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Results of multispecies trials in the sugarcane fallow

With support from the Great Barrier Reef Foundation, Farmacist Mackay conducted two replicated trials and 19 demonstration sites in the Mackay region. A summary of the key outcomes are provided below with more detailed information available on the Farmacist website.

Background

Planting multispecies crops during the sugarcane fallow period is still a relatively new concept for the majority of the sugarcane industry. Trials conducted in other industries, and countries, have shown many benefits achieved from planting a multispecies crop, however there was limited information on the actual benefit provided to a tropical sugarcane growing region. Farmacist Mackay worked alongside local sugarcane growers to address this limitation and collect information on soil physical, chemical and biological changes as a result of multispecies break crops.

Soil Physical Conditions

Measurements were collected from a replicated trial which showed improvements in effective rooting depth, earthworm counts and water infiltration as a result of planting multispecies crops, presented in the following tables:

Table 1. Effective Rooting Depth (penetrometer reading) before and after fallow treatments

Treatment	Before (mm)	After (mm)	Change (mm)
Multispecies higher EC soil	264	584	320
Sprayed fallow higher EC soil	224	433	209
Multispecies lower EC soil	185	364	179
Sprayed fallow lower EC soil	240	269	29

Table 2. Earthworm counts from each treatment before and after fallow treatments

Treatment	Before (number found)	After (number found)	Change (number found)
Multispecies higher EC soil	17	25	8
Sprayed fallow higher EC soil	14	9	-5
Multispecies lower EC soil	0	7	7
Sprayed fallow lower EC soil	4	9	5

Table 3. Water infiltration comparison before and after fallow treatments

Treatment	Before (mm/min)	After (mm/min)	Change (mm/min)
Multispecies higher EC soil	3	25	22
Conventional higher EC soil	2.2	8.5	6.3
Multispecies lower EC soil	5	3.16	-1.84
Conventional lower EC soil	6.17	6.57	0.4

