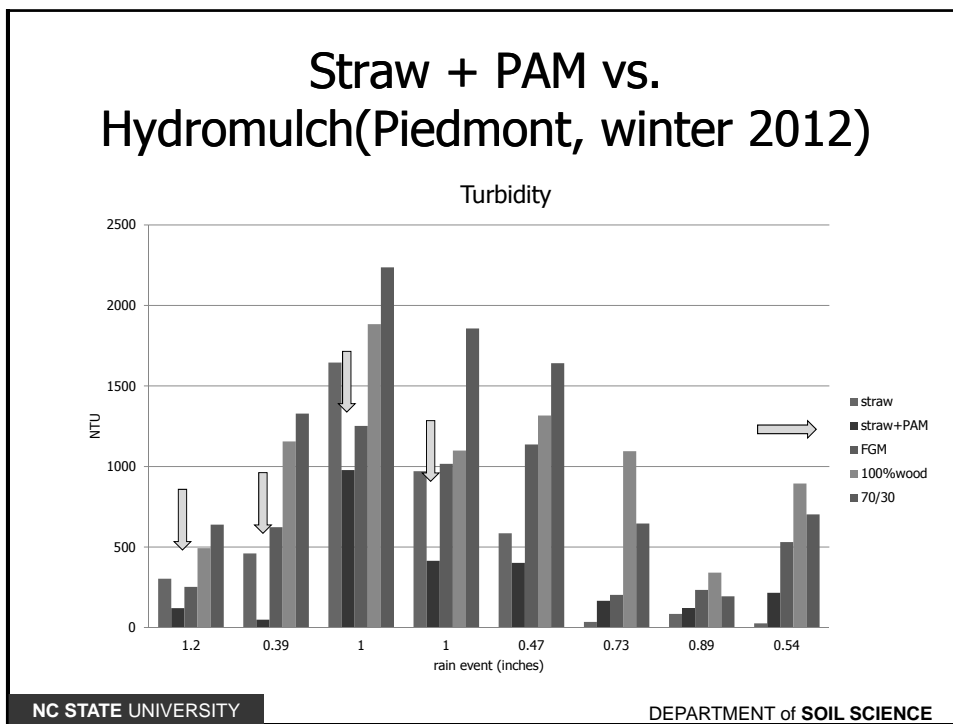
Treatment	Site 1,	Site 2,	Site 3,	Site 4,	Site 5,
	Kinston	West Jefferson	Garner	Apex	Holly Springs
	Total sediment loss (kg ha <sup>-1</sup> )				
Straw			3,685a	51bc	36b
Straw+PAM			1,261ab	29c	29b
SMM			959bc	N/A	35b
BFM			1,930ab	N/A	N/A
FGM			333c	164ab	N/A
WFM			N/A	237a	120ab
WCB			N/A	221ab	210a

PAM=Polyacrylamide. FGM=flexible growth media. SMM=stabilized mulch matrix. BFM=bonded fiber matrix. WFM=wood fiber mulch. WCB=70:30 wood fiber/cellulose blend.

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## Summary: Erosion

- For 2 sites, all mulches performed similarly.
- For 1 site, 2 of 3 hydromulches were better than straw; 1 hydromulch was better than straw+PAM; straw+PAM was as good as the BFM.
- For 1 site, straw+PAM was better than all 3 hydromulches; straw alone was better than WFM.
- Last site, straw = straw+PAM = SMM; WCB worse than all three.



### Vegetative Cover

	Site 1, Kinston	Site 2, West Jefferson	Site 3, Garner	Site 4, Apex	Site 5, Holly Springs
<b>Treatment</b>					
	<b>Cover (%)</b>				
Straw				56a	75b
Straw+PAM				54a	67b
SMM				N/A	93a
BFM				N/A	N/A
FGM				28b	N/A
WFM				34b	94a
WCB				32b	96a

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## Summary: Vegetation

- For 3 sites, there were no differences in cover for any mulch treatment.
- For 1 site, straw and straw+PAM had significantly more cover than FGM, WFM, and WCB.
- Last site, SMM=WFM=WCB and all were better than either straw treatment. However, high tackifier application was likely the cause.

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## Careful with the Tackifier...



