Alternatives to Burning Crop Residues in Alfalfa Grown for Seed:

Economic/Pest Management Impacts and Interactions Between Selected Burning Alternatives and Precision Crop Spacing

Plot design

- Row spacings at 22” or 30”
- Seed spacing at 1 5/8” or 3 3/8”

- Treatments- burning, tilling, mowing, or do nothing.

The plots were established in summer 2007 and grown out by the Wagoner’s through 2008. In February 2009 and 2010 we applied the burning, mowing and tilling treatments.

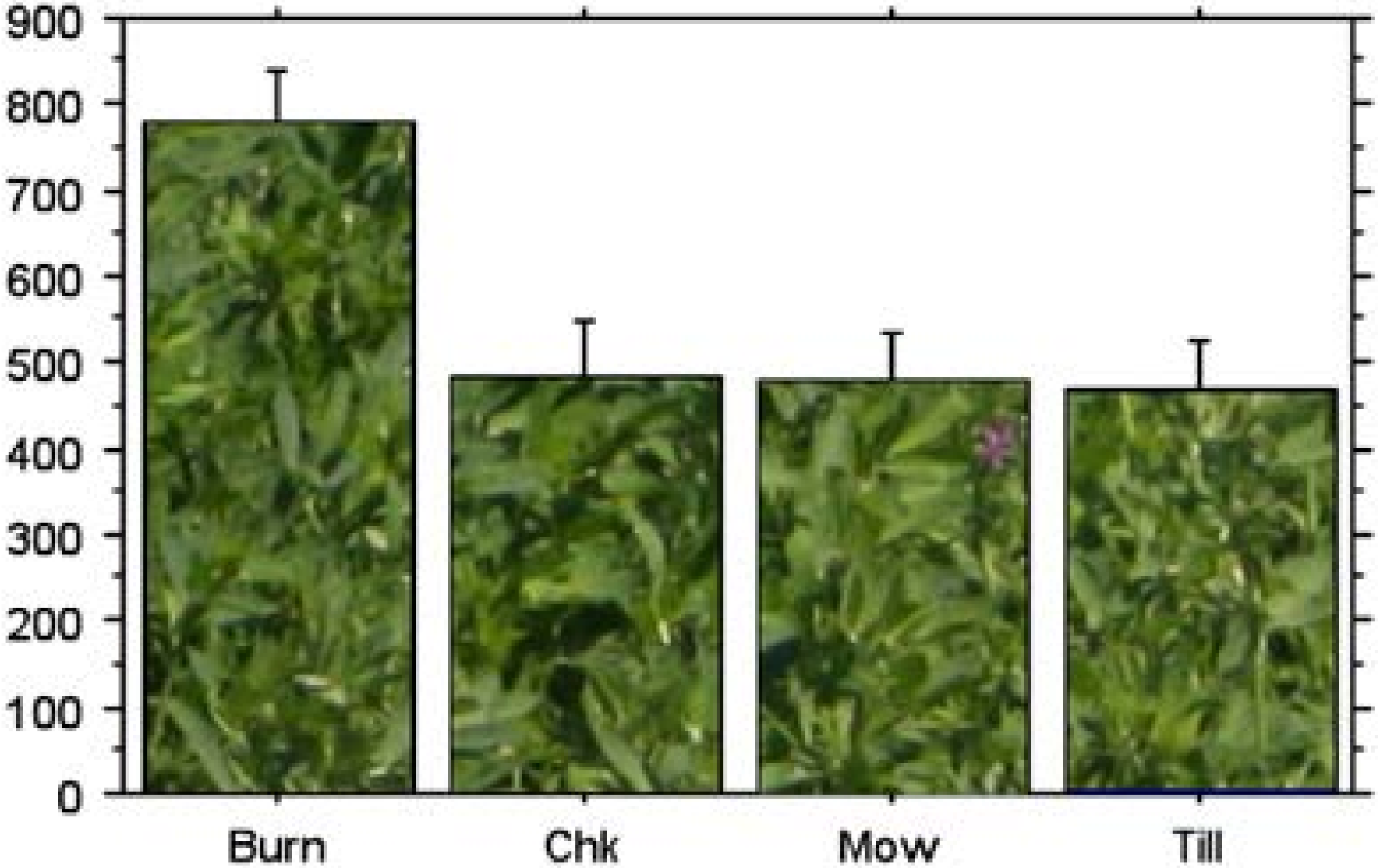
Field burning spring 2009

Research plots after burning spring 2009

