



PRODUCING SUCCULENT BIOMASS IN NAMIBIA

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NAMIBIA BIOMASS RESEARCH SYMPOSIUM 7 SEPTEMBER 2022

BACKGROUND

- Climate change mitigation strategy: carbon capture
 - Plants most efficient carbon capture machines
- Large scale deployment of “bioenergy with carbon capture and storage” (BECCS) technology
 - Conventional bio-energy crops
 - Intensive land and water use
- Competition with food production
- Carbon capture by water efficient plants
 - thrive where conventional agriculture fails
 - resilient to future warming



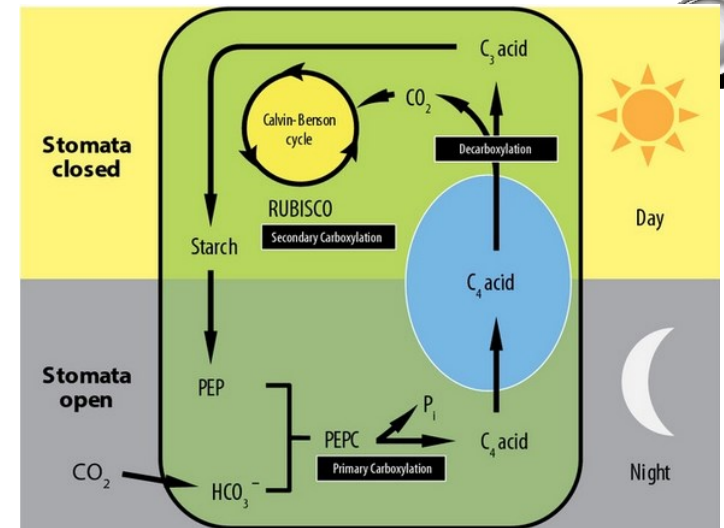
Jatropha curcas (Photo: Marco Schmidt, African Plants)



Euphorbia mauritanica (Photo: Vera De Cauwer)

SUCCULENT PLANTS AND CAM

- Water-efficient succulent plants
 - Morphology adapted to dry conditions
 - Crassulacean Acid Metabolism (CAM) mode of photosynthesis
 - As little as 10% of water needed by conventional plants yet can capture as much CO₂
- Carbon capture potential > 20 tonnes CO₂/hectare.year
- > 10,000 CAM species but very few used in agriculture
 - Prickly pear (*Opuntia ficus-indica*)
 - Agave species: e.g. *Agave tequilana*, *Agave americana*
 - Pineapple (*Ananas comosus*)
 - Rubber-hedge euphorbia (*Euphorbia tirucalli*)



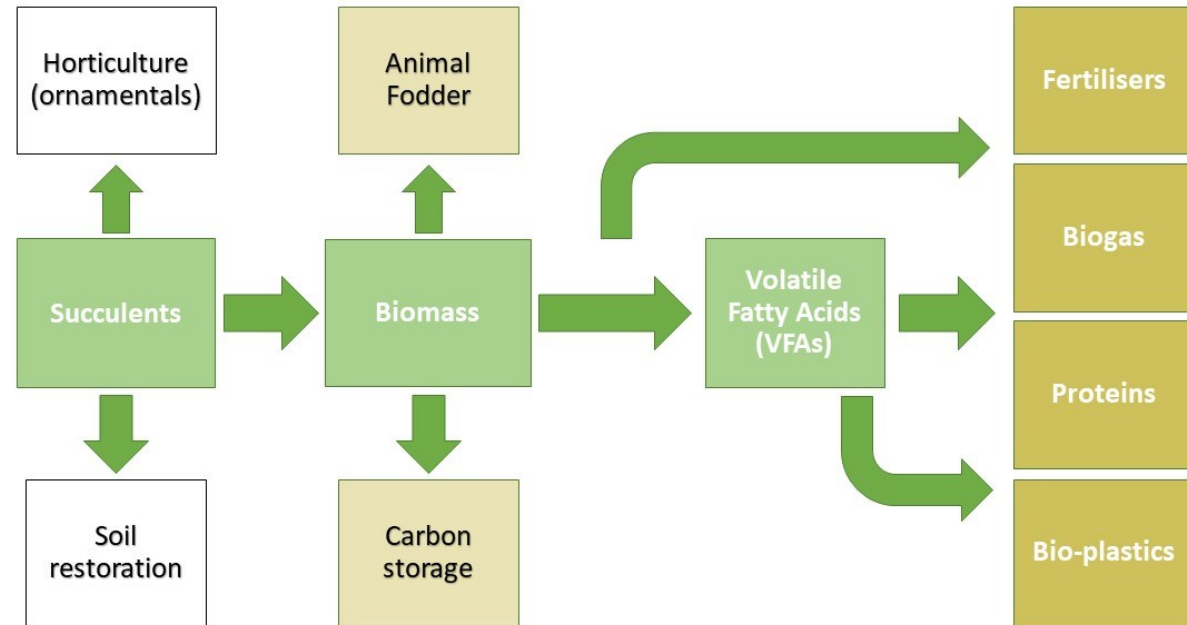
CAM pathway (Borland et al., 2014)



