



# From Fuels to Forage:

## Strategic use of forage kochia (*Bassia prostrata*)

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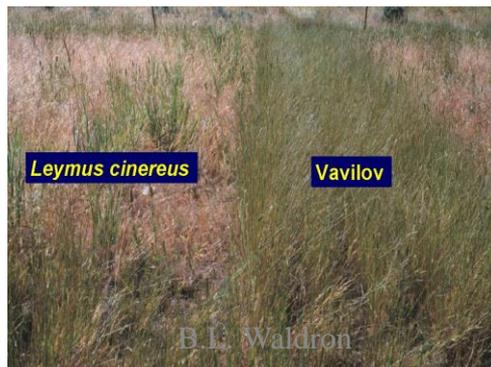
# FRR Rangeland Research - Mission

PLANTS FOR THE WEST



To develop plant materials and applications for rangelands and pastures with improved

- nutritive value,
- forage productivity, and
- weed- and fire-resistance



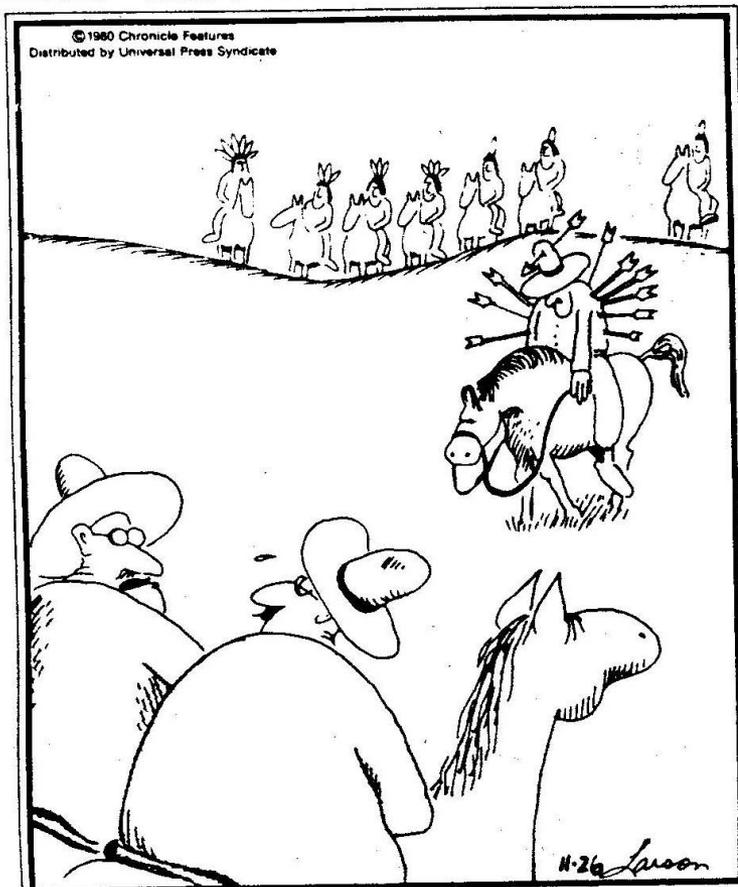


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PLANTS FOR THE WEST

# Forage kochia (*Bassia prostrata*)

## The Far Side



"Now stay calm . . . Let's hear what they said to Bill."



“Professor Weed”  
or  
“Miracle Plant”



# Forage kochia (*Bassia prostrata*)

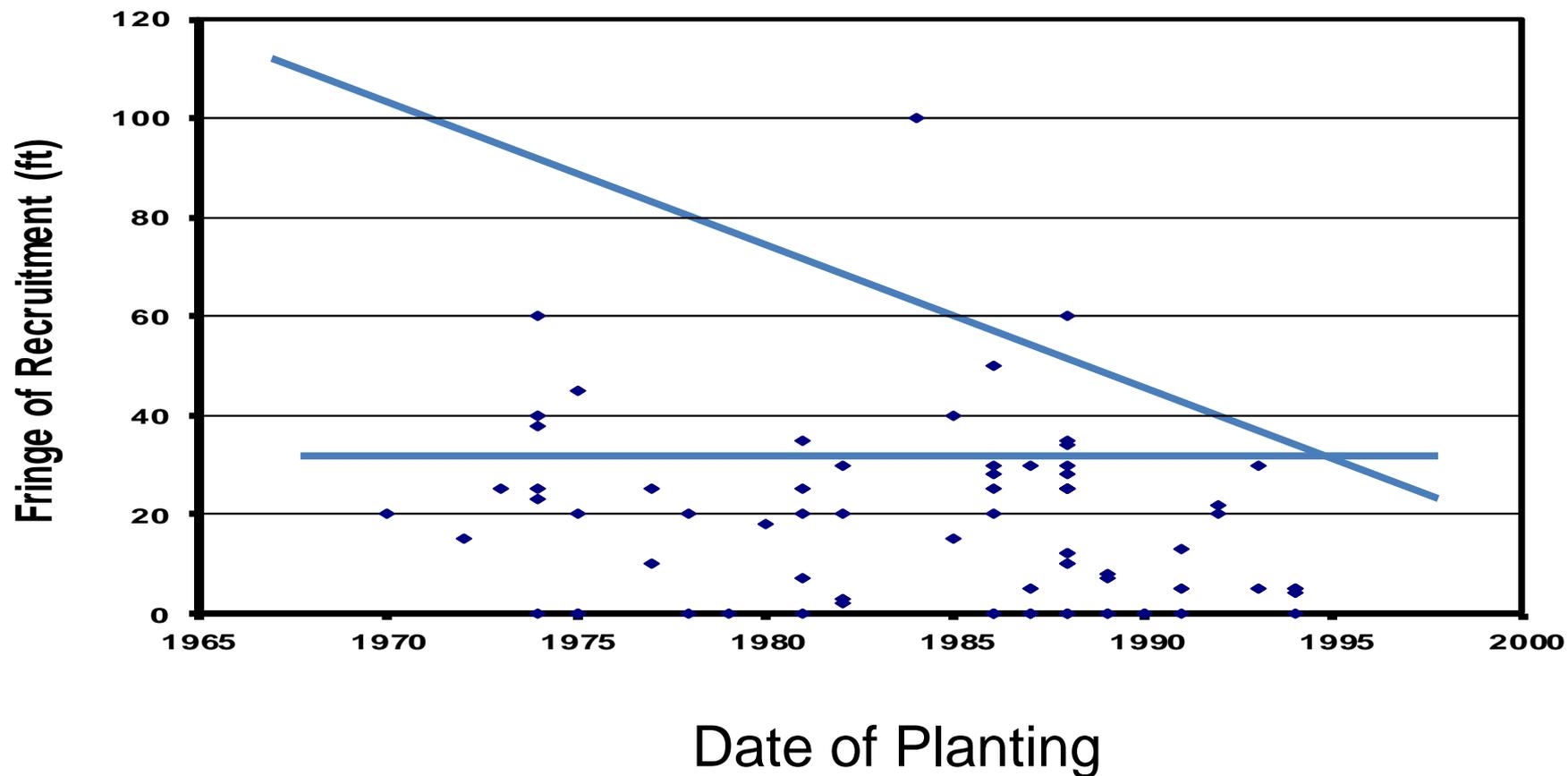
- a perennial semi-shrub – that is **not invasive** like the weedy annual kochia.
- forage kochia is drought (5 to 14 ppt zones) and salt/alkali tolerant.
- Establishes and competes with cheatgrass.
- Does not accumulate toxic levels of nitrates or oxalates.
- **Immigrant** was the only variety in the U.S. until March 2012.
- Immigrant is short statured (~9-18 inches).