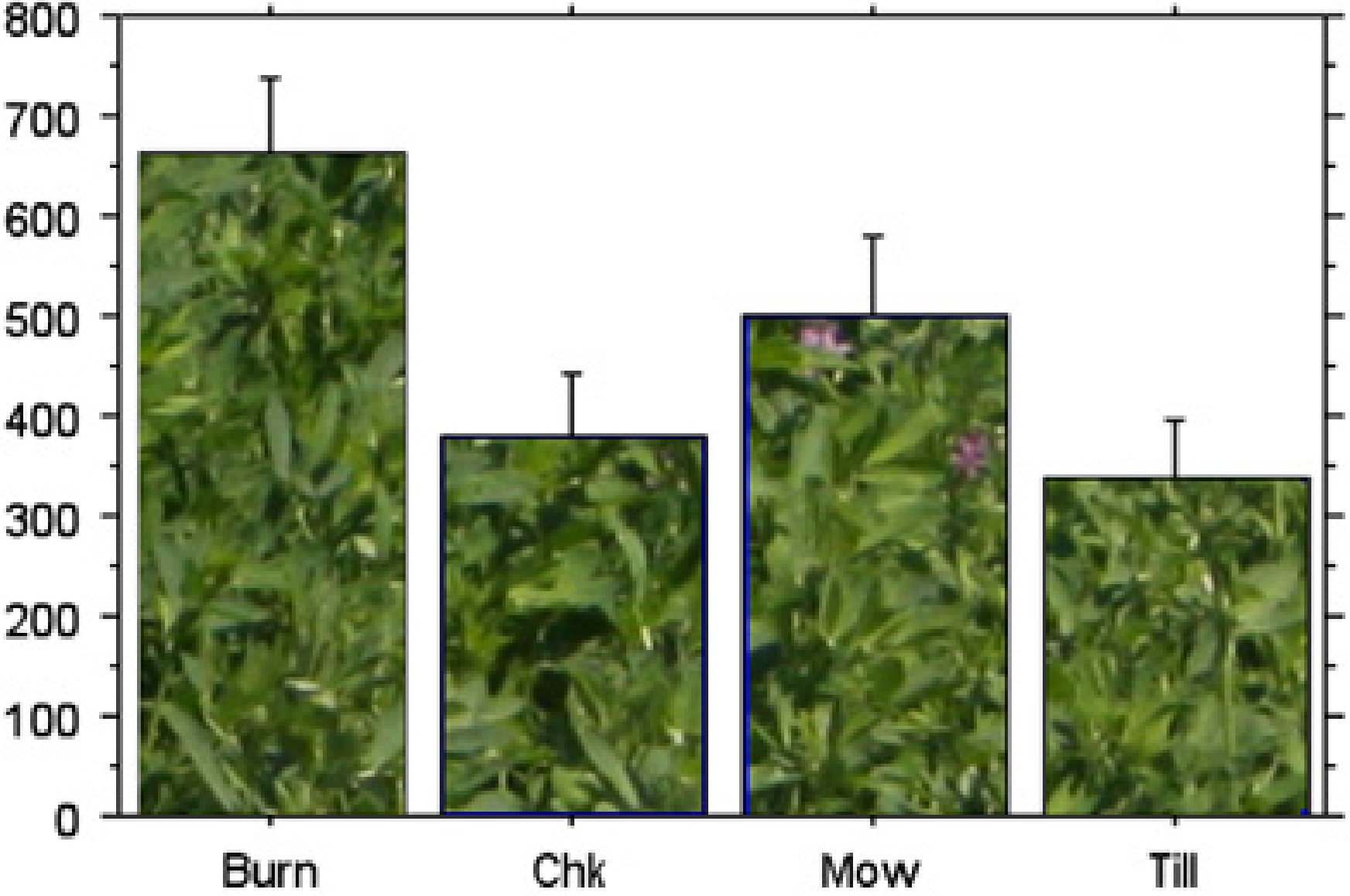
Seed Yields (lbs/acre) in response to Treatment, Row, and Seed Spacing

Treatment*	Row Spacing	Seed Spacing	2009 Yield*	2010 Yield*
Burn	22”	1-5/8”	885	792
Burn	22”	3-3/8”	845	533
Burn	30”	1-5/8”	682	687
Burn	30”	3-3/8”	697	632
Check	22”	1-5/8”	716	582
Check	22”	3-3/8”	449	361
Check	30”	1-5/8”	387	376
Check	30”	3-3/8”	382	246
Mow	22”	1-5/8”	326	567
Mow	22”	3-3/8”	448	552
Mow	30”	1-5/8”	387	360
Mow	30”	3-3/8”	742	529
Till	22”	1-5/8”	488	433
Till	22”	3-3/8”	576	203
Till	30”	1-5/8”	428	424
Till	30”	3-3/8”	381	342

