COOPERATIVE EXTENSION
UNIVERSITY OF HAWAI'I AT MĀNOA
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Cover Crops Adaptability to Water Stress

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Introduction

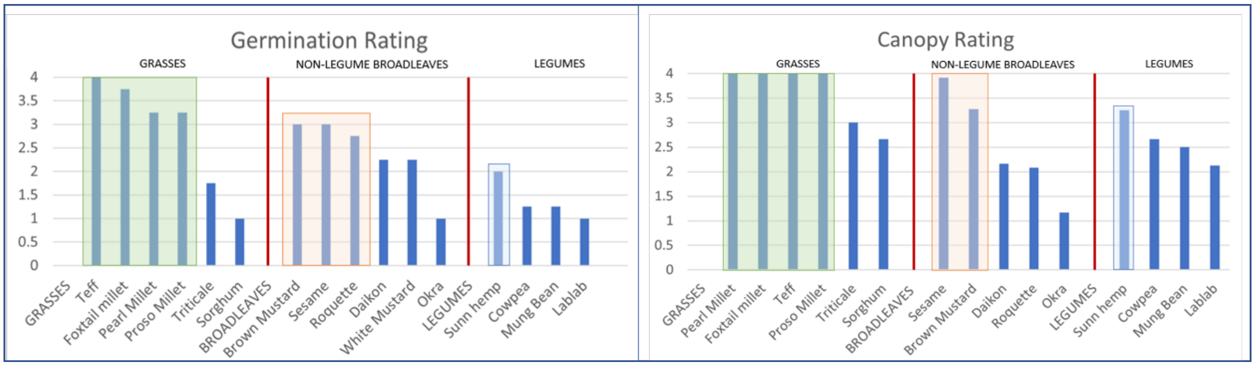
Reduced water availability threatens agricultural viability across the state. Management of soil moisture in crops is key to increasing drought resilience and critical to the future of cropping systems in Hawaii. Cover crops are increasingly being used for their ability to improve soil health, increase soil organic matter and nutrient availability, and increase soil water holding capacity.

This project aims to increase on-farm water use efficiency on agricultural lands through the combined use of cover crops and conservation management. The first phase of the project consisted of seasonal variety trials (late summer and mid-winter), where sixteen cover crop species were tested for drought tolerance at the Kula Agricultural Park.

We assessed the germination, canopy cover, and biomass production of 16 potential cover crops within three functional groups (grasses, legumes, and non-legume broadleaves) under irrigated and drought conditions during late summer (August-September). The top biomass-producing grasses were sorghum and pearl millet, top legumes were sunn hemp and cowpea, and the top non-legume broadleaves were brown mustard and sesame.

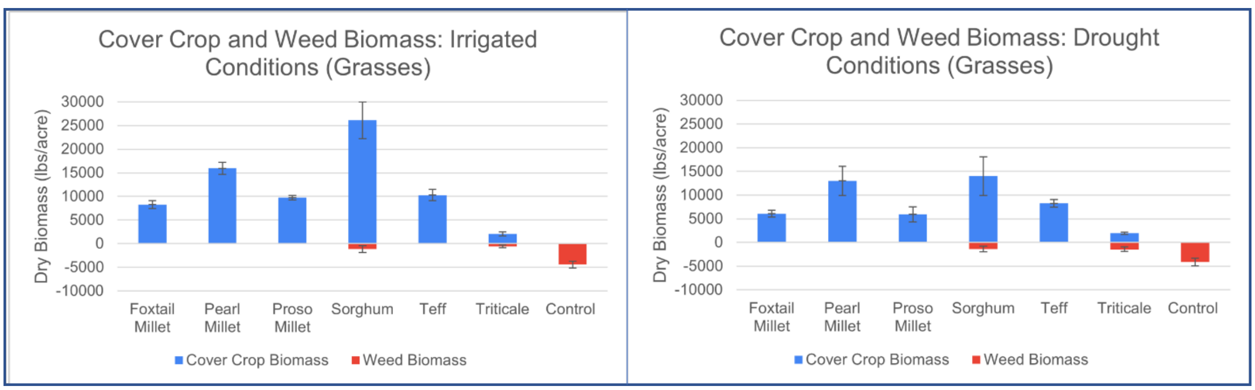
Table 1. Cover crops species tested for drought tolerance (Grasses, Non-Legume Broadleaves, and Legumes).

Grasses	Non-Legume Broadleaves	Legumes
Foxtail Millet	Brown Mustard	Cowpea
Pearl Millet	Daikon Radish	Lablab Bean
Proso Millet	Okra	Mung Bean
Sorghum	Roquette Arugula	Sunn Hemp
Teff	Sesame	
Triticale	White Mustard	