Blue agave (*Agave americana*) (SANBI)

CAM PLANTS: BASIS FOR SUCCULENT BIO-ECONOMY

- Next to carbon capturing, CAM plants can generate other products and services
- Anaerobic digestion process
- Potential model for dryland agriculture



A SUCCULENT BIO-ECONOMY IN NAMIBIA

- Namibia is suited to develop a CAM-based agronomy
 - Arid to semi-arid climate: unsuitable for conventional crops
 - Large areas of land not cultivated
 - Many areas degraded by low-intensity ranching
 - Many native CAM species
- HOWEVER:
 - None of native CAM plants tested for growth potential and very little is known about their agronomy or photosynthesis pathway
 - Non-indigenous CAM plants can become invasive



Prickly pear (*Opuntia ficus-indica*)
(Photo: Vera De Cauwer)



SUCCULENT BIO-ECONOMY PROJECT

Investigate potential of water-efficient succulent plants for commercial cultivation on drylands

Phase 1: Testing of **proof-of-concept**

- explore candidate indigenous succulents
- compare biomass production of indigenous with non-indigenous plants
- monitor soil organic carbon



Photo: Vera De Cauwer

INDIGENOUS NAMIBIAN SUCCULENTS

- Screen suitable plants:
 - non-woody biomass production potential
 - easy cultivation and harvest
- Test production of planting material
 - Cuttings from wild plants
 - Pot trial
- After passing pot trial > field trial



Succulent plants native to Namibia: Dollarbush (*Tetraena (Zyghophyllum) stapfii*) and *Euphorbia damarana* - Photos: Vera De Cauwer, 2020

PRELIMINARY RESULTS INDIGENOUS POT TRIAL

No rooting success	Very low to low rooting success	Medium to good rooting success
<i>Euphorbia damarana</i>	<i>Euphorbia gariepina</i>	<i>Euphorbia mauritanica</i>
<i>Euphorbia lignosa</i>	<i>Euphorbia spartaria</i>	<i>Coleus neochilus</i>
<i>Tetraena stapfii</i>	<i>Psilocaulon coriarium</i>	<i>Kleina longiflora</i>
<i>Salvadora persica</i>		<i>Cynanchum viminale</i>
<i>Mesembryanthemum barklyi</i>		<i>Coleus dinteri</i>
<i>Tetragonia schenckii</i>		
<i>Calicorema capitata</i>		
<i>Tetraena cylindrifolia</i>		



Pencil bush (Kleina longiflora)
Photo: Vera De Cauwer

BIOMASS PRODUCTION: FIELD TRIAL

- Established in 2020 at Erhardshof farm
- Comparison of 3 non-indigenous with **indigenous** succulent species :
 - *Euphorbia tirucalli*
 - *Opuntia ficus-indica*
 - *Portulacaria afra*
 - *Euphorbia mauritanica*
 - *Kleinia longiflora*
 - *Coleus neochilus*
- Non-indigenous: production potential documented in other countries
- Game fence necessary



