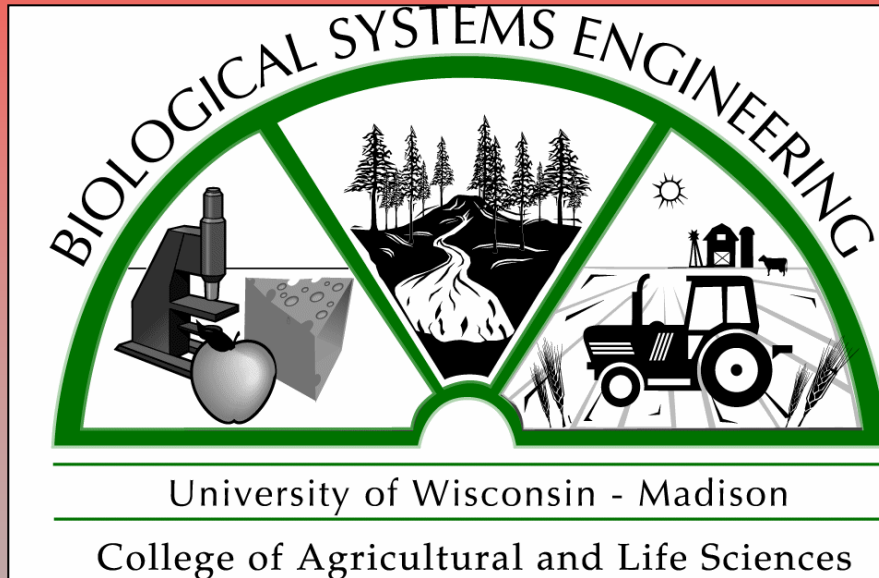


SOURCES AND USES OF BIODIESEL FUELS

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Biodiesel Fuels

- Background
- Biodiesel production and sources
- Difference between biodiesel and petroleum diesel
- Selecting a biodiesel source

Background

➤ Rudolph Diesel

Designed compression ignition engine in 1897

Used peanut oil

➤ Petroleum fuels

Increased need for fuels-gasoline, heating oil

Refined crude oil to meet specific use needs

Introduced constraints due to emissions

Modified engines

Modified fuels

Biodiesel Production and Sources

Sources of Biodiesel

World market (2002)

