

## REPLACING HERBICIDES WITH GROUNDCOVERS IN THE VINEYARD

Benjamin A. Loseke

**Special Thanks to:** Dr. Paul Read, Dr. Ellen Paparozzi, Dr. Erin Blankenship, Dr. Chuck Francis, Dr. Brian Wardlow, Steve Gamet, Eric Nelson, Scott Dvorak, Dave Stock and Mike Fritz

# Benefits of using groundcovers in the vineyard

- Reduced herbicide usage
- Reduced erosion
- Increased soil fertility, water holding capacity and structure
- Reduced soil compaction
- Increased Biodiversity
- Regulate vine growth
- Improved air and water quality
- Nitrogen fixation

#### **Project objectives**

- How do 4 different groundcover mixes planted in the alleyways and in rows compete with newly planted vines for water?
- Do groundcovers established simultaneously with vineyard planting have negative effects on vine growth?
- What impact do groundcovers have on vine growth, bud break, fruit quality and wine quality?
- How quickly do the groundcovers establish?
- Can Infrared thermography (IRT) be used to assess grapevine water status using the crop water stress index (CWSI)?
- Will a thermal camera affordable to a grower be sensitive enough to measure water stress?
- Do beneficial insect populations increase as a result?

## BEGINNING OF PROJECT

													Wate	r																						400'																			
	Trea	atmen	t1		Vestern Yarrow, Bridsfoot Trefoil, Dutch					Sourc	e		_																		Plant	Numbe	er																	ROV	'				
_	Trea	atmont	2	-	Hard Fe	SOUG	Clov Sheep E	/er Facou	a Sidaos	ate Gra	ma Bi	uffalor	ar acc		_		5	2 51	50 43	48	47 -	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 ;	32 31	30	29 28	3 27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9 :	8 7	6	54	3 2	4 I	1		
	i i e e	kinen			i laiui e	rscue,	oneepi	Blu	e, oldeoa Je Grama	is ura I	ina, Di	unaioj	grass,			54	53 5	2 51	50 43	9 48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 3	32 31	30	29 28	27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9	8 7	6	54	3 ;	2 1	2	Blo	ck 1
	Trea	atment	13	KY Bluegrass, White Clover, Red Fescue, Hard Fescue,																																																			
	Chewing Fescue, P Rye						_	54	53 5	2 51	50 43	9 48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 :	32 31	30	29 28	3 27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9 :	87	6	5 4	3 3	2 1	3		_								
	Trea	atment	(4				техока	a Bun	alograss					E	56 59	5 54	53 5	2 51	50 43	9 48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 3	32 31	30	28	27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9	8 7	6	54	3	2 1	4		_
	Trea	atment	t 5	Veed Free																																																			
													58	57 5	56 59	5 54	53 5	2 51	50 43	9 48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 3	32 31	30	29 28	3 27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9 8	87	6	54	3 7	2 1	5		
	Trea	atment	t 6		Co	ntrol	_	_		_			0 50	57 5	10 FI		E0 E	0 F1	50 44		47	10 15				10			20 2	5 34	22.4	12 . 24	20			20 25	24 2	0 00	- 21 - 4	0 10	10	17 10			10 1	1 10		0 7			-			Die	
	-	-		-	-		_					0	3 06	57 5	06 0	0 04	53 5	2 91	00 43	9 40	47 .	46 49	44	43 4	2 41	40	59 JC	, si	36 3	9 34	33 .	52 31	30	23 20	5 21	26 20	24 2	.3 22	21 4	20 19	10	17 16	10 1	+ I.3	12 1	1 10	3 1	• •	•	0 4	3 4			БЮ	* 2
											61	60 5	9 58	57 5	56 59	5 54	53 5	2 51	50 43	9 48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 3	32 31	30	29 28	27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9	87	6	54	3 (	2 1	7		_
									~					<b>F7 F</b>					<b>FO</b> 44		47	40 45														~ ~							<i></i>												
									63	3 62	61	60 5	9 58	57 5	06 59	04	53 5	2 51	50 43	9 48	4/ •	46 45	44	43 4	2 41	40	59 38	5 37	36 3	5 34	33 .	52 31	30	29 28	3 27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9 :	8 7	6	5 4	3 2	4	8		
				-				65	64 63	3 62	61	60 5	9 58	57 5	56 59	5 54	53 5	2 51	50 43	9 48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 3	32 31	30	29 28	27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9 :	87	6	54	3 /	2 1	9		
