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Engine Dynamometer Testing of a Non-Road, Tier III Diesel Operated on Soy and Animal Based Biodiesel

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Introduction

- Engine dynamometer evaluation of Soy and Animal based biodiesel vs CARB diesel. Test fuels were: CARB Diesel, S20, 50, S100, A5, A20, and A100
- ISO 8178-C1, 8-mode, engine dynamometer test protocol was followed
- Test project is in support of ARB's Biodiesel Multi-Media Evaluation

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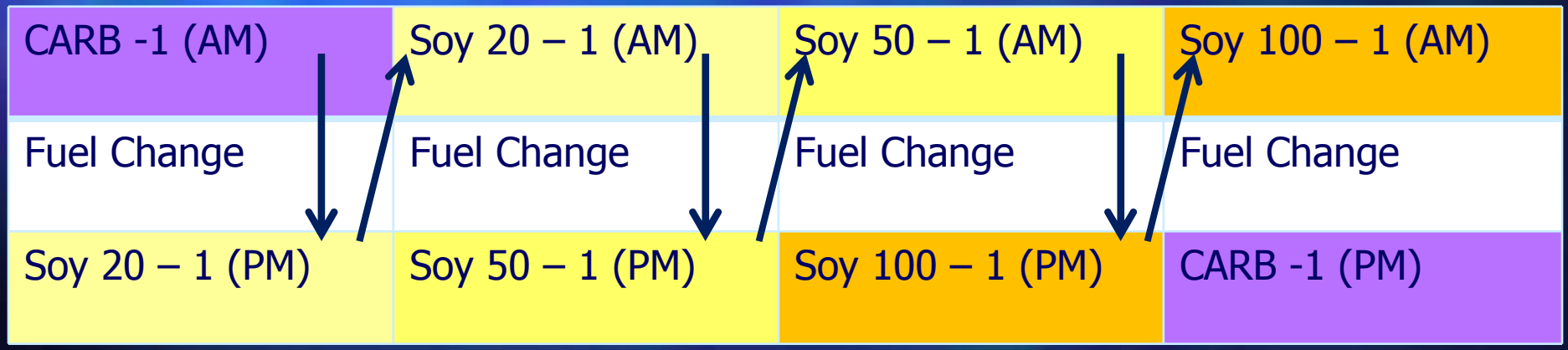
Fuel Test Sequence

Typical week of testing:

- Two, 8-mode tests per day with a fuel change
- Six replicates per fuel
- Seven fuels (CARB-D, S20, S50, S100, A5, A50, A100)