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## Hydroseeder Diving



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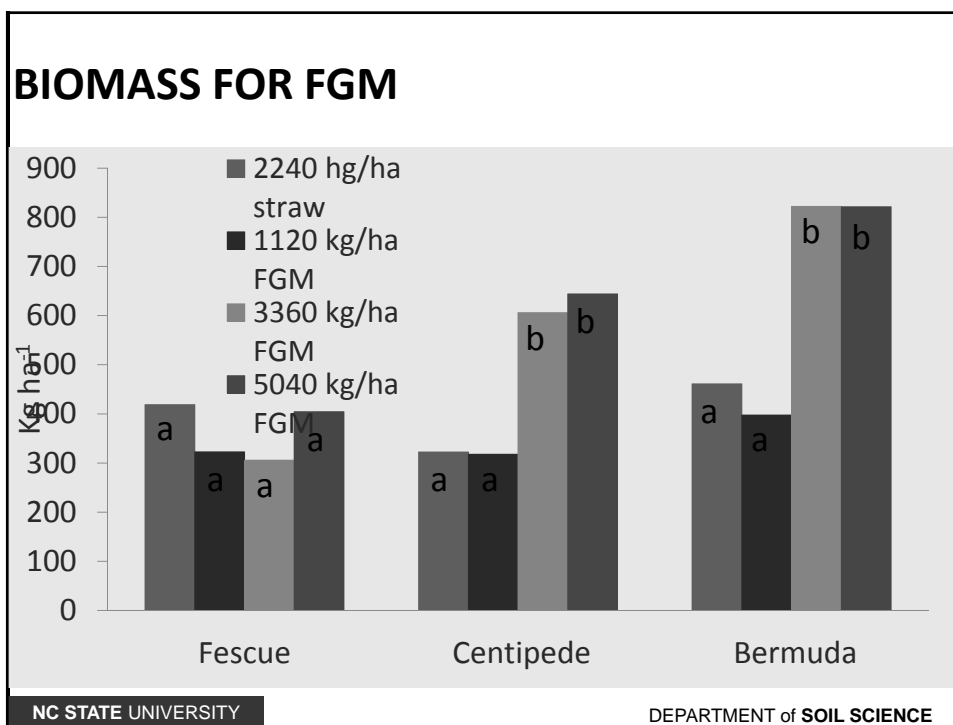
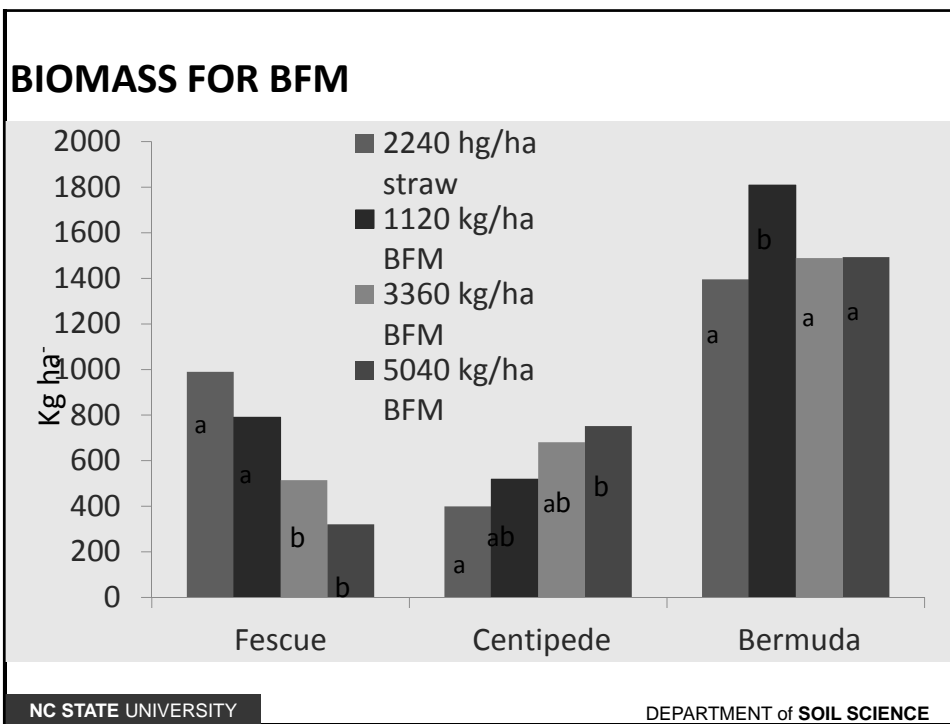
## Greenhouse Study: Hydromulches

Mulch:

- 1) Straw -  $2240 \text{ kg ha}^{-1}$
- 2) BFM (bonded fiber matrix) and FGM (flexible growth media) -  $1120 \text{ kg ha}^{-1}$  (low rate)
- 3) BFM (bonded fiber matrix) and FGM (flexible growth media) -  $3360 \text{ kg ha}^{-1}$  (recommended rate)
- 4) BFM (bonded fiber matrix) and FGM (flexible growth media) -  $5040 \text{ kg ha}^{-1}$  (high rate)



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## Does PAM Reduce Erosion?

- PAM usually reduced erosion rates for typical ground covers.
- Straw + PAM (30 lb/ac) can outperform blankets and hydromulch.
- But poor ground coverage by mulch may reduce or eliminate PAM benefits.

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## Does PAM Improve Vegetation Cover?

- We have not found clear evidence of improved grass stands when PAM was applied.
- Previous work showed small but significant increases in early grass coverage (McLaughlin and Brown, 2006).

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## Conclusions

- Any ground cover is better than none (>90% reduction rule).
- Hydromulches and blankets alone *may* be more effective than straw alone.
- PAM may improve straw performance to hydromulch or blanket level.
- Minimum PAM application rate of **20 lb/acre** is needed to be effective, 20-30 lbs/ac best.
- The application of PAM to bare soil is not a substitute for mulch.

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## Careful About Plastic Netting!



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## Careful with the PAM Mixing!



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## Questions



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