

ACCOMPLISHMENTS REPORT

Northwest Regional Biomass Research Center

October 2016 – September 2017

Submitted by Dan S. Long, Coordinator

Research Units Reporting:

Forage Seed and Cereal Research Unit – Corvallis, OR

Soil and Water Conservation Research Unit – Pendleton, OR

Agricultural Systems Research Unit – Sidney, MT

Jet fuel from 18 cool-season oilseed feedstocks evaluated in a semi-arid environment.

Renewable jet fuel feedstocks can potentially offset the demand for petroleum-based transportation resources and diversify cropping systems. However, identifying suitable feedstock supplies remains a primary constraint to adoption. ARS researchers in **Sidney, Montana** conducted a 4-yr study to investigate the yield potential of six winter- (*Brassica napus*, *Brassica rapa*, *Camelina sativa*) and 12 spring-types (*Brassica carinata*, *Brassica juncea*, *B. napus*, *B. Rapa*, *C. sativa*, *Sinapis alba*) of cool-season oilseed feedstocks in eastern Montana dryland cropping systems. A camelina variety named 'Joelle' was the only fall-seeded variety that survived the typically harsh northern Great Plains winters. Hail storms caused up to 95% yield loss in spring camelina types in 2 of 4 years in the study, but the fall-seeded 'Joelle' was harvested before the hail occurred showing the benefit of an early maturing crop in regions prone to late season hail. Identification of this winter-hardy variety will provide a beneficial option for diversifying dryland cropping systems and mitigating the risk of crop failure. Across all species and varieties, seed yields ranged from about 200 to 2000 kg/ha. Overall, winter camelina (1400 kg/ha) in addition to spring types of *B. napus* (1900 kg/ha), *B. carinata* (1300 kg/ha), and camelina (1800 kg/ha) showed the best potential for jet fuel feedstocks in the semi-arid northern Great Plains, USA.

Fertilizer N inputs determined for biomass feedstock in a semi-arid environment. Renewable fuel feedstocks help offset demand for petroleum-based energy resources. Switchgrass, a warm-season perennial grass, has been utilized as feedstock for lingo-cellulosic ethanol production and direct energy via combustion, but little is known about switchgrass potential in the northern Great Plains or the impact of N fertilizer application on biomass production in semi-arid environments. ARS researchers in **Sidney, Montana** initiated a long-term study in 2009 to determine the impact of four fertilizer N rates (0, 25, 50, 75 lb/acre) applied annually on switchgrass production. Biomass from 2011 to 2015 ranged from 0.8 to 5.5 and averaged 2.6 ton/acre across N rates. Overall, fertilized switchgrass produced 2.9 ton/acre biomass and responded to fertilizer N application in three of five years, but response to rates above 25 lb/acre was inconsistent.

Spectral yellowness index accurately predicts yield of canola. Bright yellow canola flowers can adversely affect the ability to predict above-ground biomass, which is an important parameter for estimating crop yield. ARS scientists with the Soil and Water Conservation Research Unit in

Pendleton, Oregon determined how yellow canola flowers influence the overall reflectance of light from the crop canopy. Values of a novel spectral index, computed from the ratio of the green and blue wavebands, were strongly related with variation in canola flower density. By accommodating this flower variation, the new index improved the estimation of plant biomass and leaf coverage, and the index also performed well when predicting oilseed yield based on the premise that yield is directly proportional with flower and seed pod numbers. The index is potentially useful to private firms and government agencies that monitor crop conditions and estimate crop yields at county and state levels. Crushing plants can use this information to find and procure oilseed, which helps minimize storage and transportation costs.

Sulik, J.J., and D.S. Long. 2016. Spectral considerations for modeling yield of canola. *Remote Sensing of Environment*. 184:161-174.

