Cover crops with contrasting root systems: plant development and nitrate movement during the winter

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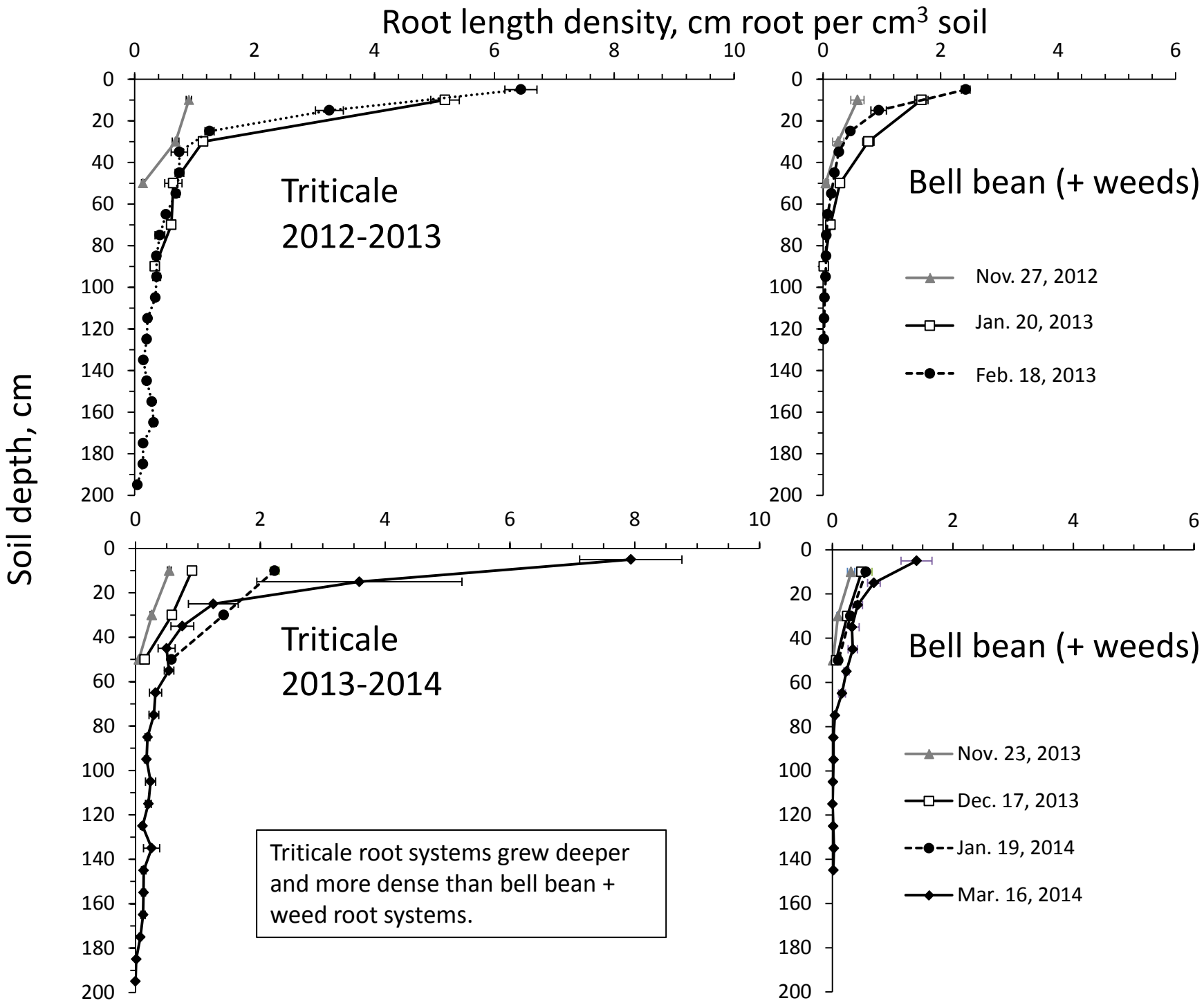
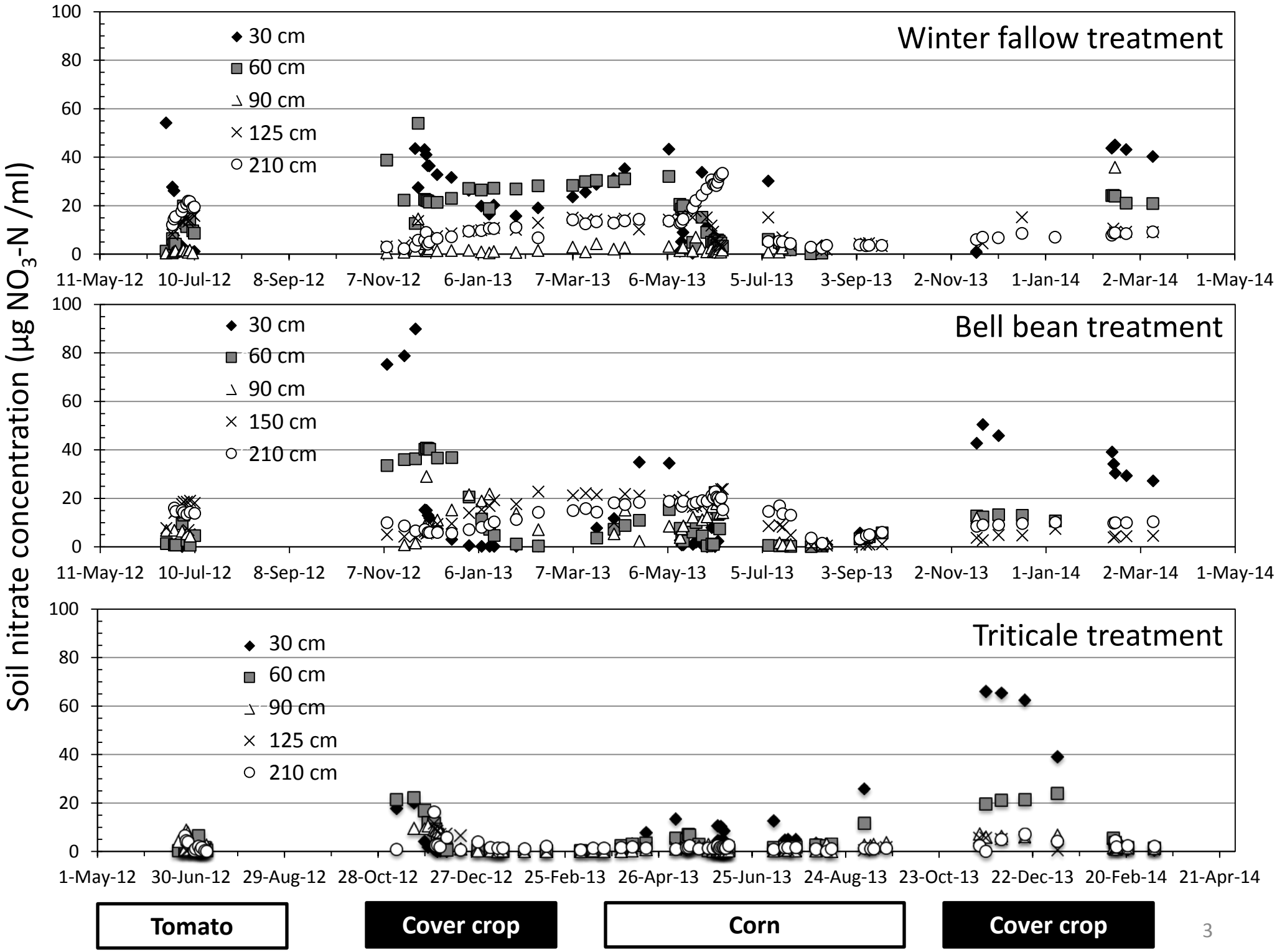
Cover crop yields and nitrogen content 2009-2014