# Age of planting is not related to forage kochia recruitment

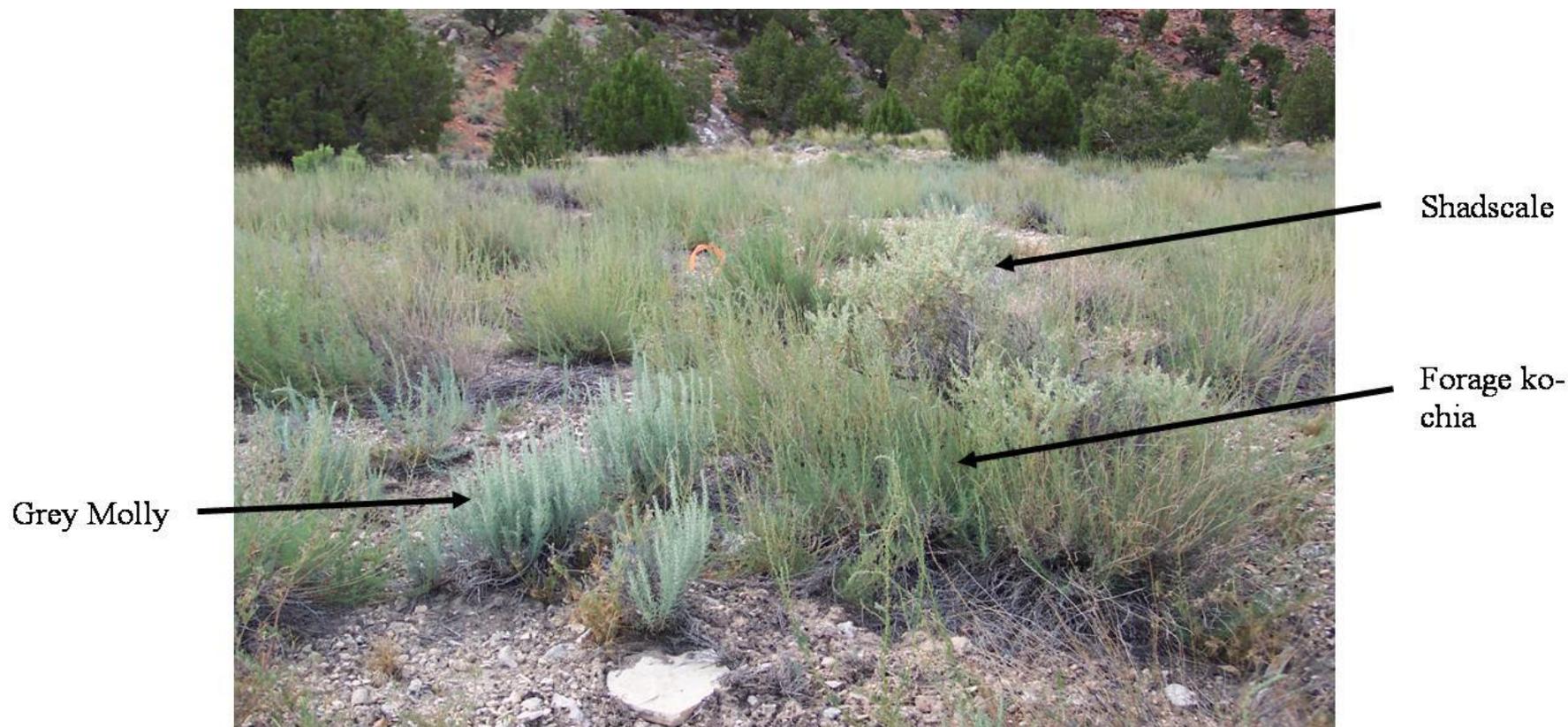
Waldron et al. 2001. Forage kochia: Friend or foe. Shrubland Ecosystem Genetics and Biodiversity Symp. Proceedings RMRS-P-21. USDA, Forest Service





# **Increases species richness and biodiversity, and is compatible with native species.**

Salina Canyon, I-70, mile post #60 north side – planted in 1975.





