

Native plant
Grows in high desert
Resin in flowers and stems
AKA Gumweed

SAF from Native Crops on Arid Lands: the Case for Grindelia

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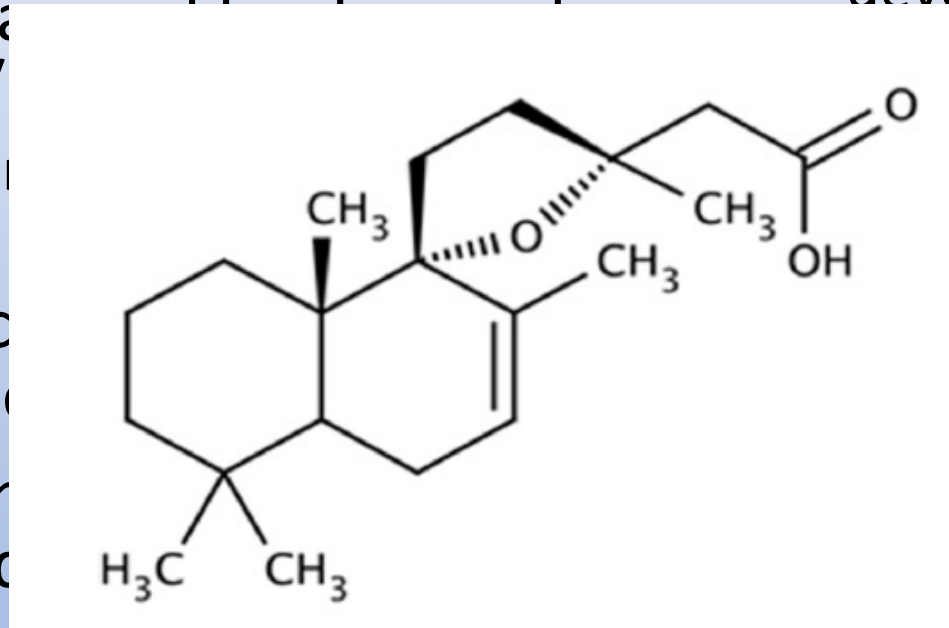
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Grindelia (gumweed)

Strengths

- Grindelia is indigenous in the high desert (NV, OR, ID, UT, WA)
- Grows on marginal soils with little water /
 - Doesn't compete for feed
- 1800 kg biocrude shown- high yield
- Biocrude composed of grindelic acid
 - Preliminary studies with biphasic catalyst have demonstrated success in upgrading



Challenges

- Not a commercial plant
 - Significant work is needed to develop agronomic models
- Feedstocks are unfamiliar with biorefinery
- Development is at an early stage
- Work to date is based on plants grown from wild seeds
- Requires a long-term strategy

Grindelia (gumweed)

Opportunity

- Yields are likely to increase substantially
- Biocrude is readily converted to jet-fuel-like molecules
- Low requirement for hydrogen
- Make good use of underutilized marginal lands in Western US
- Provide cash crop in rural areas facing challenges from draught and climate change

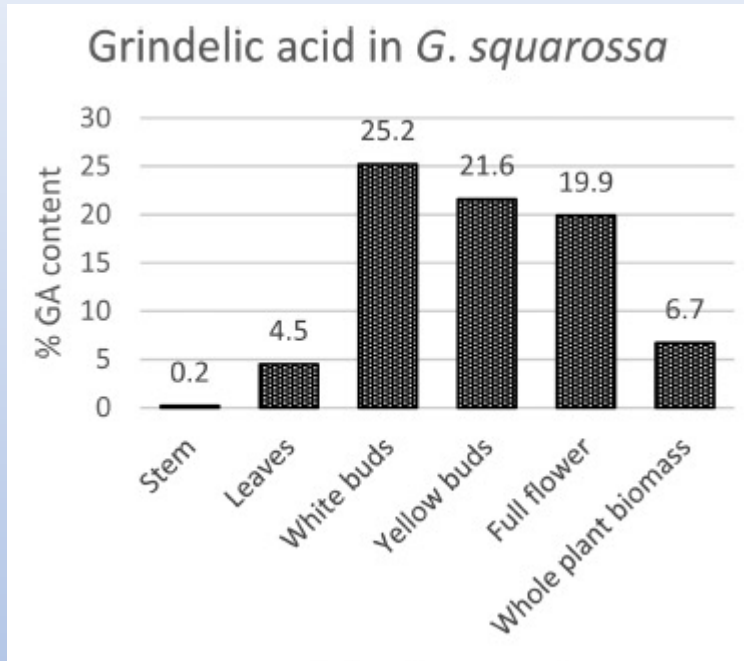
Path for development

- Screen accessions for biocrude yield
- Develop agronomic models
 - Common gardens
 - Field studies
- Develop enterprise budget for commercial production
- Evaluate markets for bagasse
- Develop supply chain / logistics
- Optimize catalytic upgrading
- Perform TEA and LCA to identify path of successful development

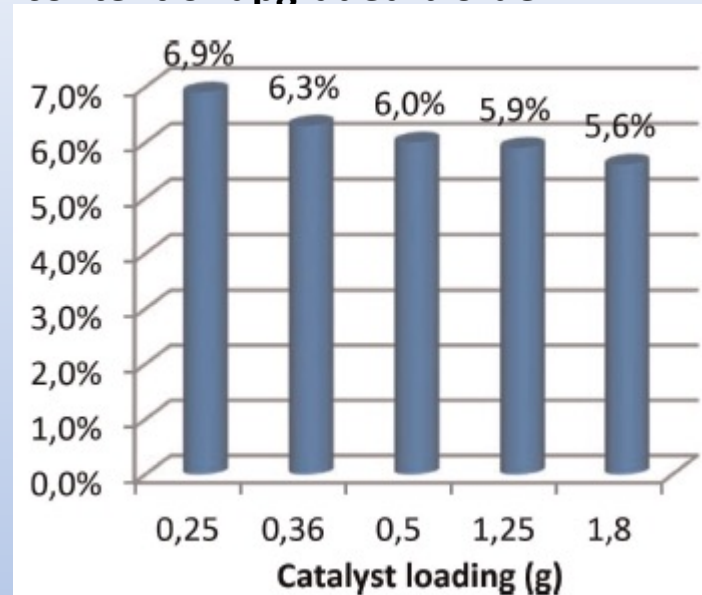
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Grindelia (gumweed)

Location of biocrude in Grindelia plant



Effect of catalyst loading on oxygen content of upgraded biofuel



HHV of upgraded biofuel

Table 7. Higher heating value test of the biocrude and the oil phase products after the reactions at various temperatures.

Sample	Reaction Conditions	HHV (MJ/Kg) ^[a]
1	Fresh <i>Grindelia squarrosa</i> EBC	31.20 ± 0.6
2	180 °C	39.10 ± 0.9
3	200 °C	39.20 ± 0.5
4	220 °C	40.33 ± 1.2
5	240 °C	42.64 ± 0.6
6	260 °C	42.65 ± 0.5
7	280 °C	42.82 ± 0.6