Canola/rapeseed – 84 %

Sunflower – 13 %

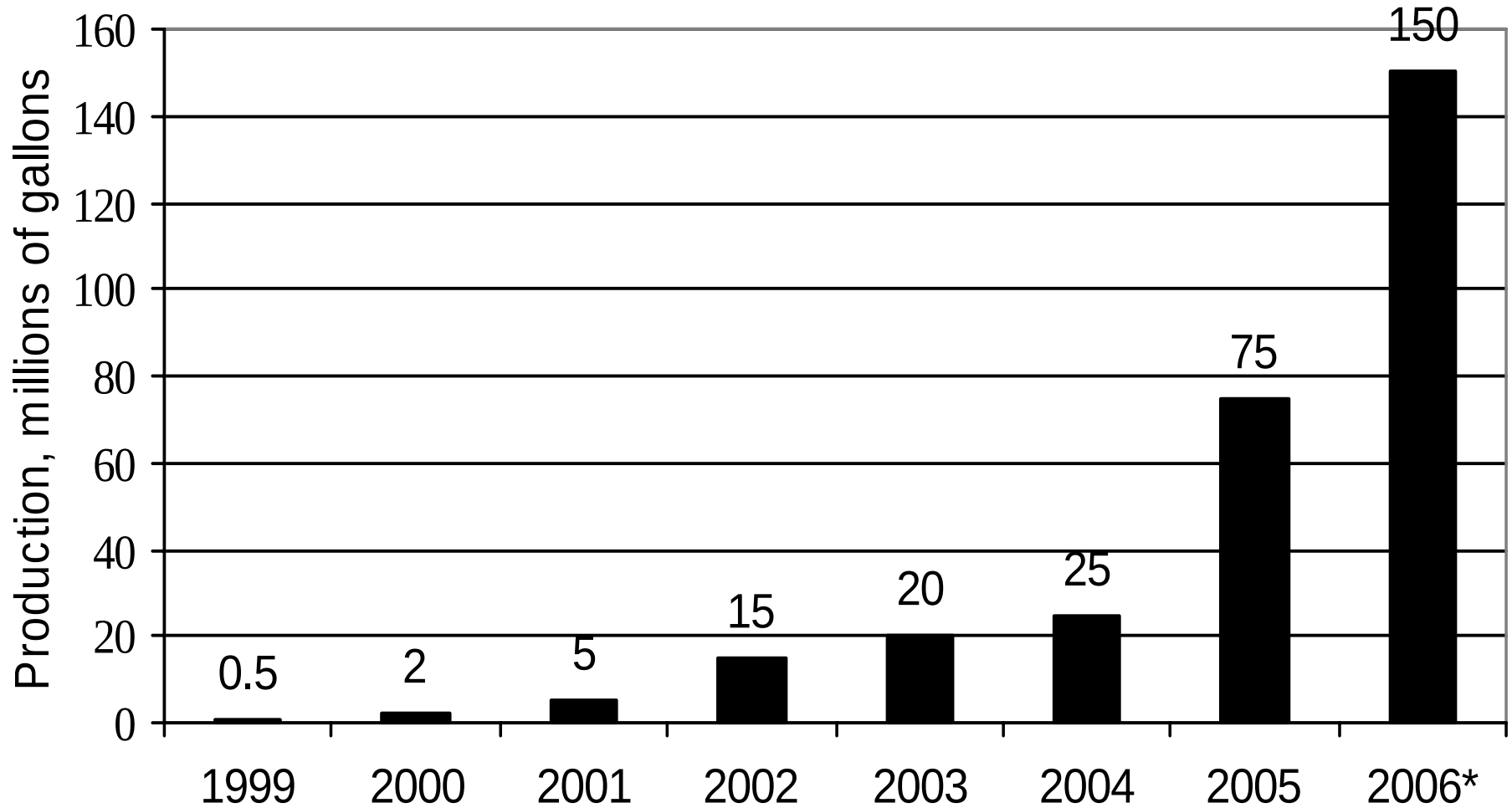
Soybeans – 1 %

Palm – 1 %

Production biodiesel - 2002

Eastern Europe – 550 mil. gal.

US – 15 mil. gal. and growing



Production of Biodiesel Fuel in the US (*2006 estimate)