# **Increases species richness and biodiversity, and is compatible with native species.**





# Forage kochia lacks weedy attributes.

1. Forage kochia does not compete well against established perennial communities.
2. Age of planting was not associated with distance of recruitment.
3. Cannot build up a seed-bank due to seed viability of less than one year.
4. Shrubs such as shadscale and Wyoming big sagebrush can spread into forage kochia seedings.
5. It will spread and become established on disturbed, degraded, and marginal soils.



# Wildfire and Greenstrips

## The strategic use of forage kochia:

- Can help reduce the frequency and size of wildfires.
  - Reduced fuel load
  - Non-flammable properties
- Can move rangeland from invasive annuals to a stabilized perennial plant state
- Can assist in restoration of native shrubs and grasses.

Ash and soil from Milford Flat fire being carried in the wind northward over I-15 and Wasatch urban areas



# Wildfires and Greenstrips





# Wildfires and Greenstrips





# Forage kochia establishes and competes with cheatgrass

## Blowout area of Twin Peaks fire - Newhall et al., 2004. Rangelands 26:3-7.

2nd yr after burn under drought



1988

Initial Establishment



1989



1991

September 2019

B.L. Waldron

Site Stabilization



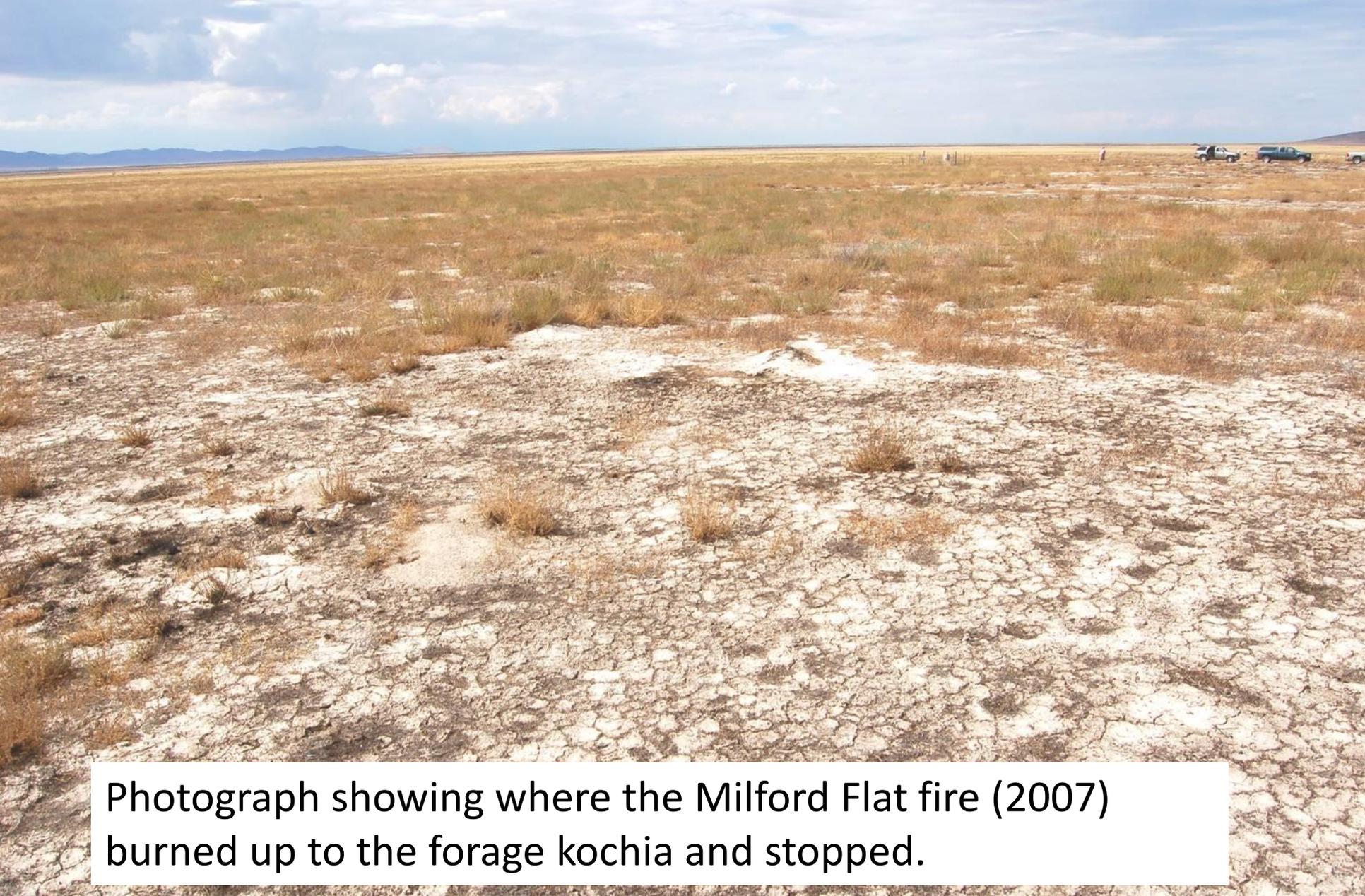
1996



## Forage kochia can establish in harsh conditions and stop wildfires

- Milford Flat fire (2007) burned 350,000 acres.
- Including the 18,000 acres burned by Twin Peaks fire (1986).