Yield in pounds per acre (standard error) by treatment in 2009



Yield in pounds per acre (standard error) by treatment in 2010



Spring 2009 & 2010 Insects

- Population assessments of pest and beneficial arthropods were taken by sampling the research plots with sweep nets, yellow sticky cards, and pitfall traps.
- Amber Vinchesi went through all these in Fall 2009 & 2010
- Over wintering Lygus populations were reduced significantly ($p<0.05$) by burning

Impact on Disease (White Mold)

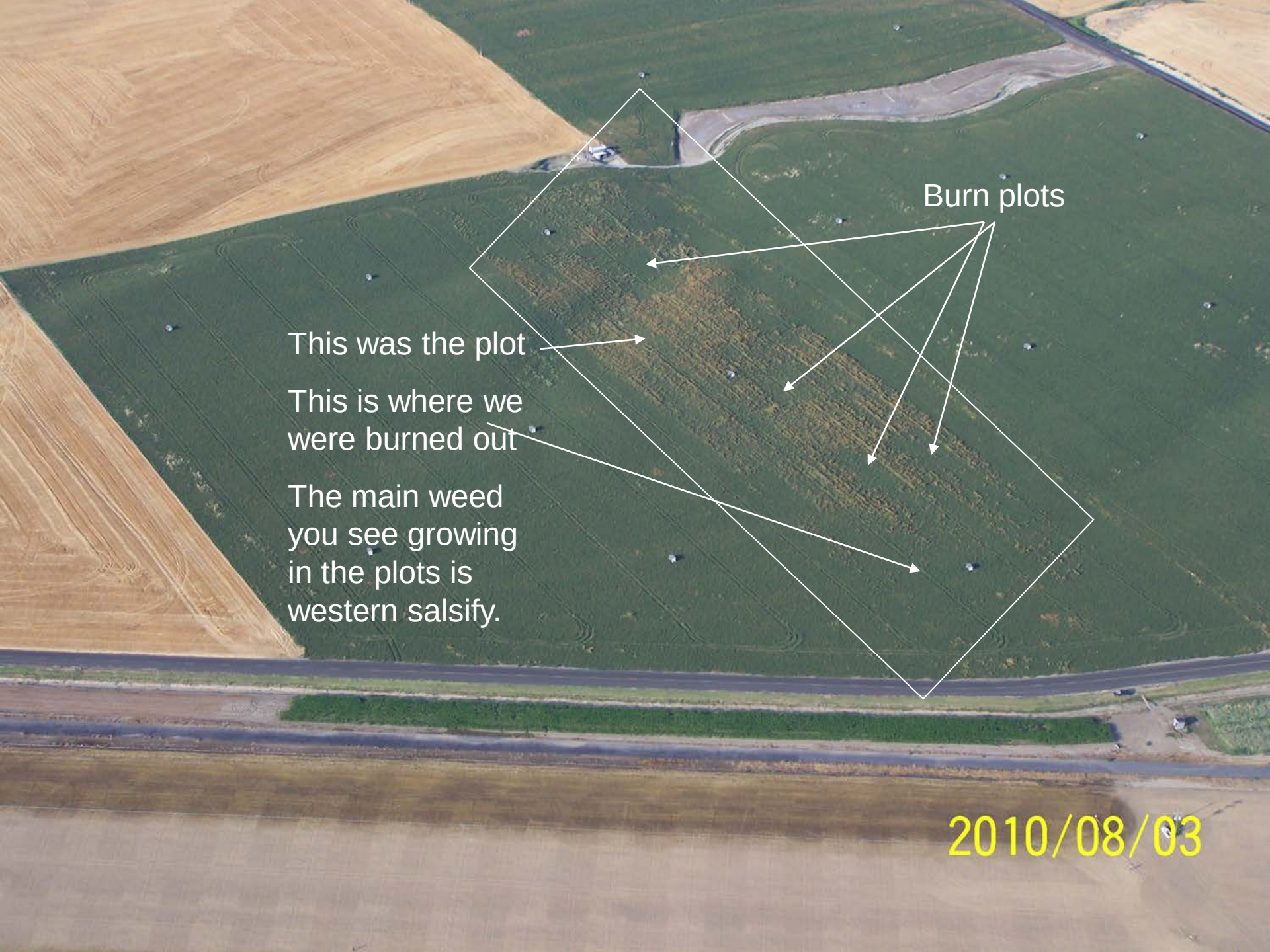
- White mold sclerotia are a concern for seed producers.
- When substantial populations are present addition seed screenings of harvested seeds are required.
- More sclerotia were found in the plots that were not burned in both 2009 and 2010.