Sources

Plants

Canola/rapeseed

Soybeans

Sunflower

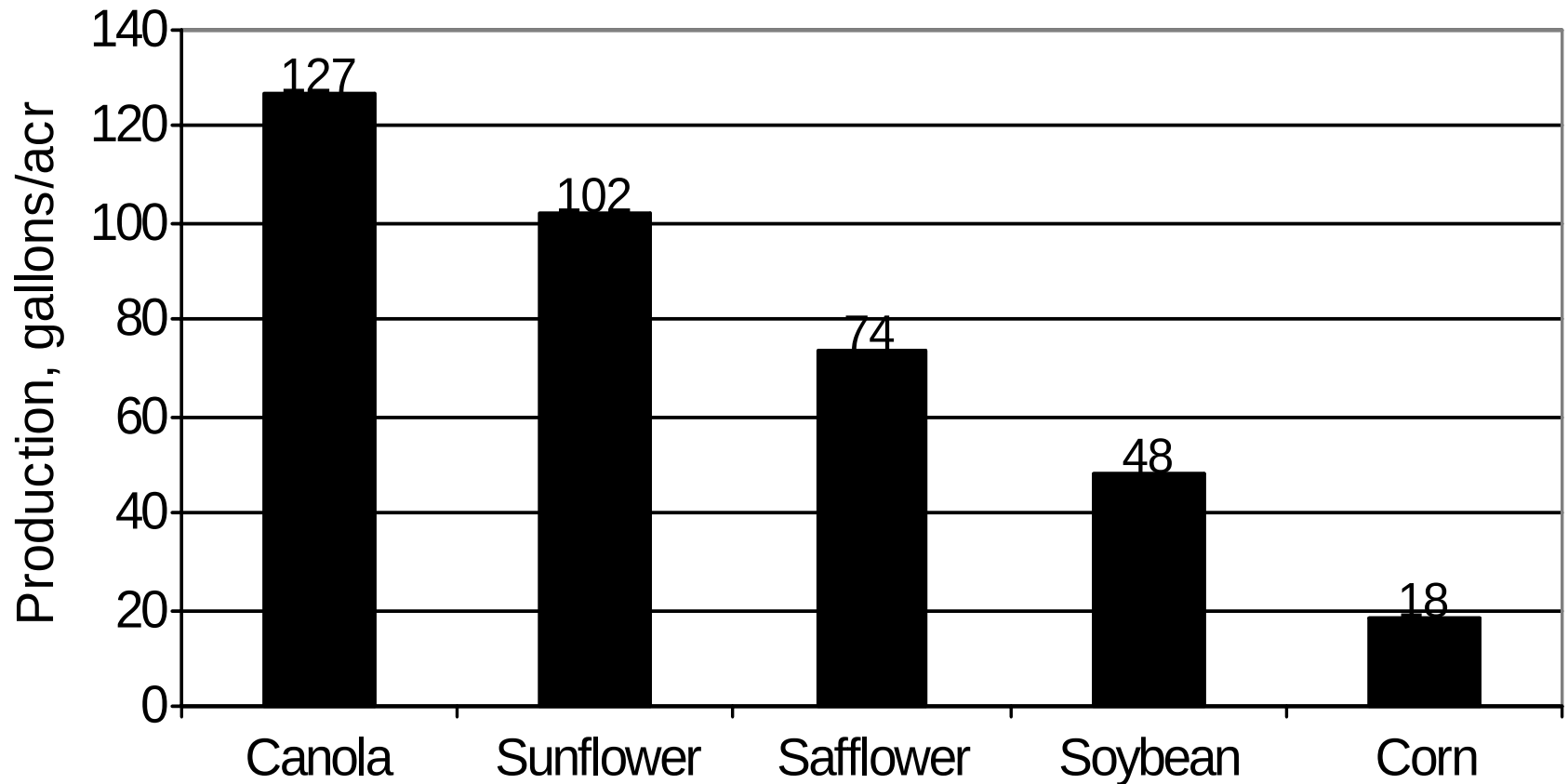
Safflower

Corn

Animal fats

Algae





Production of oil in gallons per acre.

