Embrapa Cerrados

Effects of cover crops species on *Passiflora edulis* nutrition

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Introduction

The interrows of passion fruit (PF) orchards located in the Cerrados region of Brazil are usually kept without weeds, that can compete for water and nutrients with the main crop. Over years, it is common to observe the physical, chemical and biological degradation of the soils in these rows due to the erosion and leaching of nutrients caused by strong rains, machinery traffic, heavy use of pesticides, and organic matter degradation. Such negative effects can cause reductions in PF production and quality. The establishment of cover crops in the interrows is an alternative to overcome these problems. Cover crops can protect the soil, reduce weeds and pest proliferation and avoid soil nutrients leaching. The root system of cover crops can also alter the soil biological properties with positive effects on nutrient cycling, soil quality and plant productivity.

This work was carried out to evaluate the impact of different species on soil quality and on PF nutrition and production.

Materials and methods

- Local: Passion fruit (PF) orchard, in Cerrados region, Planaltina-DF, Brazil
- Planting date: January/1999.
- Cover crop species: *Arachis pintoi, Crotalaria spectabilis, Canavalia ensiformis* L., and *Cajanus cajan*
- Cover crops propagation material: seeds, except for forage groundnut that was planted vegetatively
- Spacing:
  - PF: 3,0 m between plants x 2,5 m between rows
  - Cover crops: in the interrows strips, in rows spaced 0,50 m apart
- Statistical design: randomised block design, with 3 replications
- Soil chemical and physical characteristics before cultivation:
  - 400 g kg^{-1} clay; pH_{H_2O} = 5,5; O.M. = 21 g kg^{-1}; Al exch. = 0,15 $cmol_c\ dm^{-3}$; $Ca^{2+} + Mg^{2+}$ = 3,3 $cmol_c\ dm^{-3}$; H + Al = 4,7 $cmol_c\ dm^{-3}$; S = 31,1 mg kg^{-1}; P = 4,2 mg kg^{-1}; K = 56 mg kg^{-1}K; B = 0,27 ; Cu^{2+} = 0,8 mg kg^{-1}; Fe^{3+} = 37,7 mg kg^{-1}; Mn^{2+} = 8,8 mg kg^{-1}; Zn^{2+} = 1,9 mg kg^{-1}
- Soil fertilisation prior to planting:
  - Limed to increase the soil base saturation (SB) up 50 %;
  - 80 Kg/ha de P_2O_5 (SP) ; 50 kg/ha de K_2O (KCl); applied on soil surface and incorporated into the soil with a disc plough.
- Harvesting of the cover crops: about 180 days after emergence. Mulch was left at the soil surface. Forage groundnut is perennial specie.
- Period of data measurement: over two years.
- Parameters evaluated:
  - Vesicular-arbuscular mycorrhizae (VAM) colonisation and spores and nematodes populations from roots and soil samples collected from 0 to 20 cm depth.
  - Soil chemical properties (pH_{H_2O}, P, S, B, exchangeable cations) and organic matter content - soil samples from 0 to 5 cm and from 5 to 20 cm depth within interrow areas and 0 to 20 cm in crop rows.
  - Soil enzymes related to P (acid phosphatase) and S (arylsulfatase) cycling: soil subsamples from 0 to 5 cm depth in the cover crops area.
  - Nutrients content in leaves of PF (10th month) and in leaves of cover crops, at flowering stage.

Results

Table 1. Effect of cover crop species on the nutrient content of passion fruit leaves.

Cover crop	Fruit production	Nutrient concentration in leaves										
		N	P	K	Ca	Mg	S	B	Cu	Fe	Mn	Zn
	t ha^{-1}	g kg^{-1}						mg kg^{-1}				
A. pintoi	17.6 a	39.5	2.4 cb	16.3	14.1	2.97	3.6 a	23.9	5.5 a	128	54.4	33.0
C. spectabilis	13,0 b	38.3	2.6 ba	19.0	13.8	2.97	3.1 b	22.0	5.3 a	155	49.5	33.3
C. ensiformis	14,3 b	38.7	2.7 a	18.5	14.0	3.25	3.4 a	22.9	5.7 a	124	42.7	35.0
C. cajan	14,4 b	38.4	2.6 ba	19.3	13.1	2.80	3.5 a	23.5	5.7 a	118	44.7	35.9
Spontaneous species	16,1 ba	39.4	2.3 c	20.7	14.7	3.10	3.7 a	24.0	4.3 b	122	49.5	32.4
CV (%)	10.3	7.6	5.0	17.2	13.5	10.3	7.4	8.0	9.9	16.9	18.0	6.3

Means with the same letter, in the same column, are not significantly different.