Photograph showing where the Milford Flat fire (2007) burned up to the forage kochia and stopped.



# Wildfires and Greenstrips





# Wildfires and Greenstrips





# Wildfires and Greenstrips





# Wildfires and Greenstrips





# Wildfires and Greenstrips



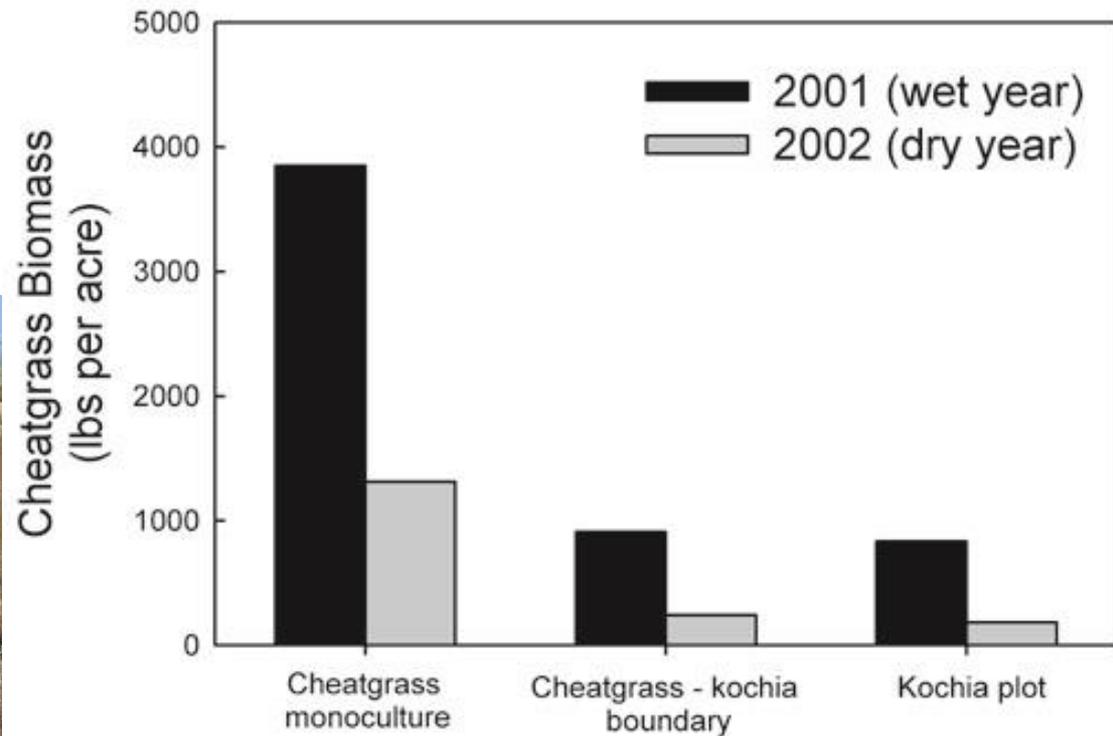


# Wildfires and Greenstrips





# Forage kochia establishes and competes with cheatgrass Skull Valley, UT – Monaco et al. 2003. *Rangelands* 25:26-29.





# Forage kochia can rehabilitate Gardner Saltbush ecosystems invaded by halogeton. Smith et al. 2016. REM 69:390-398



June  
1999



September  
2009



# Forage kochia can rehabilitate Gardner Saltbush ecosystems invaded by halogeton. Smith et al. 2016. REM 69:390-398



**“Results indicate that Russian wildrye and forage kochia can establish and reduce halogeton frequency, thereby providing an opportunity for rehabilitation of halogeton-invaded areas.”**



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PLANTS FOR THE WEST

# Snowstorm forage kochia does not burn





# Forage and habitat

The strategic use of forage kochia:

- Can provide forage and habitat for livestock and wildlife
- Can reduce grazing pressure on sensitive rangelands.





# Livestock — Forage kochia can extend the grazing season into the fall and winter



**Winter grazing in Box Elder County, Utah**  
Immigrant is short-statured limiting range of use.



**Early fall grazing near Evanston, Wyoming**



# Forage kochia increases carrying capacity of winter ranges

Species (Nov. harvest)	Box Elder Co., UT 2002-03	Tooele Co., UT 2007-08
<i>Kochia Pasture</i>	lb/acre	lb/acre
Kochia	905	1717
Wheatgrass	395	592
Total	1299	2309
<i>Control Pasture</i>		
CWG/cheatgrass	~400	394
Increase	3X	6X



# Forage kochia increases nutritional quality of winter ranges

Species (Nov. harvest)	Box Elder Co., UT 2002-03	Tooele Co., UT 2007-08
<i>Kochia Pasture</i>	Crude protein (%)	Crude protein (%)
Kochia	9.6	11.7
Wheatgrass/ Cheatgrass	5.3	3.1

- Forage kochia provides protein source (>7%)
- Forage kochia has lower fiber and equal digestibility compared to grass
- Forage kochia improves digestion of low-quality, dormant grasses