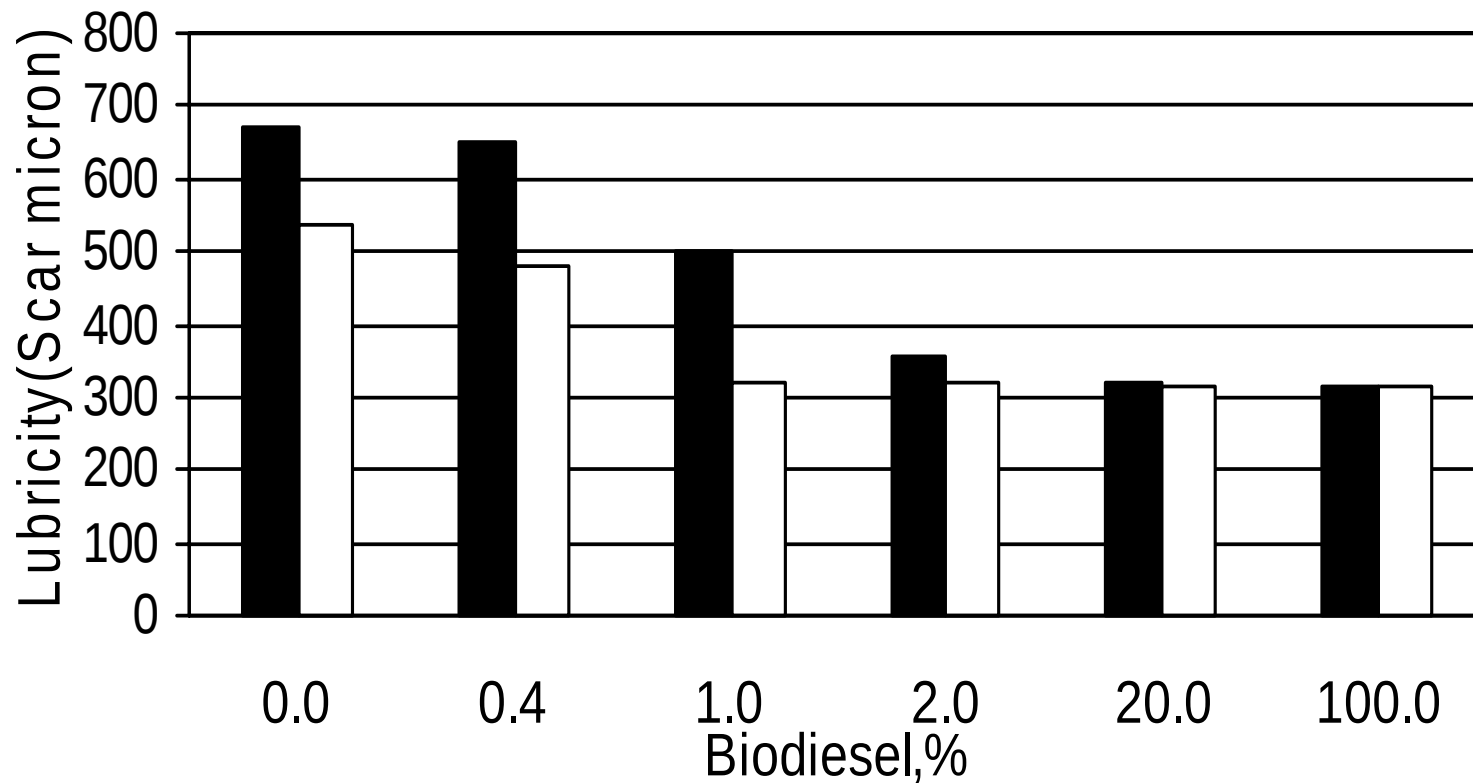
Differences – biodiesel and diesel

- Characteristics – positive
 - Lubricity
 - Cetane rating
 - Environmental emissions
- Characteristics – negative*
 - Cloud and pour point
 - Water contamination
 - Solvent properties

*Can be addressed with additives and proper handling and storage

Lubricity

