

WILLIAMS LABORATORIES  
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1) Alteration in seed oil combustibility by a soybean chlorophyll mutant.

Crop farmers are understandably interested in use of vegetable products as petroleum substitutes. Much of this interest now centers around fuels for internal combustion engines. Use of "raw" or slightly modified seed oils as diesel fuel is attractive for a number of reasons: 1) oil extraction is a rather simple, straight-forward process; 2) the high-protein by-products are already being used in commercial animal feed supplements; and 3) energy and dollar cost balances are easily calculated, and seem to favor on-farm processing. Short of "breakthrough" increases in yields, commercial development of seed oil fuels for non-farm use is probably unrealistic. This is not to say that all vegetable oils have no promise for commercial development.

Essential to achieving efficient adaptation of vegetable oils as fuels for internal combustion engines will be alteration of engine design and secondary modification of vegetable oils themselves. Genetic modification is an option which, at present, holds unknown promise. Accumulation of experience with vegetable oil fuels will undoubtedly add to the present body of knowledge about desirable chemical qualities for breeders to guide on.

During my high school days in the 1950s, I worked extensively with pulse-jet engine design and combustion. Last fall, with a long leftover engine and test stand, I undertook a brief study of pulse-jet combustion character of seed oils from several soybean varieties and mutants.

The pulse-jet engine is literally "a horn that blows itself." With some acoustical complications, it is simply a tube with reed- or leaf-type valves and a fuel injection system at one end. A spark plug, a compressed air source, and an explosive-at-ambient-pressure fuel-air mixture are required for starting. Once started, compression and combustion are self-sustaining, and fuels with low volatility and high flash point can be substituted for the gasoline or propane "starter."

The engine I used in my tests consumes 15-20 gm of fuel per minute and generates 150 to 200 gm of static thrust. The measure of "combustion efficiency" used for comparison of raw seed oils was gm of thrust/gm of fuel/sec. An "emissions trap" consisting of a 2 lb coffee can stuffed with glass wool was placed into the exhaust path 20 cm from the engine nozzle. This trap was

dried in a 200°C oven for 15 minutes, weighed, "run" for one minute, dried for another 15 minutes, and reweighed to get a measure of "non-volatile" emissions.

I detected essentially no varietal differences in "combustion efficiency" or "emissions." To my surprise, however, one chlorophyll mutant (phenotypically similar to  $y_9$ , though of untested allelism) gave consistently higher (ca. 10%) combustion efficiency values and lower (ca. 15%) emissions values than all others tested, including the "normals."

I have enlisted the help of local college chemistry departments in comparing oil from this mutant with its parent line ('Williams'). At this point, I can only say that the mutant seems to have slightly lower than normal viscosity. If my measurements can be taken seriously, they indicate that genetic modification of seed oil fuels may indeed have a future. I would be happy to correspond directly with anyone about details and future developments (and seeds) on this matter.

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