

Sugarcane at Gay and Robinson





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Organizations

- HARC
- DBEDT
- HNEI
- USDA, PMC Moloka`i
- UH, CTAHR
- NREL

Banagrass

- ❑ Cultivar of *Pennisetum purpureum*, a tropical grass species native to Africa
- ❑ Used for forage, biomass and orchard windbreaks

History

- ❑ Banagrass was introduced to Hawaii from Australia by the Hawaiian Sugar Planters' Association through normal plant introduction protocol in the mid 1970's.
- ❑ On release from quarantine in Hawaii after one year at Beltsville MD and one year on Moloka'i, banagrass was planted at the sugarcane breeding station at Maunawili, Oahu.

Biomass Attributes Noticed

In the 1980's and 90's:

- Vigorous growth and upright stature of banagrass were noted at Maunawili.
- It was increased and compared to sugarcane in HSPA biomass trials.

Biomass Trials

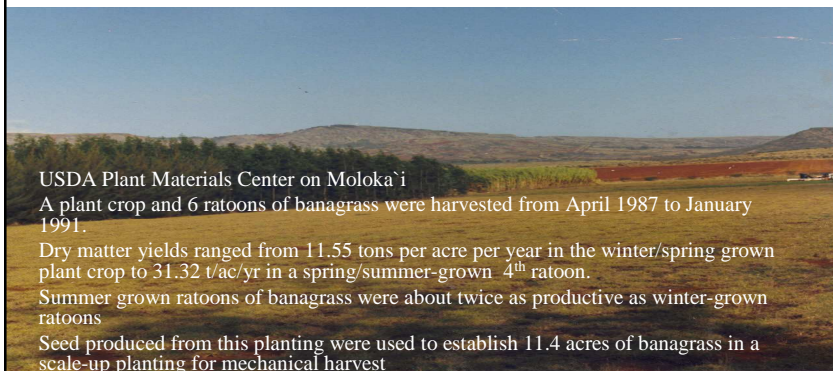
- In 1982 to 1984: First planted in “Energy Cane” trials in Ewa and Kunia on Oahu
- In 1986: included in the HSPA “Biomass to Energy” trial on Moloka`i*
- In 1988: propagated and planted in 5 standard HSPA replicated trials in comparison with sugarcane.

* Sponsored by DBEDT

Replicated Trial

- ❑ HSPA compared banagrass and sugarcane in 5 locations at sugar plantations on four islands (Wu and Tew 1989 HSPA internal report).
- ❑ Average plant crop yields (annualized) across all sites for banagrass were about equal to sugarcane yields at 18.5 tons of dry matter per acre per year.
- ❑ Ratoon yields were substantially higher at 42 tons dry matter per acre per year, about double that of sugarcane at the same locations.

HSPA “Biomass to Energy” Project*



USDA Plant Materials Center on Moloka'i

A plant crop and 6 ratoons of banagrass were harvested from April 1987 to January 1991.

Dry matter yields ranged from 11.55 tons per acre per year in the winter/spring grown plant crop to 31.32 t/ac/yr in a spring/summer-grown 4th ratoon.

Summer grown ratoons of banagrass were about twice as productive as winter-grown ratoons

Seed produced from this planting were used to establish 11.4 acres of banagrass in a scale-up planting for mechanical harvest

Funded by DBEDT

Banagrass Yield on Moloka`i

Harvest Number	Crop Days	Dry Matter*	Season
1	217	11.55	winter/spring
2	212	27.21	summer/fall
3	188	18.81	winter/spring
4	289	20.35	fall/winter
5	176	31.32	spring/sum
6	223	14.51	winter/spring
7	280	15.13	fall/winter

*Ton/Acre/Year

Scale-up Banagrass Planting, Moloka`i*PMC

- ❖ 0.73 ton of seed per acre was used to plant the 11.4 acre scale-up
- ❖ The plant crop dry matter yield was 26.1 t/ac/yr based on hand harvest of 12 replications.
- ❖ The ratoon yield was 30.1 t/ac/yr
- ❖ The average yield for the plant and ratoon combined was 28 tons/ac.
- ❖ 7 months harvest for plant and 8 months for the ratoon

*Osgood and Dudley 1996

Banagrass Plant Crop at 7 Months from Planting



Moloka`i Banagrass Harvest



Moloka`i Banagrass Harvest



Direct Loading into Truck



Mechanical Harvest Data*

❖ Harvester productivity (Ac/Hr)	0.65
❖ Average particle length (in)	11.3
❖ Bulk density (lb/cu foot)	7 to 8
❖ Actual Dry matter yield (ton/ac)	16.7
❖ Annualized Dry matter yield (ton/ac)	26
❖ Recovery (%)*	73
❖ Biomass harvest rate (T/Hr)	27

*Osgood, Dudley and Jakeway, 1996

**Determined from residue recovery (4.5 Tons)

Banagrass Characteristics

Positive

- ❖ High yield of biomass dry matter
- ❖ Rapid growth, fast close in, early harvest at 7 to eight months
- ❖ Low weed control cost, especially in ratoons
- ❖ Upright habit for harvest efficiency
- ❖ At least 7 ratoon crops before replanting,
- ❖ Planting and harvest with “off the shelf” sugarcane equipment

Banagrass Characteristics

Negative

- ❖ Poor germination of vegetative seed pieces and poor stands. Can be overcome by planting extra seed.
- ❖ Some weed potential especially in wet environments.
- ❖ Grown exclusively for cellulose. No useful soluble fraction as with sugarcane
- ❖ High ash content may be problem in energy conversion. May require milling before conversion
- ❖ No current research or breeding program making production risky.

Conclusions

- ❑ Banagrass is a highly productive biomass crop yielding more dry matter per acre-month than sugarcane in ratoons.
- ❑ At least 7 ratoons possible
- ❑ Ratoons often produce twice the biomass as the planted crop but this depends on the month harvested
- ❑ Field compaction will limit yield
- ❑ Summer-grown crops are significantly more productive than winter-grown crops
- ❑ Use depends on cellulose conversion technology

Concluding Remarks

- ❑ Bio-energy projects require large blocks of land
- ❑ Significant costs for growing, maintaining, harvest and transport.
- ❑ Industrial infrastructure requiring a long term outlook
- ❑ Integrated field and industrial operations
- ❑ High risk
- ❑ Guaranteed market for energy produced
- ❑ C4 grass biomass crops such as banagrass and sugarcane require large amounts of water and nutrient to achieve high yield.

Banagrass Plant Crop at 7 Months from Planting