Table 2. Soil fertility changes in the interrows of the passion fruit orchard.

	Soil depth	O.M.	pH	H + Al	Al	Ca + Mg	S	P	K	Cu	Fe	Mn	Zn
	cm	g dm^{-3}		$cmol_c\ dm^{-3}$			mg dm^{-3}						
A. pintoi	0-5	23.8	5.6	3.90	0.03	4.52	23	5.6	56	0.96	48	14.3	1.79
	5-20	22.6	5.4	4.85	0.17	3.23	25	2.4	15	0.66	48	13.5	1.49
C. spectabilis	0-5	23.1	5.7	3.42	0.02	4.66	29	4.4	55	1.50	45	14.9	1.64
	5-20	21.7	5.4	4.72	0.14	3.11	27	2.5	19	0.66	40	13.3	1.43
C. ensiformis	0-5	23.4	5.6	3.58	0.02	4.99	21	4.7	61	1.66	50	15.9	1.95
	5-20	20.8	5.4	4.82	0.06	3.66	42	2.5	18	0.94	48	14.5	1.73
C. cajan	0-5	23.0	5.5	4.15	0.04	4.04	25	5.1	67	1.60	49	14.9	1.93
	5-20	21.8	5.3	5.13	0.15	3.41	31	2.3	16	0.94	51	13.9	1.91
Spontaneous species	0-5	22.1	5.6	4.10	0.03	4.20	33	5.1	75	1.34	49	16.4	1.96
	5-20	22.0	5.5	4.71	0.06	3.57	24	2.4	16	0.85	47	14.3	1.53

Table 3. Dry matter production and nutrient accumulation in leaves of cover crops species cultivated in passion fruit orchard interrows.

Cover crop	DM	N	P	K	Ca	Mg	S	B	Cu	Fe	Mn	Zn
	t ha^{-1}	g kg^{-1}						mg kg^{-1}				
A. pintoi	3.9	18.4	1.74	9.5	22.5	7.90	2.20	28.5	-	-	-	43.4
C. spectabilis	6.9	25.1	2.00	13.4	9.3	2.42	1.39	22.6	11.1	457	39.9	22.6
C. ensiformis	18.3	26.0	1.45	9.6	15.7	3.51	1.02	20.2	4.7	465	35.7	15.1
C. cajan	13.1	30.3	1.16	16.1	16.5	3.19	1.25	32.8	7.8	151	27.1	32.2

Table 4. Biological and biochemical parameters evaluated in a PF orchard area.

Intercropping species	Mycorrhizal (AM)					Enzyme activityes	
	Number of spores*			Root colonization		*Phosphatase	*Arysulfatase
	Before cultivation	PF	CC	PF	CC	µp-NP g^{-1} soil h^{-1}**	
A. pintoi	5.5	71.0	70.3	73.9	52.5	284.81	10.36
C. spectablis	8.0	67.8	70.3	73.5	56.5	253.57	16.82
C. ensiformis	7.3	75.3	72.3	69.3	59.0	229.74	16.91
C. cajan	10.8	69.8	69.3	69.6	56.5	287.55	12.11
Spontaneous species	9.8	72.0	65.0	70.3	63.7	317.50	13.46
CV (%)		8.5	16.4	5.7	12.3	29.69	29.96

*Number of spores 50 g^{-1} of soil. **Soil samples collected at 0-5 cm depth
PF = passion fruit; CC = cover crops

Table 5. Pearson's correlation coeficients between PF fruits production (PROD) and P in leaves (PLEAV) of PF; P in soil (PSOIL) of PF rows and in interrows area (CC); soil phospatase activity (PHOSP), and mycorrhiza infection rate (MI-IF) in PF and in CC roots.