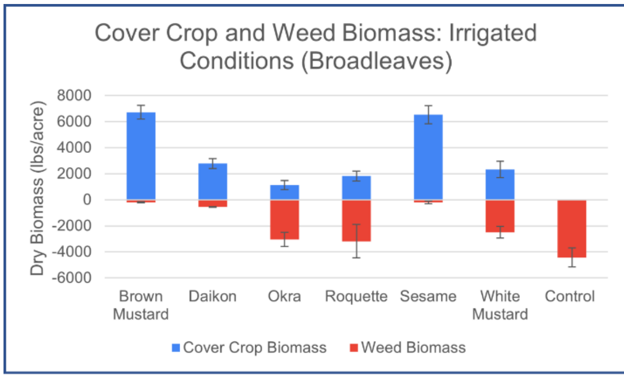


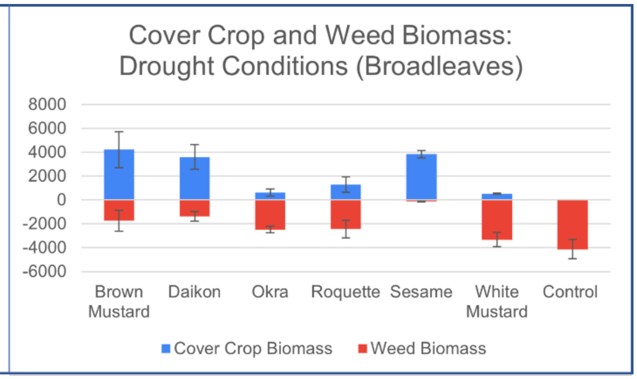
Germination rating is based on a 0-4 scale in a randomly selected 1 ft^2 area from photos taken 1 week after seeding. 0 = no germination; 1 = 1-5 seedlings; 2 = 5-10 seedlings; 3 = 10-50 seedlings; 4 = 50+ seedlings. Canopy rating is based on a 0-4 scale and estimated from photographs of 4'x5' plots. 0 = 0% cover; 1 = 0-25% cover; 2 = 25-50% cover; 3 = 50-75% cover; 4 = 75-100% cover.

Germination and canopy cover were both high in all grasses except triticale and sorghum. Brown mustard and sesame had the highest germination and canopy ratings of the broadleaves, and sunn hemp had the highest germination and canopy ratings of the legumes. Higher germination and canopy ratings corresponded with lower weed biomass at termination.

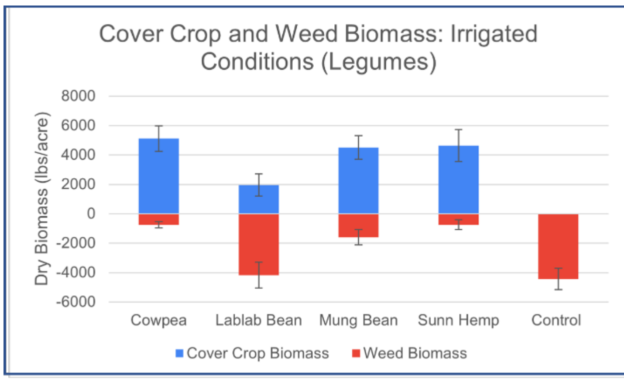


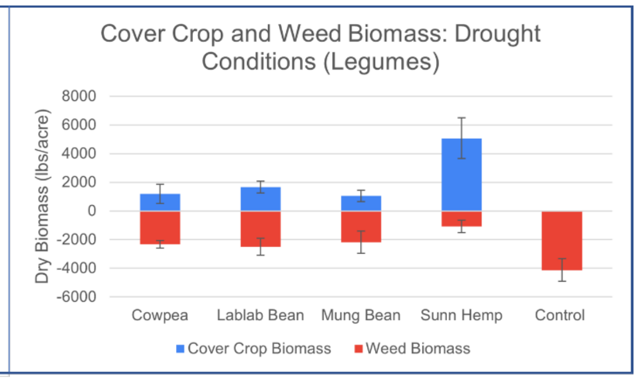
Sorghum and pearl millet were the top biomass producers under both irrigated and drought conditions. Sorghum biomass averaged around 26,000 lbs/acre under irrigated conditions and 14,000 lbs/acre under drought conditions. Pearl millet averaged around 16,000 lbs/acre under irrigated conditions and 13,000 lbs/acre under drought conditions. No weed biomass was present in any of the millet treatments or the teff, likely due to the high germination rate and canopy cover of these species. While sorghum produced the greatest biomass in both irrigated and drought conditions, it is important to note that weed suppression by sorghum was lower than other grass species likely due to the lower germination rating and canopy cover.





Sesame and brown mustard were the top biomass producers under both conditions, and daikon was also a top producer under drought conditions. Sesame and brown mustard both produced around 6,500 lbs/acre under irrigated conditions and 4,000 lbs/acre under drought conditions. Sesame had the lowest weed biomass, especially under drought conditions, likely attributable to the high germination rate and canopy cover of this species as compared with the other broadleaves tested.





Sunn hemp, cowpea and mung bean all produced high biomass when irrigated, producing between 4,500 and 5,000 lbs/acre. Sunn hemp had the highest biomass (around 5,000 lbs/acre) and lowest weed biomass under drought conditions. Sunn hemp's high germination rate and canopy cover early in the growth period likely contributed to the high weed suppression (low weed biomass) observed in the sunn hemp plots.

Conclusion

During the summer variety trial, pearl millet and sorghum, brown mustard and sesame, and sunn hemp produced the greatest biomass of the grasses, broadleaves and legumes respectively. Ultimately, the best cover crops for a given farm will depend on multiple factors, including timing of planting and availability of water, as well as farm goals for including cover crops in the rotation. For example, sorghum produces the highest biomass, making it very suitable for farms looking to increase the carbon input into their soil. However, it may not be the best choice for growers looking to increase weed suppression, due to its lower canopy cover early in growth.

Based on the data collected in this variety trial and the winter variety trial, we'll test 3 species blends using the top 2 biomass producing cover crops in each functional group. These blends will also be trialed on farms along with conservation practices such as no-till and strip tillage to optimize cover crop use and improve drought resiliency on farms in Maui County.

Acknowledgments

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