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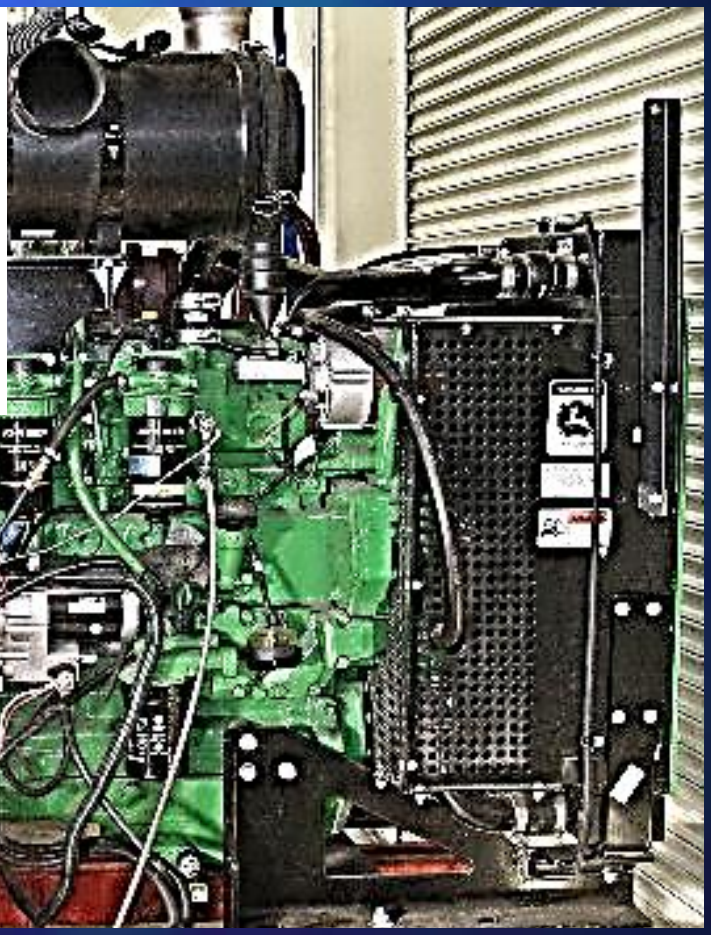
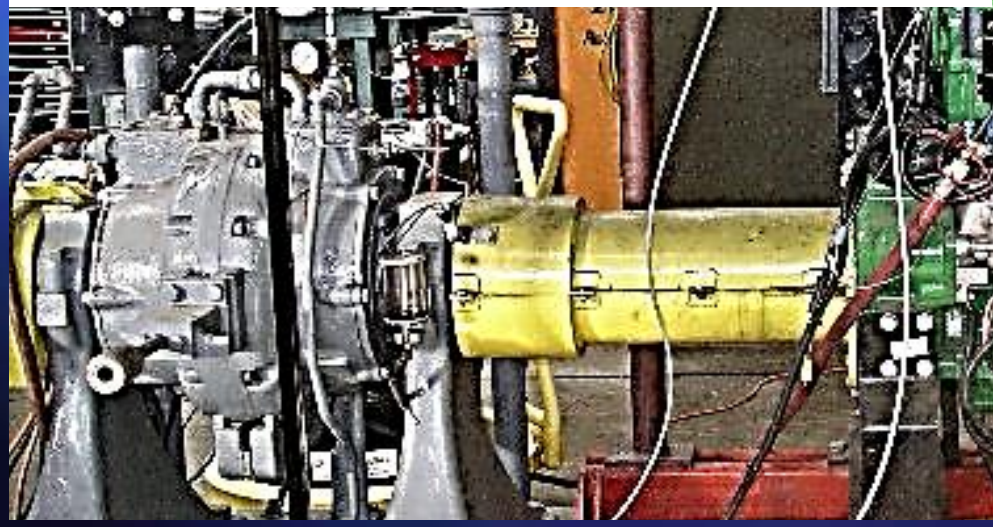
Test Engine: 2009 John Deere 4045HF285

PowerTech E™ 4.5 L Engine
Model: **4045HF285**
JD Electronic Control
115 hp @ 2400 rpm
86 kW @ 2400 rpm





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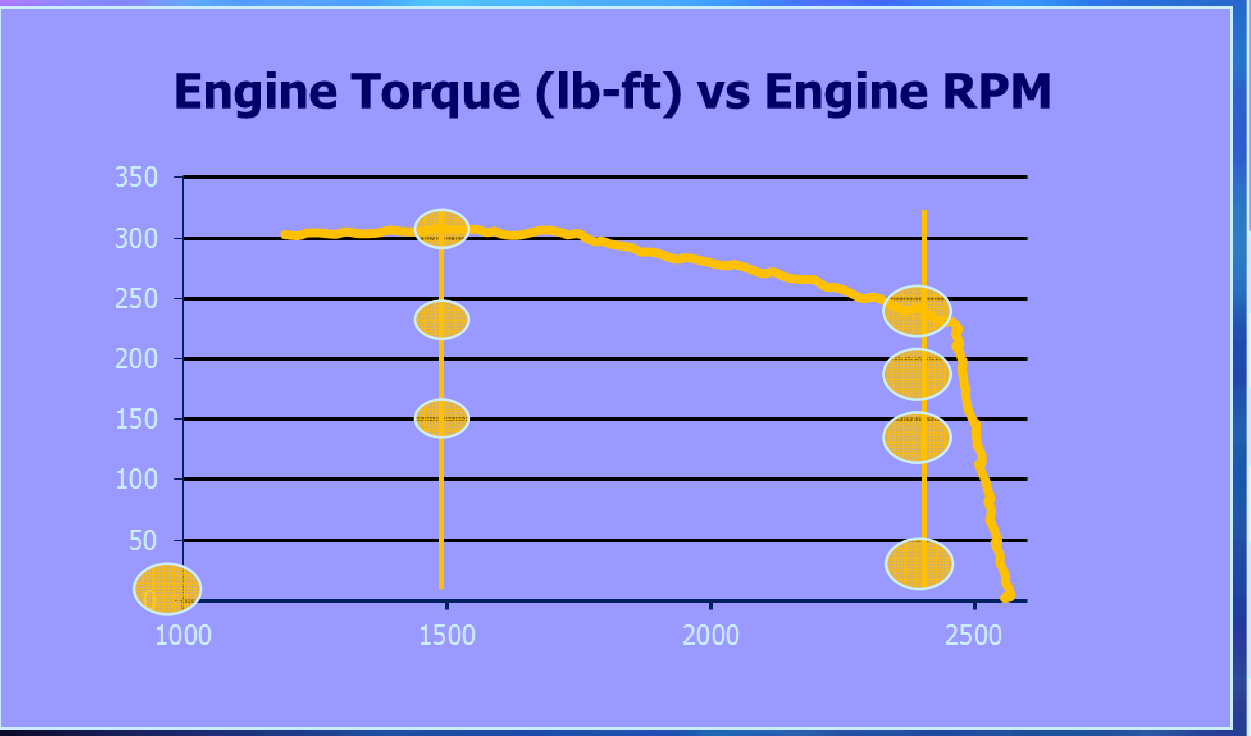
ISO 8178, Type C1, 8-Mode Test