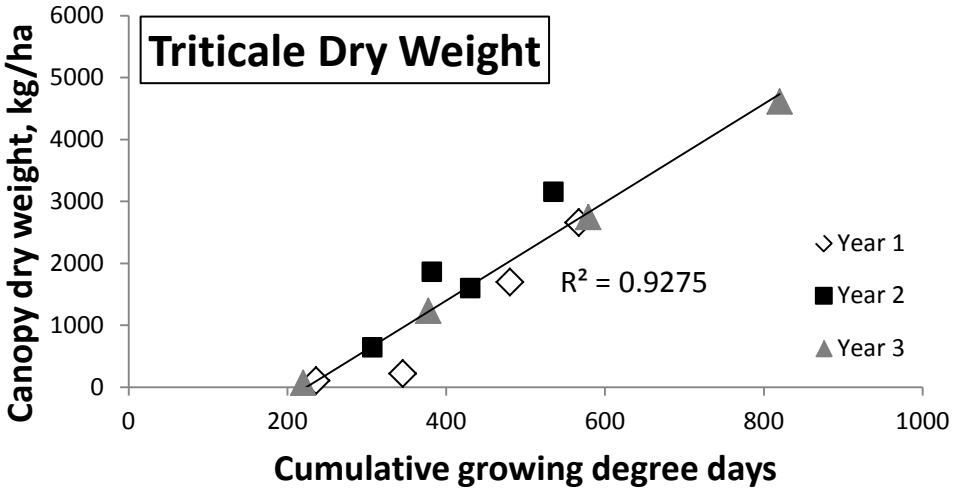
Year	Cover crop treatments	Dry weight	N content	Planting Date	Termination Date	Growing Degree Days	Water inputs
		kg ha^{-1}	kg N ha^{-1}			(°C)	inches
2009-10	Triticale	584 (±148)	14.1 (±3.5)	Nov 18	Feb 18	292	9.6
	Bell beans, vetch, oats	910 (±79)	25.0 (±2.8)	Nov 18	March 25	456	12.4
2010-11	Triticale	771 (±22)	27.0 (±0.7)	Nov 18	Feb 22	260	10.4
	Bell beans, vetch, oats	1986 (±151)	52.7 (±2.7)	Nov 18	April 5	507	17.0
2011-12	Triticale	2655 (±248)	61.1 (±5.8)	Nov 4	March 22	567	6.1
	Bell beans, weeds	3224 (±157)	81.7 (±2.2)	Nov 4	March 22	567	6.1
2012-13	Triticale	3155 (±225)	58.8 (±3.2)	Oct 19	Feb 22	535	12.8*
	Bell beans, weeds	5610 (±40)	182.6 (±4.5)	Oct 19	Feb 22	535	12.8*
2013-14	Triticale	4611 (±587)	87.3 (±16.4)	Oct 29	March 21	820	7.8**
	Bell beans, weeds	4861 (±145)	123.8 (±8.8)	Oct 29	March 21	820	7.8**