Variables	P-LEAV	P-SOIL		MI-IF		PHOSP
	PF	PF	CC	PF	CC	
PROD	-.11757	0.02236	0.02996	0.22383	0.04581	0.20543
P values	0.6765 ns	0.9370 ns	0.9156 ns	0.4226 ns	0.8712 ns	0.4626 ns
P-LEAV-PF	-	0.08108	-0.54659	-1.13979	-0.24896	0.27945
P values		0.7739 ns	0.0350 *	0.6193 ns	0.3709 ns	0.3131 ns
n	15	15	15	12	12	15

PF = passion fruit; CC = cover crops
*P 0.05; ns = not significant.

Table 6. Pearson's correlation coeficients between PF fruits production (PROD) and S in leaves (SLEAV) of PF; S in soil (SSOIL) in PF rows and in interrows area (CC); and soil arysulfatase activity (SULPH).

Variables	S-LEAV	S-SOIL	SULPH
	PF	CC	
PROD	0.60581	-0.02654	-0.46607
P values	0.0167 *	0.9252 ns	0.0799 ns
S-PLEAV-PF	-	0.42892	-0.41134
P values		0.1106 ns	0.1840 ns
SULPH	-0.35507	-0.50663	-
P values	0.1940 ns	0.0539 *	
n	15	15	15

PF = passion fruit; CC = cover crops
*P 0.05; ns = not significant.

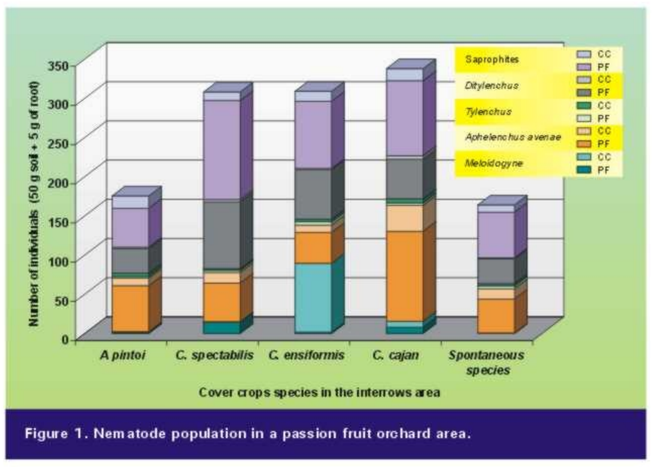


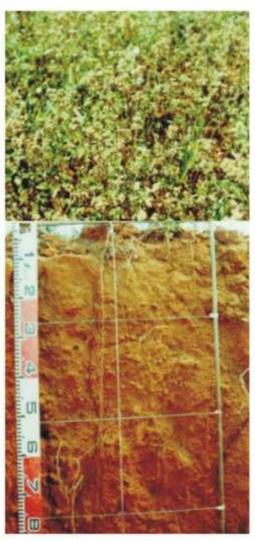
Figure 1. Nematode population in a passion fruit orchard area.


Arachis pintoi


Crotalaria spectabilis


Canavalia ensiformis


Cajanus cajan


Spontaneous species

Conclusions

- The presence of cover crops in the interrow area significantly affected PF fruit production and nutrient content in leaves (P,S, and Cu);
- P in PF leaves was significant correlated (P = 0.035) with P in soil in the interrows area, but was not related with the soil phosphatase activity or with the colonisation of roots by mycorrhizal fungi (AM);
- Soil arysulfatase activity in the interrows area could not explain the differences in S content in PF leaves;
- Phosphatase and arysulfatase activities were not different among treatments,;
- VA-mycorrhizal colonisation of roots was not significant different among cover crops species;
- Although there was a trend to observe differences in the chemical soil parameters in the surface layer (0 - 5 cm), as related to cover crops effects, further studies are necessary to follow up these changes;
- In PF rows, the root-knot nematode *Meloidogyne* was found to be mainly associated with the *C. ensiformis* cultivated in the interrow area. However, no negative effects on PF fruit production were associated with the presence of this plant-parasite.

Reference

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