Mode	Engine Speed	Engine Torque	Weighting Factor
1	Rated	100%	15%
2	Rated	75%	15%
3	Rated	50%	15%
4	Rated	10%	15%
5	Peak Torque	100%	10%
6	Peak Torque	75%	10%
7	Peak Torque	50%	10%
8	Idle	0%	15%

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Soy Based Biodiesel Test Results

Soy	Fuel	NOx (g/bhphr)	PM(g/bhphr)	CO (g/bhphr)	THC(g/bhphr)	CO2(g/bhphr)
Ave.	CARB	2.74	0.11	1.21	0.17	643.2
	S20	2.82	0.08	1.17	0.16	650.7
	S50	2.95	0.07	1.07	0.15	648.9
	S100	3.12	0.05	0.91	0.12	656.7
COV	CARB	1.8%	16.4%	3.0%	13.5%	0.9%
	S20	1.3%	14.8%	4.6%	10.0%	1.0%
	S50	2.0%	22.4%	4.6%	7.4%	0.1%
	S100	2.0%	19.7%	1.8%	5.5%	0.5%
% Diff.	**S20**	**2.8%**	**-23.6%**	**-3.7%**	**-5.2%**	**0.7%**
	S50	**7.5%**	**-31.7%**	**-11.8%**	**-12.3%**	**0.9%**
	S100	**13.8%**	**-55.9%**	**-25.1%**	**-27.5%**	**2.1%**

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Animal Based Biodiesel Test Results

Animal	Fuel	NOx (g/bhphr)	PM(g/bhphr)	CO (g/bhphr)	THC(g/bhphr)	CO2(g/bhphr)
Ave.	CARB	2.67	0.11	1.24	0.15	649.4
	A5	2.64	0.10	1.23	0.14	652.5
	A20	2.68	0.09	1.16	0.13	656.6
	A100	2.87	0.05	0.88	0.08	657.4
COV	CARB	1.41%	7.02%	4.82%	18.66%	1.13%
	A5	2.18%	6.33%	4.27%	11.75%	1.32%
	A20	2.39%	9.59%	3.15%	7.27%	1.01%
	A100	2.32%	9.74%	2.57%	5.27%	0.96%
% Diff.	**A5**	**-1.0%**	**-5.6%**	**-1.3%**	**-7.9%**	**0.5%**
	A20	**0.7%**	**-21.8%**	**-7.0%**	**-13.6%**	**1.1%**
	A100	**7.6%**	**-55.4%**	**-29.5%**	**-47.1%**	**1.2%**