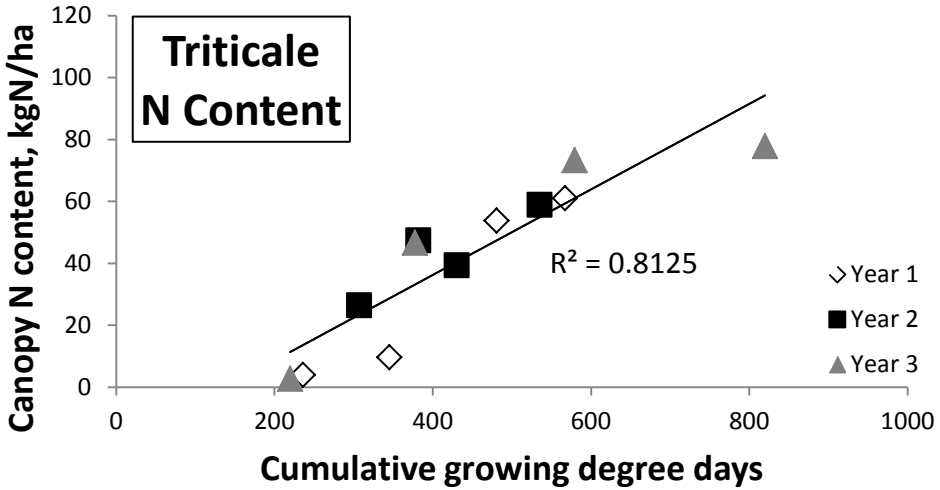
includes 2.8 inches (*) and 1.9 inches (**) irrigation to establish cover crops

- Starting mid-October exposed the plants to more growing degree days, allowing them to get established before the rainiest months.
- Weeds were a significant proportion of total biomass for the bell bean treatment (84% in 2011-12, 48% in 2012-13, and 90% in 2013-14).


Root length density, cm root per cm3 soil
Soil depth, cm
Triticale
2012-2013
Bell bean (+ weeds)
Nov. 27, 2012
Jan. 20, 2013
Feb. 18, 2013
Triticale
2013-2014
Bell bean (+ weeds)
Nov. 23, 2013
Dec. 17, 2013
Jan. 19, 2014
Mar. 16, 2014
Triticale root systems grew deeper and more dense than bell bean + weed root systems.


Soil nitrate concentration (µg NO_3-N /ml)
Winter fallow treatment
30 cm
60 cm
90 cm
125 cm
210 cm
100
80
60
40
20
0
11-May-12
10-Jul-12
8-Sep-12
7-Nov-12
6-Jan-13
7-Mar-13
6-May-13
5-Jul-13
3-Sep-13
2-Nov-13
1-Jan-14
2-Mar-14
1-May-14
Bell bean treatment
30 cm
60 cm
90 cm
150 cm
210 cm
Triticale treatment
30 cm
60 cm
90 cm
125 cm
210 cm
1-May-12
30-Jun-12
29-Aug-12
28-Oct-12
27-Dec-12
25-Feb-13
26-Apr-13
25-Jun-13
24-Aug-13
23-Oct-13
22-Dec-13
20-Feb-14
21-Apr-14
Tomato
Cover crop
Corn
Cover crop





Growing degree days and long-term weather data

- Calculated the average daily air temperature between 1982 and 2014 for Davis, CA . Used T_{base}=5°C in the formula.
- Cumulative GDDs were calculated for three temperatures: average daily temperature , 25th percentile, and 75th percentile
- Growth during the middle of the winter can be slow.