# Forage kochia average crude protein from Utah, Nevada, and Wyoming in 2006

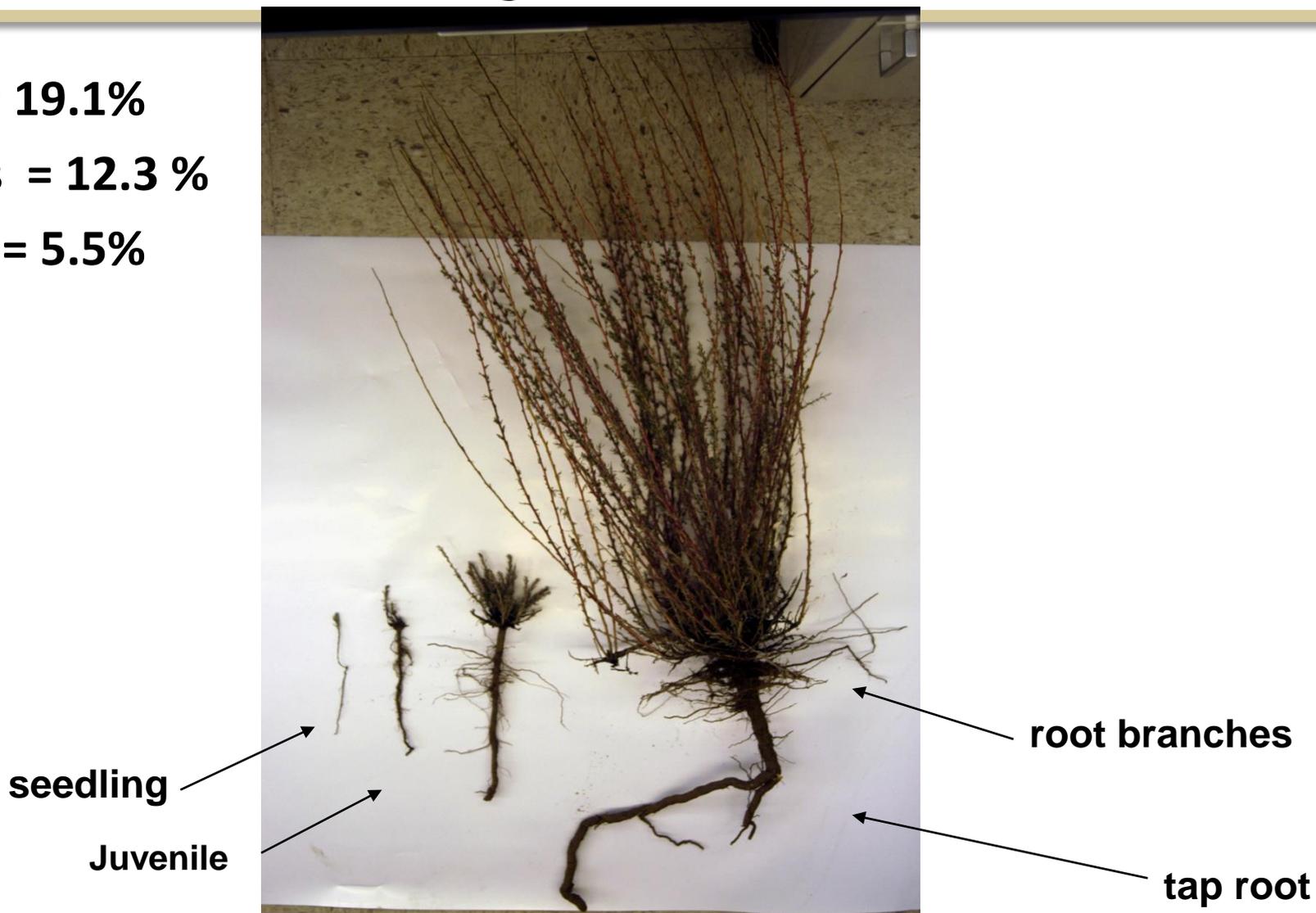
	June	July	Aug	Sept	Oct
<b><i>Crude Protein (%)</i></b>	16.5	13.0	12.9	9.5	10.8
<b><i>Nitrate (%)</i></b>	0.09	0.03	0.03	0.02	0.02
<b><i>Oxalate (%)</i></b>	3.38	3.42	2.96	2.92	2.88

- Forage kochia provides protein source (>7%) throughout season.
- Forage kochia has non-toxic levels of nitrates (< 0.5%) and oxalates.