					_		66	65	64 63	3 62	61	60 5	9 58	57 5	56 59	5 54	53 5	2 51	50 43	9 48	47 •	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 :	32 31	30	29 28	3 27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9 :	87	6	54	3 2	2 1	10	Bloc	:k 3
							67 66	65	64 63	3 62	61	60 5	9 58	57 5	56 59	5 54	53 5	2 51	50 43	9 48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 :	32 31	30	29 28	27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9	8 7	6	54	3 ;	2 1	11		
					69	68	67 66	65	64 63	3 62	61	60 5	9 58	57 5	56 59	5 54	53 5	2 51	50 4	48	47 •	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 :	32 31	30	29 28	3 27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9 :	87	6	54	3 2	2 1	12		
				_	70 69	68	67 66	65	64 63	3 62	61	60 5	9 58	57 5	56 59	5 54	53 5	2 51	50 43	48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33	2 31	30	29 28	27	26 25	24 2	3 22	21 3	20 19	18	17 16	15 1	4 13	12 1	1 10	9	8 7	6	5 4	3	2 1	13		
							0. 00									1.				Ĩ		10 10						, , ,																					Ť	· ·					
			72	71	70 69	68	67 66	65	64 63	3 62	61	60 5	9 58	57 5	56 59	5 54	53 5	2 51	50 43	9 48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 3	32 31	30	29 28	27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9 :	87	6	54	3 2	2 1	14	Bloc	:k 4
		73	72	71	70 69	68	67 66	65	64 63	3 62	61	60 5	9 58	57 5	56 59	5 54	53 5	2 51	50 43	48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 3	2 31	30	29 28	27	26 25	24 2	3 22	21 3	20 19	18	17 16	15 1	4 13	12 1	1 10	9 3	8 7	6	54	3	2 1	15		
							0. 00		0.00							, î				1.0		10 10																			Ĩ								Ť	· .	Ů.	· ·			
	75 74	4 73	72	71	70 69	68	67 66	65	64 63	3 62	61	60 5	9 58	57 5	56 59	5 54	53 5	2 51	50 4	9 48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 (	32 31	30	29 28	3 27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9 :	87	6	54	3 2	21	16		
70	75 7/	1 72	70	71	70 69	60	67 66	CE.	64 65	0 62	61	C0 E	0 50	57 F	ке в	5.54	E2 E	2 51	50 4	1 40	47	40 45		12 4	2 41	40	20 20	2 27	26 2	E 24	22 1	2 21	20	20 20	27	20 25	24 2	0 00	21 4	20 10	10	17 10	15 1	4 12	10 1	1 10		0 7	0	F 4		2 1	17		
10	10 11	+ ro	12	n	10 63	60	01 00	000	04 03	02	01	60 0	3 00	07 0	J6 J3	04	05 0	2 01	00 44	<sup>40</sup>	41	40 40	44	+3 4	2 41	40	53 GC	, sr	30 3	0 34		2 31	30	23 20	0 21	20 20	24 2	.5 22	21 4	20 13	10	17 10	10 1	+ 10	12 1	1 10	3 .	o (	°	J 4	° '	÷ '	- <sup>17</sup>		
77 76	75 74	4 73	72	71	70 69	68	67 66	65	64 63	3 62	61	60 5	9 58	57 5	56 59	5 54	53 5	2 51	50 43	9 48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 3	32 31	30	29 28	27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9	87	6	54	3 7	2 1	18	Bloc	⇒k 5
77 70	75 7	4 70	70	71	70 00	00	07 00	OF	04 07		.01	CO E	0 50	57 5	10 FI		E0 E	0 F1	50 4		47	10 15				10				E 04	22.4	0 04	- 20		07	00 0E	01 0	0 00	- 24 - 4	0 40	10	17 10			10 1	1 10		0 7					10		
11 16	10 11	+ 73	72	r1	10 63	00	01 00	60	04 63	02	01	00 0	3 98	07 0	10 0	04	05 0	2 01	00 43	48	47 1	40 40	44	+3 4	2 91	40	30 30	-37	JO J	0 34	- 33 .	2 31	30	23 28	21	26 20	24 2	.5 22	21 6	19	18	17 16	10 1	+ 13	12 1	10	3 1	• /	°	0 4	° 4	· ']	13		
77 76	75 74	4 73	72	71	70 69	68	67 66	65	64 63	62	61	60 5	9 58	57 5	56 59	54	53 5	2 51	50 43	9 48	47	46 45	44	43 4	2 41	40	39 38	3 37	36 3	5 34	33 :	32 31	30	29 28	27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	4 13	12 1	1 10	9	87	6	5 4	3 (	2 1	20		
77 70	75 7	. 70	70	71	70 00	00	67 60	OF	04 07	0.02		co =	0 50	57 5	10 F		E0 5	0 54	E0 44		47	10 15		10 4		40		2 27	20 2	F 04	22	10 04	- 20	20 20	27	20 25	24	0 00	21 /	10 10	10	17 10	15 4		10 4	1 10	0			F 4	2				_
11 16	75 74	4 73	72	n	70 69	68	67 66	65	64 63	5 62	61	60 5	9 58	07 5	56 5	54	53 5	2 51	50 43	9 48	4/	46 45	44	43 4	2 41	40	sə 38	5 37	36 3	o 34	33 3	52 31	30	29 28	5 27	26 25	24 2	3 22	21 2	20 19	18	17 16	15 1	• 13	12 1	1 10	9 3	5 7	6	o 4	3 2	4 1	21		
																												RO/	AD (18	)																									