Impact of Treatments on Sclerotia Number and Viability

Treatment	Number of sclerotia/m^2 2009	Number of sclerotia/m^2 2010	% Viability of sclerotia 2009	% Viability of sclerotia 2009
Check	41.9 a	115.2 a	51.1 a	38.6 b
Burn	24.9 a	33.9 b	41.7 a	27.9 c
Mow	41.3 a	103.8 a	49.8 a	50.2 a
Till	29.1 a	139.4 a	58.1 a	44.4 ab
P-value	0.555	0.015	0.015	0.021

Weed Management

- Prickly lettuce and Western salsify were the dominant weeds in these plots.
- Prickly lettuce abundance was unaffected by the various stubble management programs.
- Herbicides provided control.
- Western salsify control by herbicides was dependent on effective stubble management.


Burn plots
This was the plot
This is where we were burned out
The main weed you see growing in the plots is western salsify.
2010/08/03

Rodents

- An unforeseen consequence of not managing the plant/stubble residue was a substantial outbreak of pocket gophers and voles.
- We exploited this and ran a rodent control study.

Looking at Emissions

Johnston, W.J. & C. T. Golob. 2004

Quantifying post-harvest emissions from bluegrass seed production field burning

http://www.ecy.wa.gov/programs/air/aginfo/research_pdf_files/FinalKBGEmissionStudyReport_4504.pdf

Extrapolating from Johnston & Golob, when a burn was conducted on stubble left in a “low load” grass seed field 0.9 tons of combusted residue resulted in:

- 2,881 lbs of CO_2
- 291 lbs of CO
- 18 lbs CH_4
- 58 lbs $PM_{2.5}$
- 73 lbs of PM_{10}