# Crude Protein of forage kochia plant parts in early November.

- Seed = 19.1%
- Leaves = 12.3 %
- Stems = 5.5%



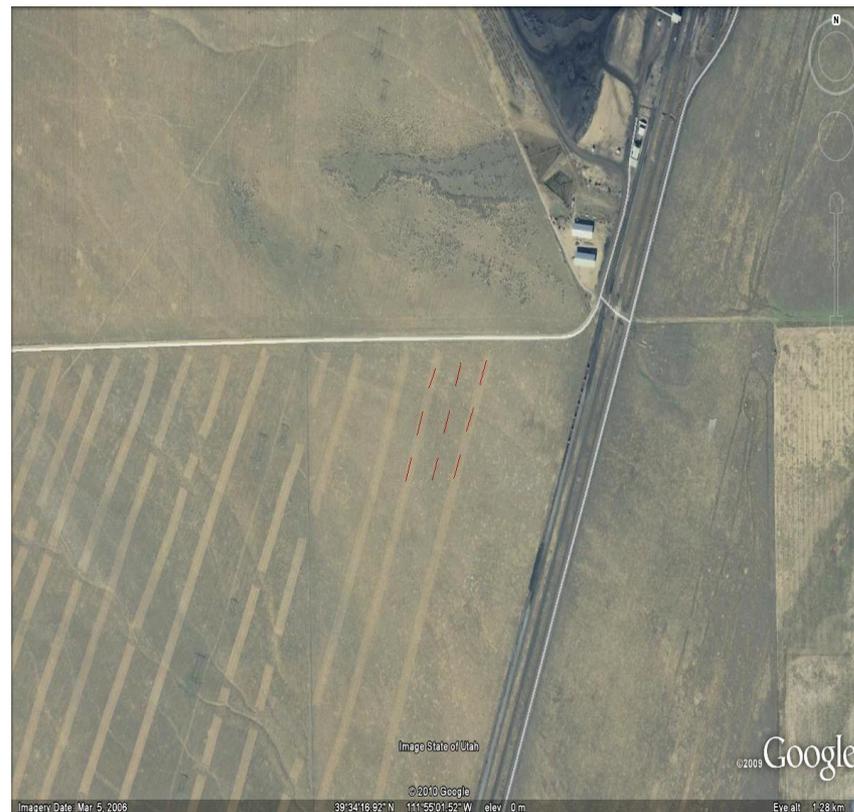


# Interseeding forage kochia into established CRP grass monoculture to improve the grazing value

## Rancher experiment in Nephi, UT

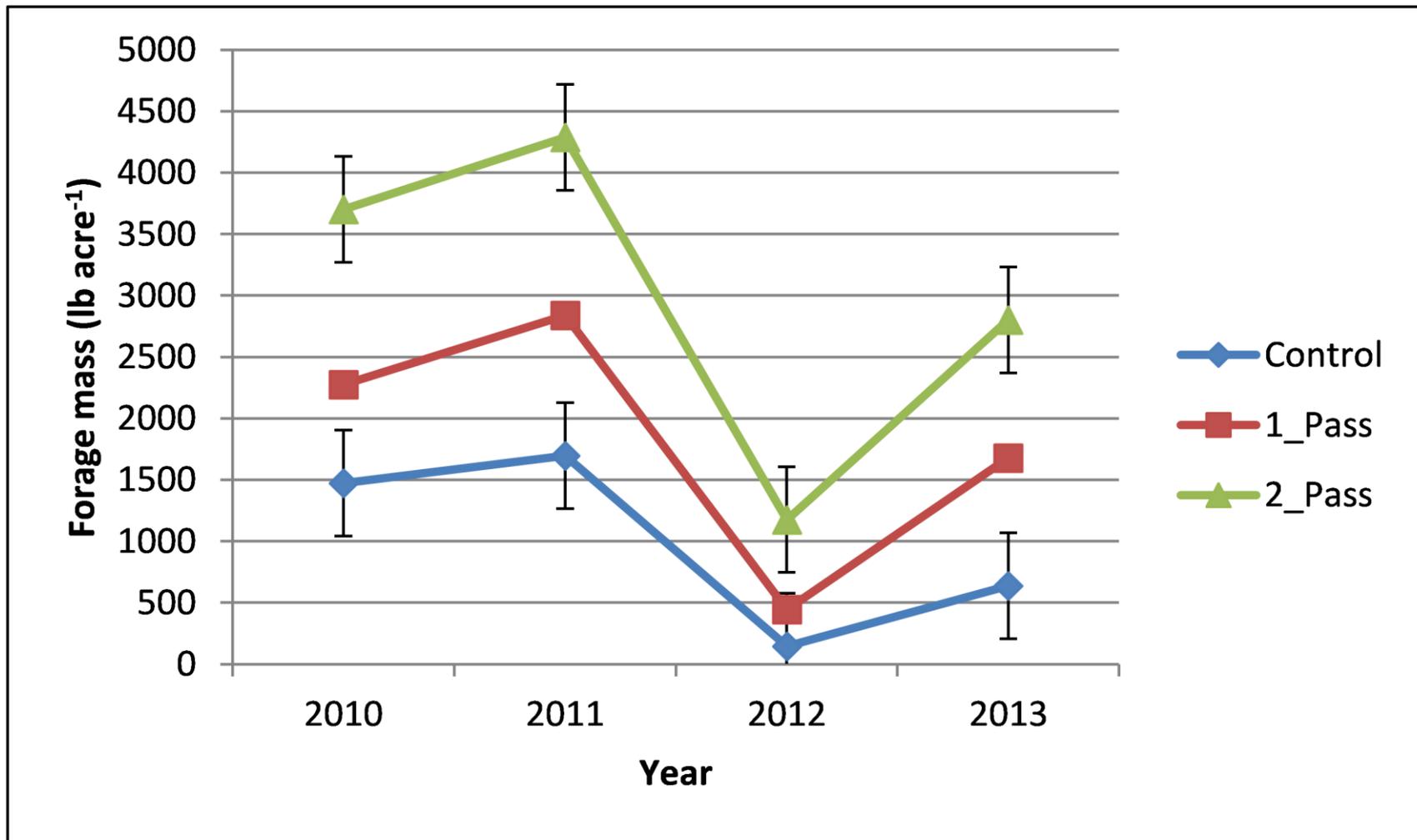
**3 treatments – in a CRP field dominated by crested wheatgrass**

- 1. Control, No disturbance – no kochia seed**
- 2. 1-pass with a chisel plow – broadcast kochia seed**
- 3. 2-pass with a chisel plow – broadcast kochia seed**





# Establishing forage kochia in CRP to improve the winter grazing value





# Establishing forage kochia in CRP to improve the winter grazing value

Table 2. Forage mass, nutritive values, and predicted intake and stocking rate (of mature, mid-gestation, 1100-lb beef cows) following interseeding forage kochia into wheatgrass-dominated Conservation Reserve Program acreage near Levan, UT. Tillage treatments included no tillage (control) and one or two passes with a chisel plow.†

Tillage	Forage mass lb/acre	CP %	ADF %	NEm Mcal/lb	NEg Mcal/lb	Predicted DMI lb/day	Predicted stocking rate AUM/acre
Two-pass	2991 a‡	8.8 a	37.5 b	0.50 a	0.25 a	21.8 a	1.6 a
One-pass	1810 b	7.8 b	38.0 b	0.49 a	0.24 a	21.9 a	0.9 b
Control	988 c	4.5 c	45.9 a	0.40 b	0.16 b	24.3 b	0.5 c
SEM	43	0.34	0.76	0.008	0.008	0.11	0.02

† CP, crude protein; ADF, acid detergent fiber; NEm, net energy for maintenance, NEg, net energy for gain; DMI, dry-matter intake.