#### Vineyard establishment









### Irrigation





#### **Groundcover Planting**





#### Germination



#### Establishment





- Treatment 1 Roadside Mix (Stock Seed Farms)
- Western Yarrow, Birdsfoot Trefoil, Dutch Clover



- Treatment 2 Custom Native Grass Mix
- Hard Fescue, Sheeps Fescue, Sideoats Grama, Buffalograss, Blue Grama





- Treatment 3 Vineyard/Orchard Mix (Stock Seed Farms)
- KY Bluegrass, White Clover, Red Fescue, Hard Fescue, Chewings Fescue, P Rye





- Treatment 4
- Texoka Buffalograss



Control

Natural Vegetation + Weed Free Strip Beneath Vines



#### Data Collected - 2014, 2015, 2016

- Soil Samples (all years)
- Groundcover Rate of Establishment (2014)
- Vine Length (2014)
- Pruning Weights (2015 & 2016)
- Leaf Water Potential, i.e. Plant Water Status (2015, 2016)
- Crop Water Stress Index (2015, 2016)
  - Leaf temperature
  - Irradiance
  - Ambient air temperature
  - Wind speed
  - Relative humidity
- Bud Break (2016)
- Harvest Data (2016)



## RESULTS (DATA OVERLOAD)

#### Rate of GC establishment (2014)





#### Shoot Lengths (2014)



#### Pruning weights 2014 & 2015



#### Date of Bud Break (2016)

Julian Days until Bud Break



#### Water Competition Summer 2015



Mean Leaf Water Potential of all Reps on Each Collection Date

#### Water Competition Summer 2016



Mean Leaf Water Potential 07/06/2016

#### Mean Leaf Water Potential 08/01/2016



#### Mean Leaf Water Potential 07/12/2016





#### Mean Leaf Water Potential 08/10/2016



#### Harvest Results (2016)



Harvest Caveat: Estimated 50% Crop Loss from Herbicide Drift

#### Harvest Results (2016)





#### Infrared Thermography

- Idea: as plants begin to become water stressed their leaf temperature will increase as stomata close and transpiration slows
- Thermal cameras are able to detect this change
- Using the leaf temperature we can plug the values into the crop water stress index (CWSI) for a standard water stress level between 0 and 1





#### LWP and CWSI Correlation





https://www.youtube.com/watch?v=bqpAk30HDe4

![](_page_34_Picture_0.jpeg)

#### **Preliminary\* Recommendations**

- Results suggest planting groundcovers in year 2 after vines have had one year to establish
- Groundcovers should be taken care of as if they provided economic value to the vineyard (i.e. irrigation, fertilization, etc.)
- Native grass groundcovers appear to stress the vines the most
- Final Recommendation: TO ENHANCE VINEYARD SUSTAINABLITIY, PLANT SOMETHING!

### Questions

![](_page_36_Picture_1.jpeg)