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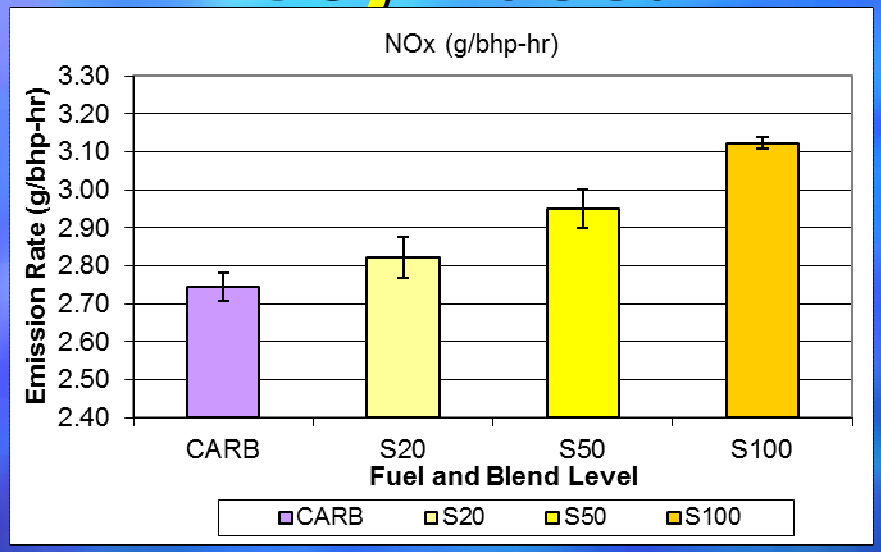
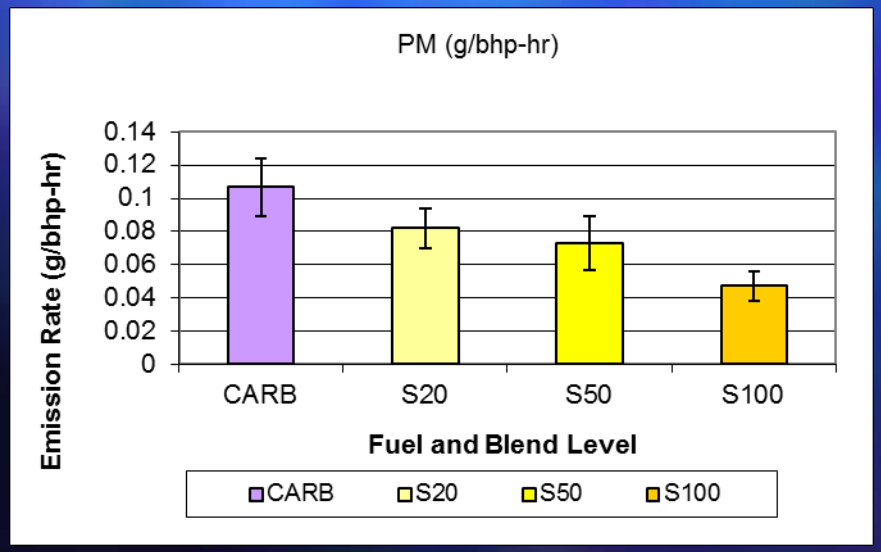
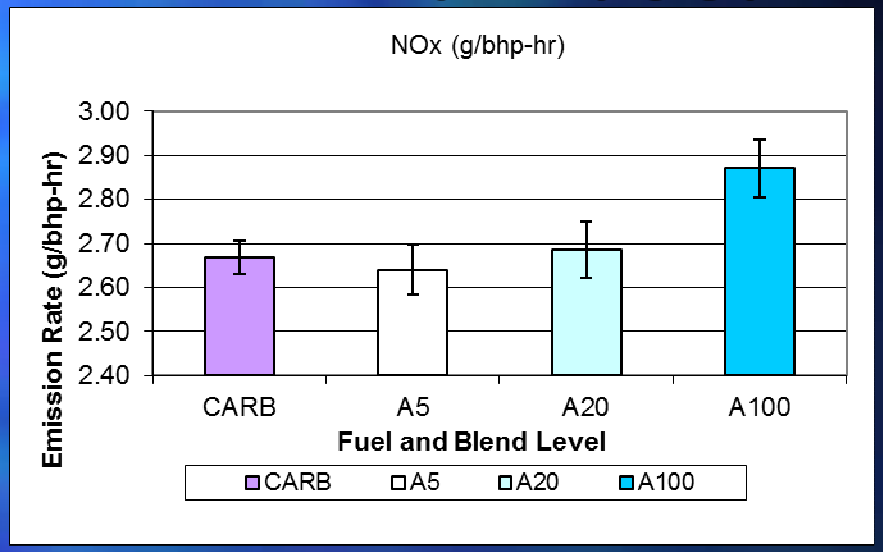
Results (NOx and PM)