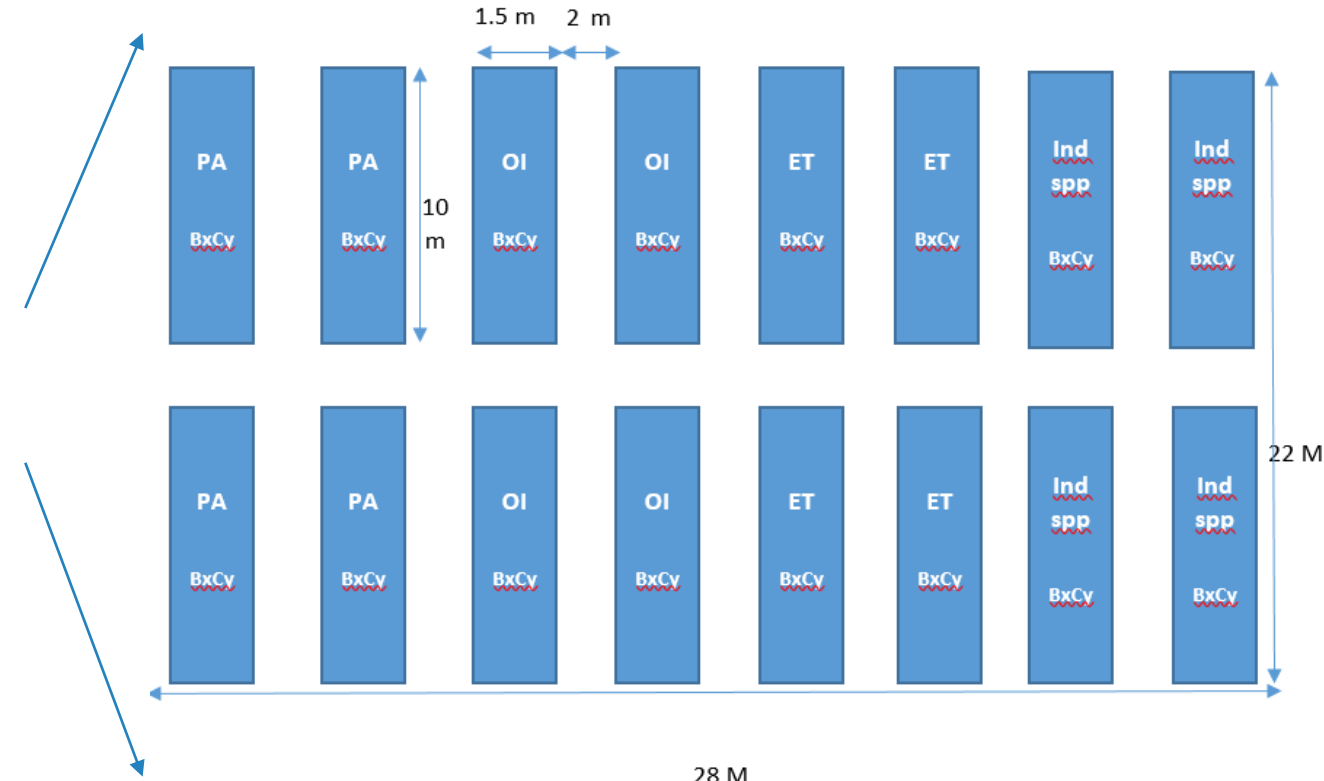
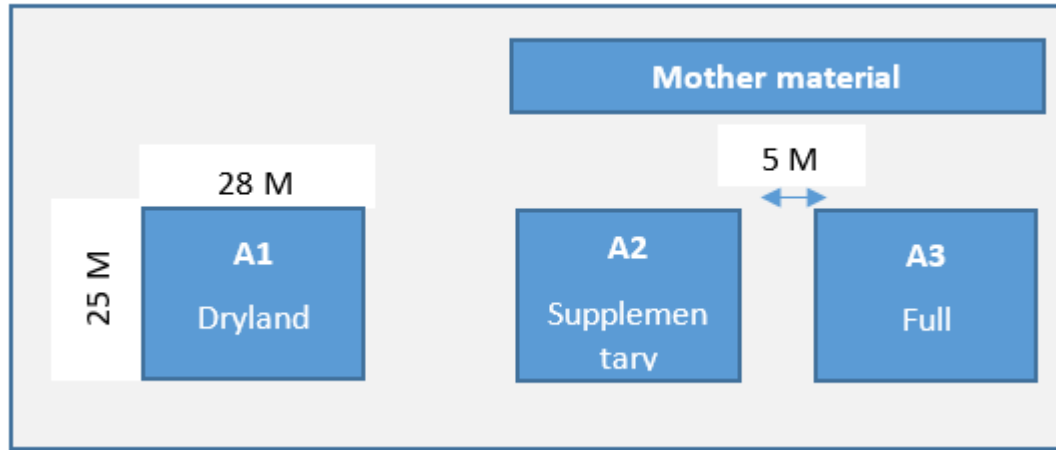
Euphorbia tirucalli – Photo: Lovisa Katanga

BIOMASS PRODUCTION: FIELD TRIAL

- Planting of cuttings
- Investigation of optimal agronomic conditions:
 - Fertilisers: control (none) versus minimum fertilisers
 - Irrigation: control, top up, 30 mm per month
 - Planting density: medium versus dense