‡ Values within a column followed by a different letter are significantly different at the  $P = 0.05$  probability level as determined by an LSD test.



# Livestock Summary — forage kochia can extend the grazing season into the fall and winter

## 1. Cattle will consume forage kochia.

Waldron, B.L., B.W. Davenport, J.C. Malecheck and K.B. Jensen. 2010. Relative cattle preference of 24 forage kochia (*Kochia prostrata*) entries and its relation to forage nutritive value and morphological characteristics. *Crop Science* 50: 2112-2123.

## 2. Forage kochia increases carrying capacity of rangelands (by at least 3X) and provides critical levels of protein.

Waldron, B.L., L.K. Greenhalgh, D.R. ZoBell, K.C. Olson, B.W. Davenport and M.D. Palmer. 2011. Forage kochia (*Kochia prostrata*) increases nutritional value, carrying capacity, and livestock performance on semiarid rangelands. *Forage and Grazinglands*. doi:10.1094/FG-2011-0301-01-RS.



Winter grazing (gestating cows) in Box Elder Co., UT



October grazing in Tooele Co., UT



# Establishing forage kochia in CRP to improve the winter grazing value

Table 3. Economic analysis following interseeding forage kochia into wheatgrass-dominated Conservation Reserve Program acreage near Levan, UT. Tillage treatments included no tillage (control) and one or two passes with a chisel plow.

Tillage	Total cost†	Amortized cost‡	Grazing value§	Net return
			\$/acre	
Two-pass	69.00	17.28	64.26 a	46.98 a
One-pass	54.00	13.52	38.34 b	24.82 b
Control	0.00	0.00	18.80 c	18.80 c
SEM			0.82	0.81

† Calculated on the basis of actual seeding costs, including tillage costs for one-pass chisel plow treatment at \$15/acre, two-pass chisel plow at \$30/acre, forage kochia pure live seed (PLS) cost of \$17.37/lb, planting rate of 1.9 PLS lb/acre, and aerial broadcast seeding cost of \$6/acre.



# Livestock Summary – forage kochia can extend the grazing season into the fall and winter

3. Forage kochia reduces winter feeding costs by at least 25% (\$0.25/cow/day in 2004 dollars) and improves cattle body condition compared to feedlot.

Waldron, B.L., D.R. ZoBell, K.C. Olson, K.B. Jensen and D.L. Snyder. 2006. Stockpiled forage kochia to maintain beef cows during winter. *Rangeland Ecology & Management* 59: 275-284.

4. Forage kochia increases grazing value of rangelands by \$28/acre compared to perennial grass monoculture.

Waldron, B.L., J.E. Banks, R.L. Newhall, D.L. Snyder and K.J. Thornton. 2016. Interseeding Forage Kochia into Established CRP to Improve Fall and Winter Grazing Potential. *Crop, Forage & Turfgrass Management* 2. doi:10.2134/cftm2015.0200.

## Added Economics Value:

Given that forage kochia is now planted on an estimated 1 to 2 million acres across the western U.S. -

- a. Added grazing value - \$28 to 56 million/yr
- b. Cost savings over feedlot - \$12 to \$24 million/yr.



Winter grazing (gestating cows) in Box Elder Co., UT



October grazing in Tooele Co., UT



# Immigrant forage kochia is great for fall/winter grazing; However . . .

- Due to its short stature and fine stems – The use of Immigrant is limited because of snow accumulation greater than 12 inches





# Evaluation and breeding of forage kochia near Howell, Utah



**Snowstorm kochia**

**Immigrant kochia**



# 'SNOWSTORM', a New Taller, High-Yielding, Protein-Rich Forage Kochia Cultivar

**“Snowstorm is named for its ability to extend the grazing season into the fall and winter and because it provides ranchers and land managers a new, taller, more productive, more nutritious forage kochia cultivar . . .”**

Waldron, B.L., S.R. Larson, M.D. Peel, K.B. Jensen, T.C. Mukimov, A. Rabbimov, D.R. ZoBell, R.C. Wang, R.C. Smith, R.D. Harrison and B.W. Davenport. 2013. 'Snowstorm', a new forage kochia cultivar with improved stature, productivity, and nutritional content for enhanced fall and winter grazing. *Journal of Plant Registrations* 7: 140-150.





# 'SNOWSTORM'- a New, Taller, Higher-Yielding, Protein-Rich Forage Kochia Variety

Mean performance of Snowstorm compared to Immigrant. Data from 8 locations (over multiple years) in Utah, Idaho, Wyoming, Oregon, and Montana.