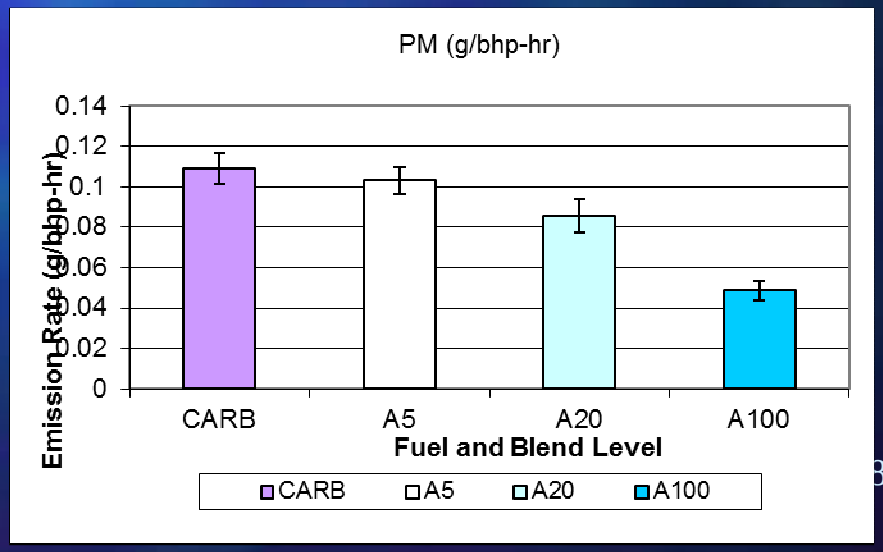
Soy Based





Animal Based





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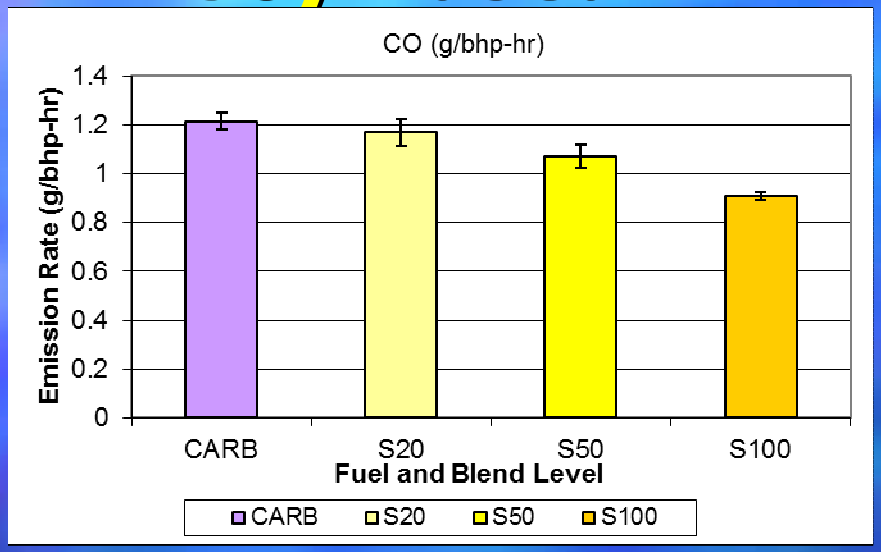
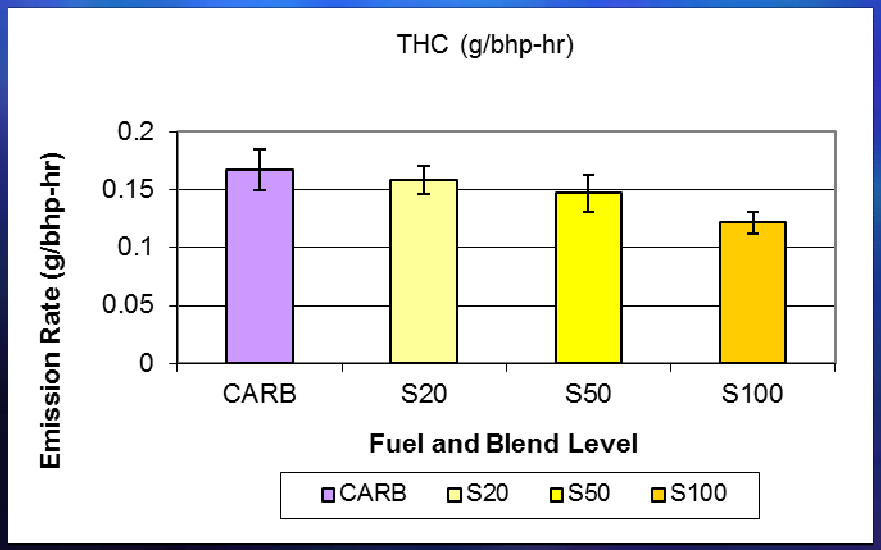
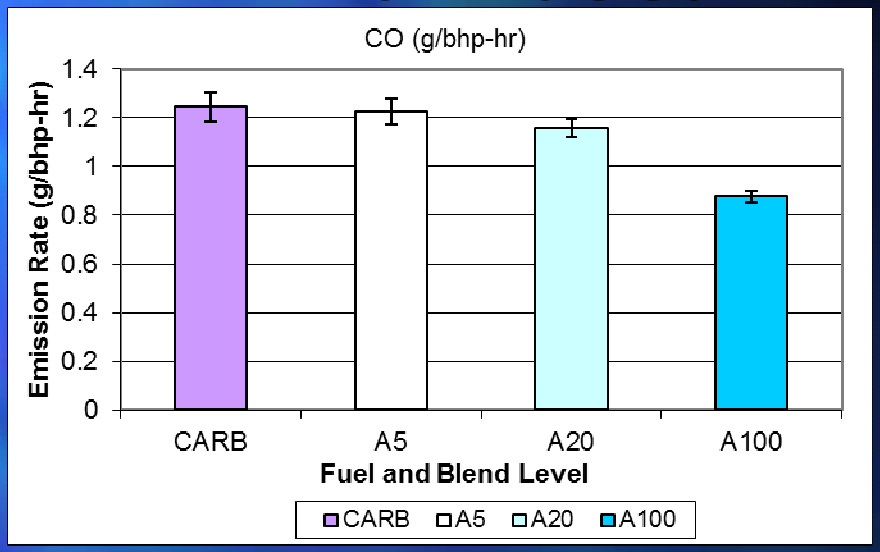
Results (CO and THC)