LAYOUT FIELD TRIAL



28 M

FOLLOW UP OF FIELD TRIAL

Maintenance and monitoring:

- Replacing dead cuttings
- Irrigation and applying fertilisers
- Weeding!
- Biometric measurements as proxy for biomass production: 3 times per year

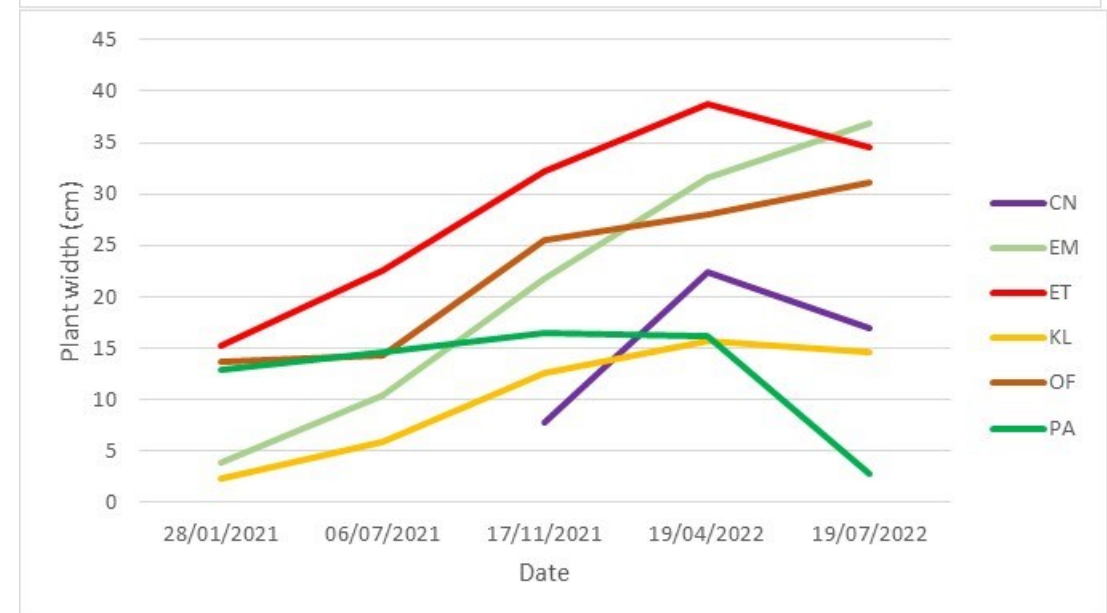
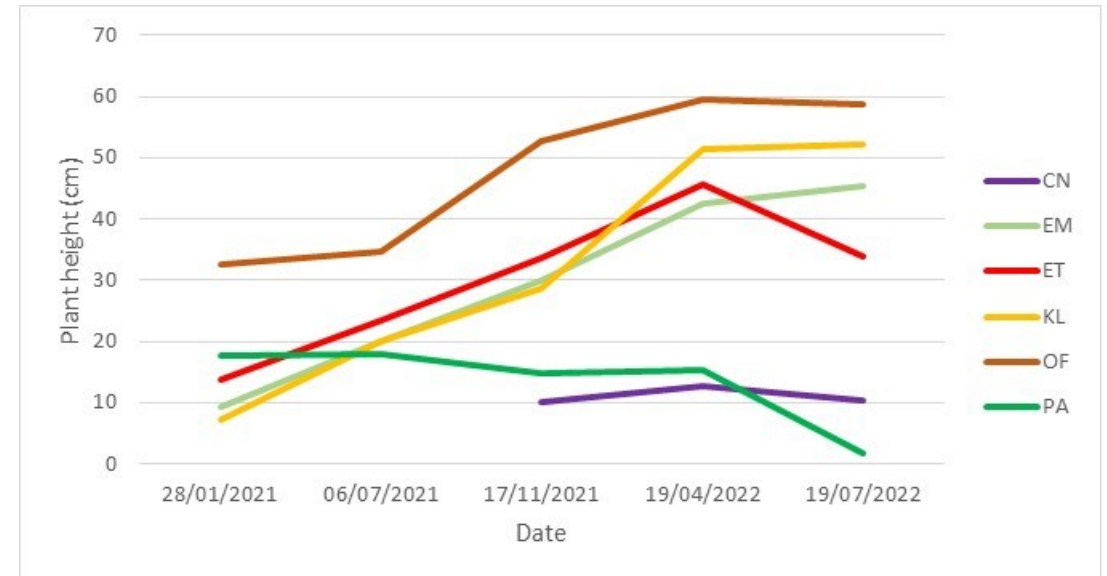
Waiting for plants to grow 😊