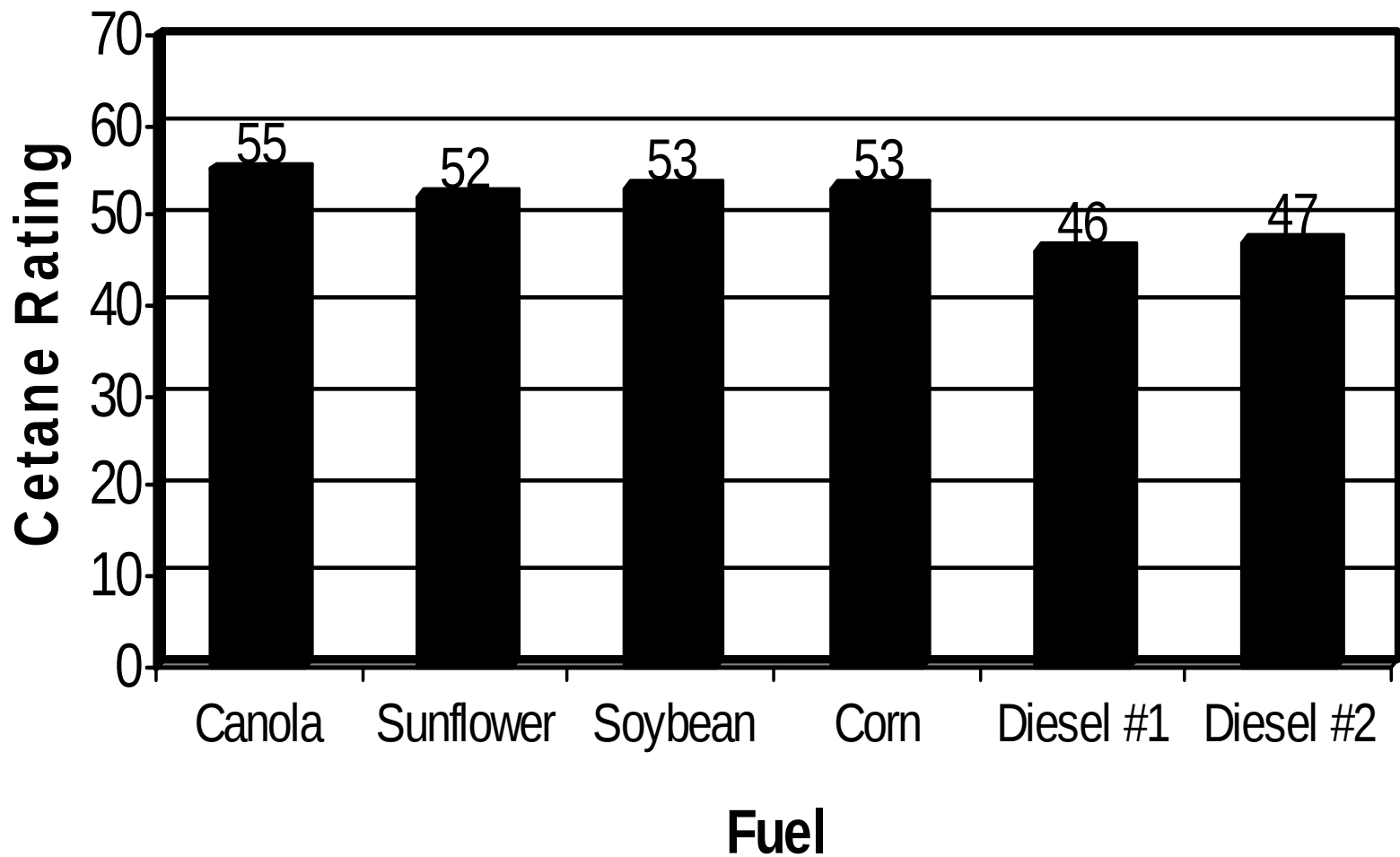
- Ability of the fuel to lubricate
- Needed for fuel pump and injectors
- Small tolerances and high pressures create greater need
- Test-ball on cylinder lubricity evaluator
- One tractor mfr. recommends 450 microns or less
- Biodiesel improves lubricity of petroleum diesel
 - Improves until 2 % biodiesel
 - Remains constant beyond 2%