Tall wheatgrass feedstock potential and response against invasive weeds. The abundant productivity of grass in stream buffers can provide non-food feedstocks for advanced cellulosic biofuels. ARS researchers with the Soil and Water Conservation Research Unit in **Pendleton, Oregon**, examined the management issues related to production of tall wheatgrass, alfalfa, and a mix of these two species along stream channels within 4.5M acres of dry cropland in the inland Pacific Northwest. Results showed that tall wheatgrass and a mix of tall wheatgrass and alfalfa could effectively compete against non-native annual weed species, especially where tall wheatgrass was the predominate species in the mix treatment. Weed control before seeding was important to establishing a crop capable of out-competing weeds, followed by diligent weed control following overbank storm flows. Tall wheatgrass is a viable cellulosic biofuel crop to help meet the Renewable Fuel Standard, but weed management will be critical to prevent crop failure in the driest portions of the region.

Williams, J.D., D.S. Robertson, and S.B. Wuest. 2015. Biofuel feedstock production potential in stream buffers of the inland Pacific Northwest: Productivity and management issues with invasive plants. *Journal Soil and Water Conservation* 70(3):156-169.

Ethanol production potential of ephemeral stream buffers in Pacific Northwest dryland. Meeting the goals set by the Energy Security and Security Act for production of lignocellulosic biofuels requires the evaluation of all potential feedstock sources. The most productive areas of the arid and semiarid west are those near to rivers and streams. In the dryland cropping region of the interior Pacific Northwest, much of the land adjacent to streams has been taken out of crop production to create conservation buffers. ARS researchers with the Soil and Water Conservation Research Unit in **Pendleton, Oregon** evaluated the productivity and extent of these areas using a perennial grass, tall wheatgrass, commonly used in conservation buffers. Although annual productivity within our research sites was similar to that found in the Midwest and southern portions of the United States, the area suitable for this level of productivity is not sufficient to make a substantial contribution to lignocellulosic biofuel production.

Williams, J.D., Robertson, D., Long, D.S., Wuest, S.B., Kumar, D., Juneja, A., and Murthy, G. 2016. Ethanol production potential from conservation buffers in the inland Pacific Northwest. *Journal*

of Renewable and Sustainable Energy. 8(5): <http://dx.doi.org/10.1063/1.4962414>. Log No. 309904

Biochar amendments to abandoned mine soils facilitate phytostabilization of metals to improve water quality. In the United States, over 12,000 miles of rivers and streams are adversely affected by contaminated water draining from abandoned mines. Phytostabilization is a highly effective method that prevents metals and low pH runoff from entering sensitive waterways. However, soil conditions at mine sites are not typically conducive to plant establishment. ARS scientists in **Corvallis, Oregon** in collaboration with other ARS and Environmental Protection Agency researchers, determined that biochar amendments to mine soils increase soil pH, permeability, and sequester heavy metals in such a way that plants are able to establish and reproduce. This discovery may provide remediation specialists with a cost-effective and simple method to remediate abandoned mines, and improve water quality, while simultaneously providing a biochar-based market for low-value agricultural residues.

Phillips, C.L., Trippe, K.M., Whittaker, G.W., Griffith, S.M., Johnson, M.G., Banowetz, G.M. 2016. Gasified grass and wood biochars facilitate plant establishment in acid mine soils. *Journal of Environmental Quality*. 45:1013-1020. doi: 10.2134/jeq2015.09.0470.

Novak, J.M., Ippolito, J.A., Lentz, R.D., Spokas, K.A., Bolster, C.H., Sistani, K.R., Trippe, K.M., Phillips, C.L., Johnson, M.G. 2016. Soil health, crop productivity, microbial transport, and mine spoil response to biochars. *BioEnergy Research*. 9(2):454-464.

On-farm biochar production meets the on-farm demands for both power and liming amendments. Biochar, a carbon rich soil amendment has been used in small farms to improve soil health and soil moisture. However, limited quantities and the cost of biochar limit biochars' use in large-scale agriculture. ARS researchers in **Corvallis, Oregon** determined that the use of biochar in wheat production is feasible if the biochar is produced on-farm, using locally abundant residues. Additionally, scientists determined that biochar not only meets the demand for on-farm power and lime, but that it can also outperform lime as a soil amendment and increase wheat yield by 290%.