Photo: Vera De Cauwer

PRELIMINARY RESULTS FIELD TRIAL

- Height increase: *Kleinia longiflora*
- Width increase: *Euphorbia mauritanica*
- Decline in plant sizes due to frost: especially *Portulacaria afra* and *Euphorbia tirucalli*, but also *Coleus neochilus*
- *Portulacaria afra* not doing well: establishment takes time, termites



FROST DAMAGE



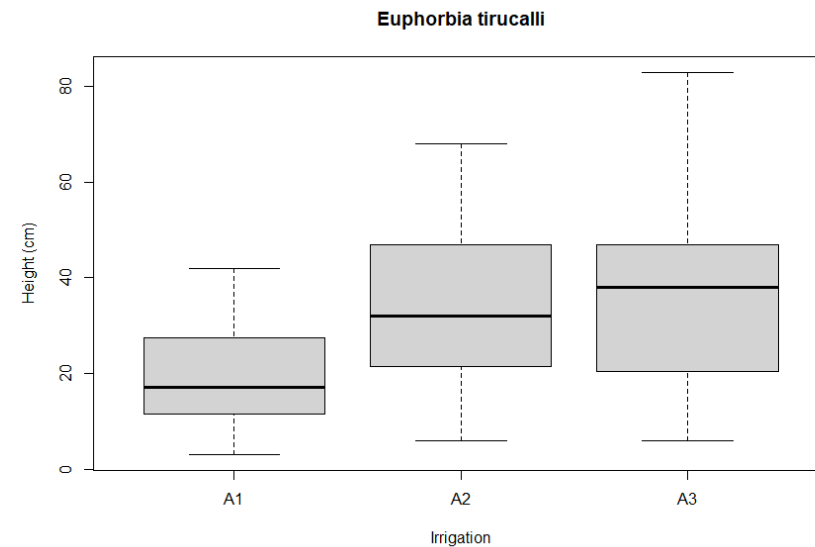
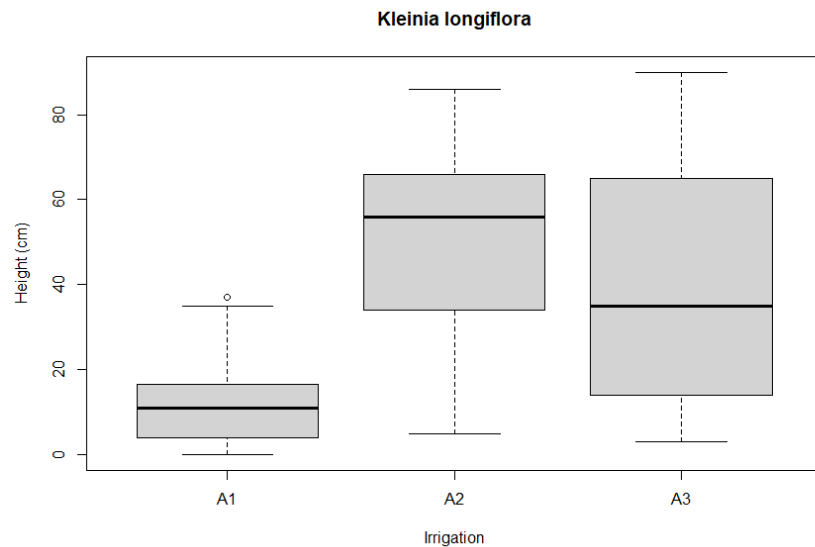
BEFORE



Photos: Absalom Shitalangaho and Vera De Cauwer

PRELIMINARY RESULTS FIELD TRIAL: EFFECT IRRIGATION

- No significant effect on *Portulacaria afra* and *Opuntia ficus-indica*
- All others: positive effect irrigation



CONCLUSIONS AND WAY FORWARD

- Many native species not suited for biomass production, many still to screen
- Cultivating suitable indigenous succulents takes time
 - Different from growing plants that have been bred for centuries
 - Field trial: **indigenous are growing quicker than non-indigenous plants**
- Succulent plants need protection from sun and frost in field when young
 - Using nursery seedling will speed up biomass production
- Irrigation regimes need to be adapted to species
- Several years of data of field trial: economics of succulent production



Euphorbia avasmontana
Photo: Vera De Cauwer

THANK YOU

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