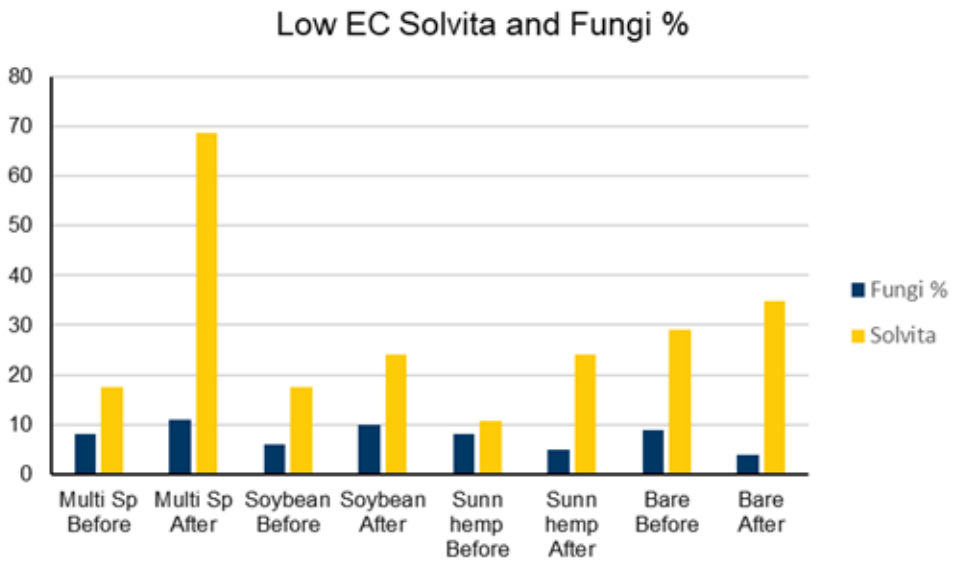
Soil Biological Conditions

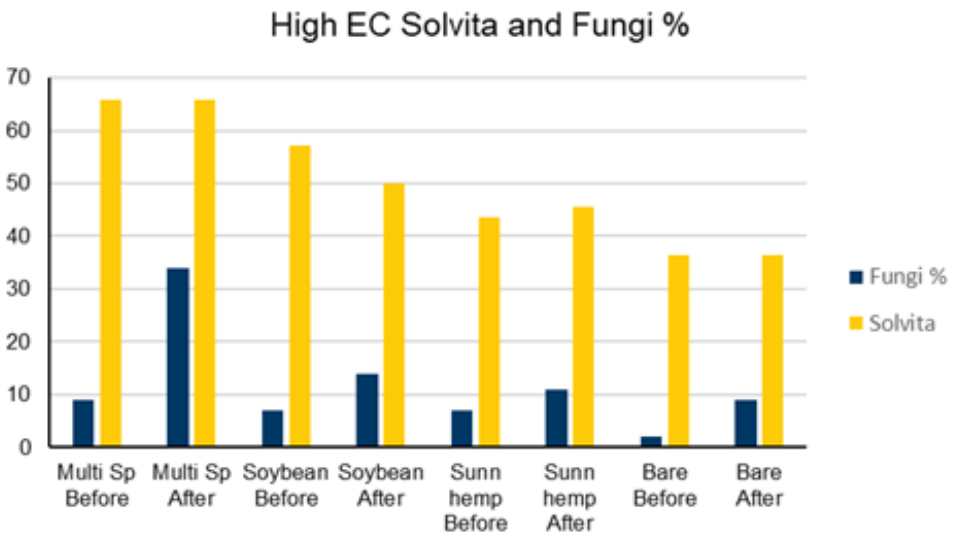
In a replicated trial, the Haney soil health score was used to compare the changes to the average score across four different fallow treatments. The results indicated that planting any break crop was more beneficial than a bare/weedy fallow as can be seen in Table 4.

Table 4. Results from fallow management trial 2021-2022

Treatment	Details	Average Haney soil health score* change	Cost of seed
Bare/weedy fallow	Sprayed fallow	-2.55	$0
Multispecies crop broadcast	10 species mix broadcast and worked in	1.6	26 kg/ha $114.64/ha
Soybeans on beds	2 rows soybean planted on preformed beds	1.6	60kg/ha $210/ha
Cowpea broadcast	Ebony cowpea	1.15	35kg/ha $126/ha

*calculation (Solvita CO2/10) + (Total water Extractable Carbon/100) + (Total Water Extractable Nitrogen/10)





A second replicated trial was used to compare Solvita CO2 burst tests and Microbiometer readings across different fallow treatments.

Solvita CO2-Burst test is a measure of soil CO2 respiration from processed, pre-dried soils. It measures respiration following rewetting of the soil and serves as an overall indicator of soil microbial potential.

The microbiometer is a soil test for microbial biomass and fungal to bacterial ratio which can be used to assist in determining the health of the soil (higher fungi % is generally healthier soil).

Results showed that the multispecies treatment had increased fungi % in both replications and increased Solvita CO2.

Below: The Microbiometer (left) and the Solvita CO2 Burst test (right) used for biological analysis.

Soil Chemical Conditions

Using before and after soil samples taken in the low and high EC zones at 19 different sampling blocks across the Mackay region (with a total of 38 samples) a trend for changes in soil chemical properties was identified. These included:

- 89% of samples showed an increase in phosphorus Colwell following the multispecies crop
- 84% of samples had:
  - an increase in organic carbon
  - an increase in potassium % and Nitric K
  - an increase in EC (1:5).

Interesting points in regard to samples taken in the high and low EC zones showed all samples taken in the high EC zones had:

- A decrease in pH (1:5 water)
- An increase in water soluble calcium
- An increase in water soluble magnesium.

All samples taken in the low EC zones showed:

- An increase in zinc (HCl)
- An increase in water soluble phosphorus
- An increase in water soluble copper.

A statistical analysis (via the R Studio package: Lme4 linear model analysis, to address effect of site, followed by an analysis of deviance (Type II Wald chi square test) at the 95% confidence limits) of 8 of these sites identify:

- for organic carbon % EC significantly affected results with the high EC zone recording increased levels of organic carbon % both pre and post multispecies treatment
- pH after multispecies significantly declined
- no significant effect on phosphorus or potassium following multispecies
- sulphur results showed a significant increase after the multispecies crop.

The following table shows the average soil analysis results for the high and low EC zones across the sites. Note the increase in organic carbon %, phosphorus (BSES), potassium (Nitric K) and sulphur following the multispecies crop, and the reduction in pH (1:5 water).

Table 5. Averaged soils analysis results, pre and post Multi spp., fallow cover cropping by soil electrical conductivity (EC) zone. Phosphorus (P), potassium (K), sulphur (S), pH (water), organic carbon percentage (OC%) and percentage of aluminium saturation (Al%).

Soils analysis results	EC	Al%	K (nitric)	OC%	P (BSES)	pH	S
Prior to multispecies	High	1.49	1.45	1.04	21.86	6.06	8.14
	Low	7.15	1.40	0.89	29.43	5.55	6.89
Post multispecies	High	3.86	1.55	1.16	30.57	5.54	15.13
	Low	7.00	1.44	1.09	44.86	5.34	10.51

Conclusion

After analysing the results from replicated trials as well as demonstration sites, it appears the multispecies crops are generally having a positive impact on the soil physical, chemical and biological properties at the sites monitored.

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