Combustion efficiency was calculated at 87%

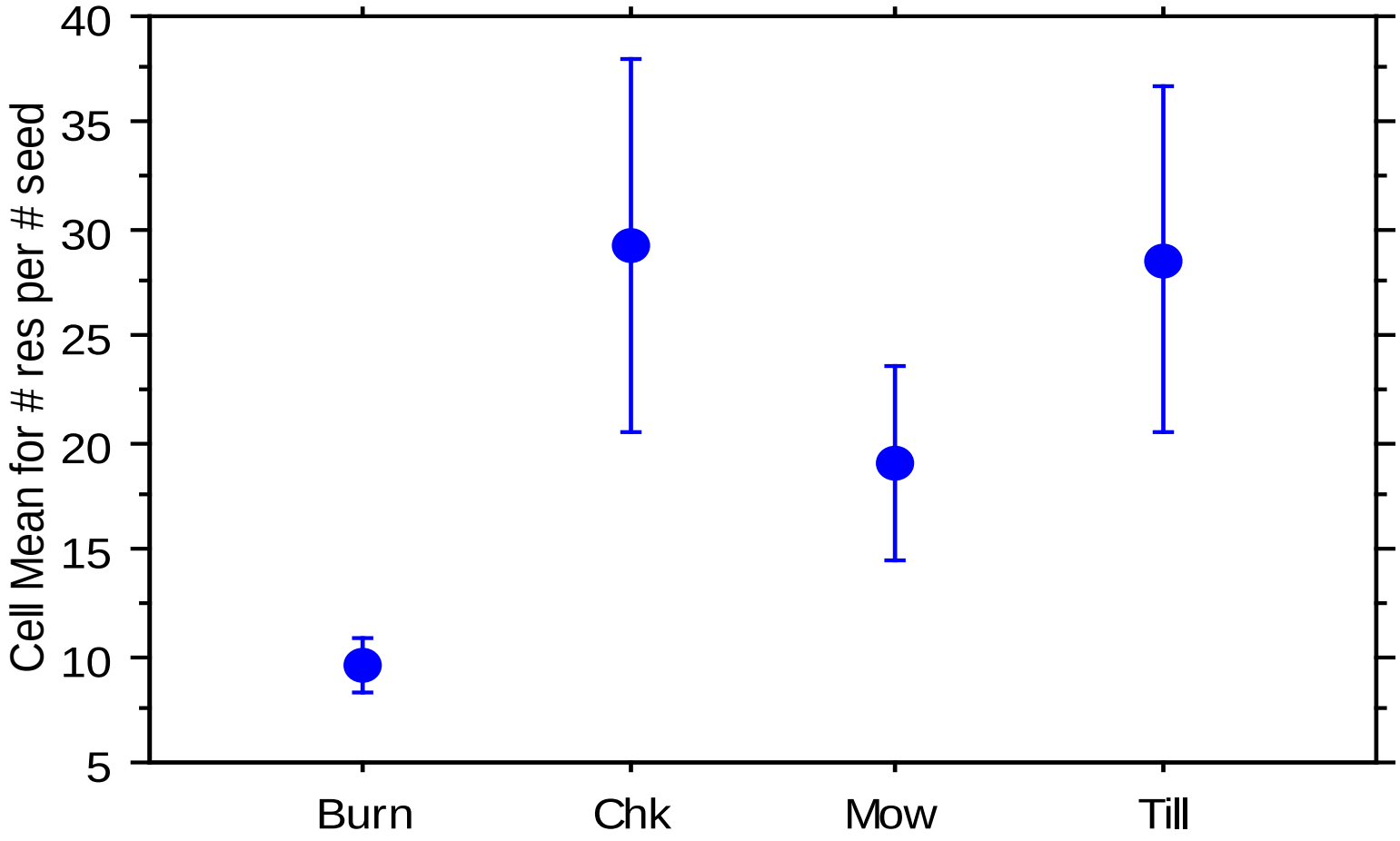
Emissions per acre

Spacing	22x1-5/8	22x3-3/8	30x1-5/8	30x3-3/8
2009				
Residue	0.73 tons[a]	0.54 tons[b]	0.61 tons[ab]	0.58 tons[b]
CO_2 lbs	2337	1729	1953	1857
CO lbs	309	228	258	245
CH_4 lbs	29	22	24	23
$PM_{2.5}$ lbs	42	31	35	45
PM_{10} lbs	53	39	44	42
2010				
Residue	3.46 tons[a]	2.44 tons[b]	3.30 tons[a]	2.24 tons[b]
CO_2 lbs	11,090	7,813	10,557	7,167
CO lbs	1,466	1,032	1,396	947
CH_4 lbs	138	97	131	89
$PM_{2.5}$ lbs	199	140	190	129
PM_{10} lbs	251	177	239	163

Field residues in February 2010 following a prior winter (2009) treatment by burning, tilling, mowing, or untreated, and a production season and the calculated emissions that would be produced by these residues if these plots were burned in February 2010.

Treatment	Seed spacing	Row spacing	Stubble (tons)	CO_2 (lbs)	CO (lbs)	CH_4 (lbs)	$PM_{2.5}$ (lbs)	PM_{210} (lbs)
Burn	22”	1-5/8”	3.46	11,090	1,466	138	199	251
Chk	22”	1-5/8”	3.38	10,848	1,434	135	194	246
Mow	22”	1-5/8”	2.86	9,153	1,210	114	164	208
Till	22”	1-5/8”	3.30	10,557	1,395	131	190	239
Burn	22”	3-3/8”	2.44	7,813	1,032	97	140	177
Chk	22”	3-3/8”	2.79	8,930	1,180	111	160	202
Mow	22”	3-3/8”	3.17	10,146	1,341	126	182	230
Burn	30”	1-5/8”	3.30	10,557	1,395	131	190	239
Chk	30”	1-5/8”	2.38	7,619	1,007	95	137	173
Mow	30”	1-5/8”	2.76	8,847	1,169	110	159	201
Till	30”	1-5/8”	2.24	10,364	1,370	129	186	235
Burn	30”	3-3/8”	2.24	7,167	947	89	129	163
Chk	30”	3-3/8”	2.50	8,015	1,059	99	144	182
Mow	30”	3-3/8”	3.65	11,688	1,546	145	210	265
Till	30”	3-3/8”	2.39	7,652	1,011	95	137	174

Mean value ± a standard error of the mean for the number of pounds of field residue present per pound of seed produced in each treatment in 2010.



Conclusions

- Burning the field residues of alfalfa seed fields has empirically proven to provide suppression of specific weeds, insects, diseases, and rodents.
- Burning removes variability in production.
- Alternate year burning offers few advantages from an emissions or production standpoint.
- Walla Walla County alfalfa seed producers are limited in the crops they can use in rotations.
- Continued burning of alfalfa field residues will benefit sustained agricultural production in minimal-irrigated agricultural areas of Walla Walla County.