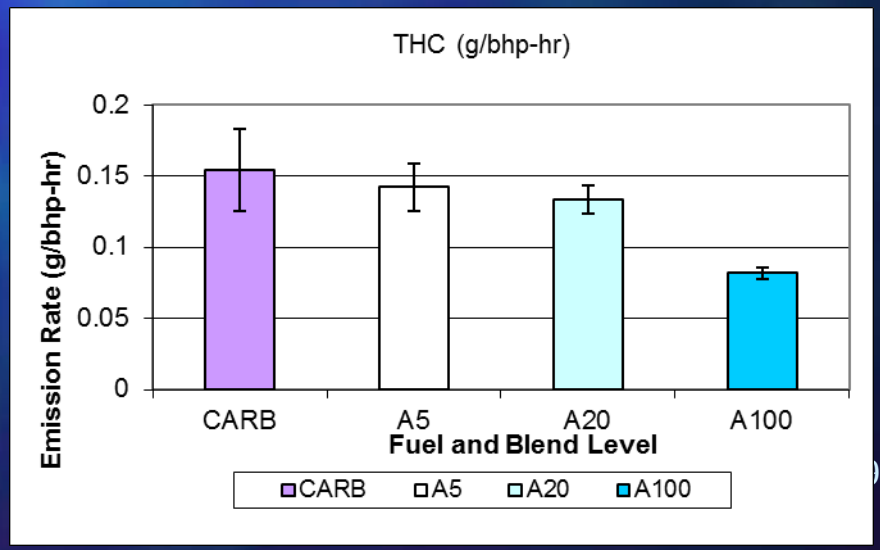
Soy Based





Animal Based





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Conclusions

- NOx increases were observed for both the Soy and Animal based fuels; however, the Animal based increases were smaller in magnitude than the Soy based fuel (7.6% vs 13.8% for A100 & S100, respectively). [1]
- Significant PM emission reductions (~55%) were observed for both the S100 and A100 test fuels.
- Reductions in CO and THC were observed with all biodiesel fuel blends.
- Long term effects of various fuels were not evaluated in this study.

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1

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