Lubricity for diesel fuel and blends of biodiesel
(lower values are better)

Cetane rating

- Indicates ignition quality of diesel fuel
 - Related to diesel knock – ignition delay
 - Improved starting in cold weather
 - Faster warmup
- General US market range: 33 – 64
- One tractor mfr. recommends 45 to 50
- Plant sources of biodiesel fuels:
 - Higher than petroleum diesel fuels
 - Similar to each other



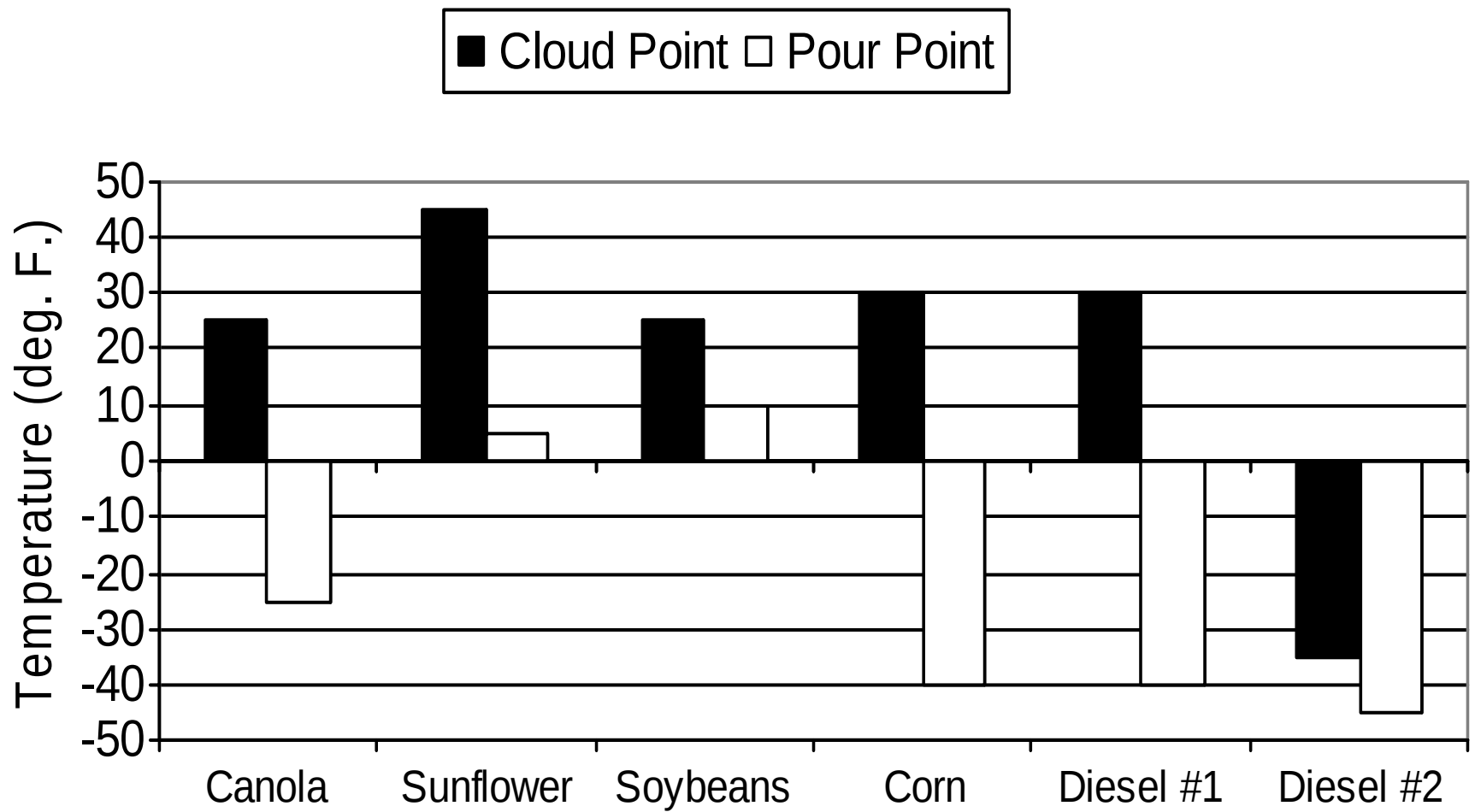
Cetane rating of diesel fuels from various sources

Energy Content

- Biodiesel has 8 to 10 % less energy per pound than petroleum fuels
- Biodiesel is 4 to 5 % more dense than petroleum fuels
- Biodiesel has 4 to 6 % less energy per gallon than petroleum fuels
- Biodiesel blends of less than 20 %, energy differences are likely not noticeable to the operator

Cloud and pour points

- Cloud point - temperature where wax crystals form as temperature is lowered
- Pour point – temperature where fuel is no longer pumpable
- One tractor mfr. recommends the cloud point should be 10° F. below the coldest temperature
- Points vary with biodiesel fuels sources
- Two solutions:
 - Antigel additives
 - Heated fuel tank



Pour and Cloud points for several diesel fuels

Emissions

➤ Decreased emissions of:

Sulfur (greatest challenge in petroleum fuels – lubricity related)

Aromatics

Hydrocarbons

➤ Slight increased emissions of:

Nitrous oxides

Solvent issues

- Biodiesel acts a solvent compared to petroleum diesel fuel
- When switching to biodiesel,
 - dirt from fuel tank etc. will dislodge and clog the fuel filter more quickly
 - fuel filter should be changed at half the interval initially

Water issues

- Water is more of a problem in biodiesel fuels
 - Microorganisms growth risk is greater
 - Microorganisms can clog fuel filters
- Solutions
 - Good housekeeping practices
 - Keep tanks filled
 - Service water traps more frequently
 - Fuel caps properly installed
 - Water trap on fuel storage tanks

Selecting a Biodiesel Source

- Fuel meets American Society for Testing Standards
 - ASTM D975-06b – Diesel fuel oils
 - ASTM D6751-06a – Biodiesel fuel blend stock
- National Biodiesel Board Quality assurance Program, BQ-9000
 - Voluntary program
 - Accreditation for biodiesel producers
 - Certification for biodiesel marketers

Closing remarks

- Biodiesel fuels have advantages
- Biodiesel fuels have disadvantages which can be overcome

QUESTIONS