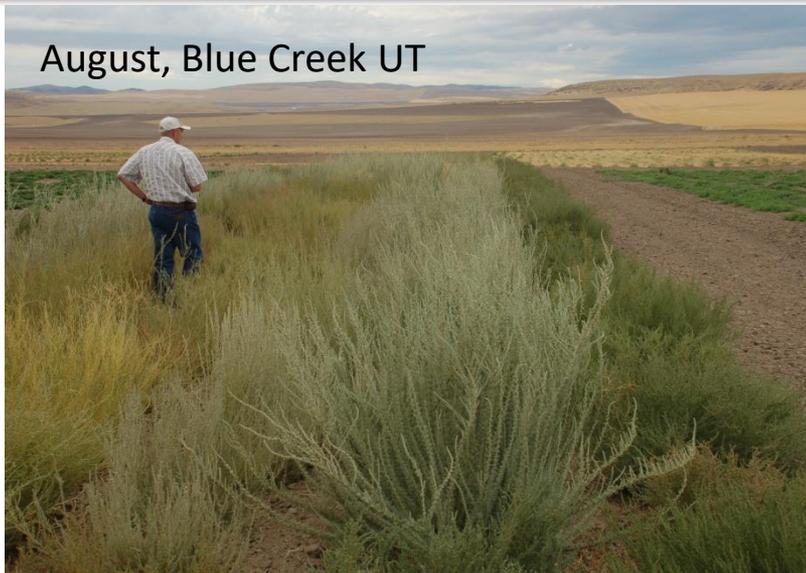
Entry	Snowstorm	Immigrant	% diff
Height (inch)	30 a	18 b	+40%
Forage (lbs/acre)	2256 a	1343 b	+40%
Protein (%)	7.9 a	6.5 b	+18%
NDF (%)	48.2 a	47.0 a	NS
ADF (%)	34.4 b	33.0 a	-4%
IVTD (%)	67.4 a	64.8 b	+4%





# Snowstorm - A new TALLER forage kochia cultivar for enhanced fall and winter grazing – what does it look like?

August, Blue Creek UT



September, Dubois, ID



October, Horse Creek, NV



November, Blue Creek UT

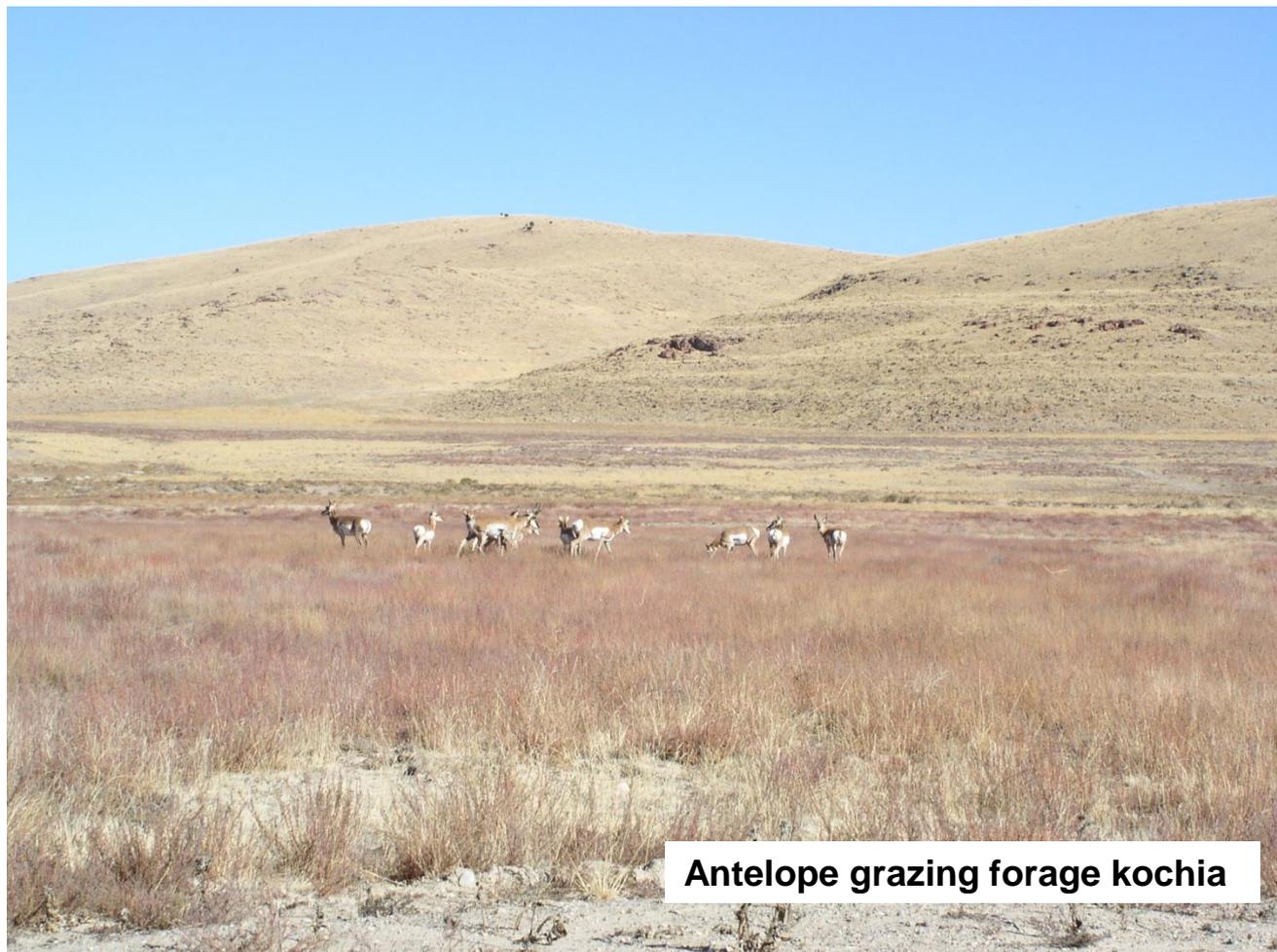


September 2019

B.L. Waldron



# Wildlife – Forage kochia can provide high quality forage and habitat for wildlife



Antelope grazing forage kochia



# Wildlife — Forage kochia can provide high quality forage and habitat for wildlife



Sage grouse utilizing forage kochia greenstrip around lek

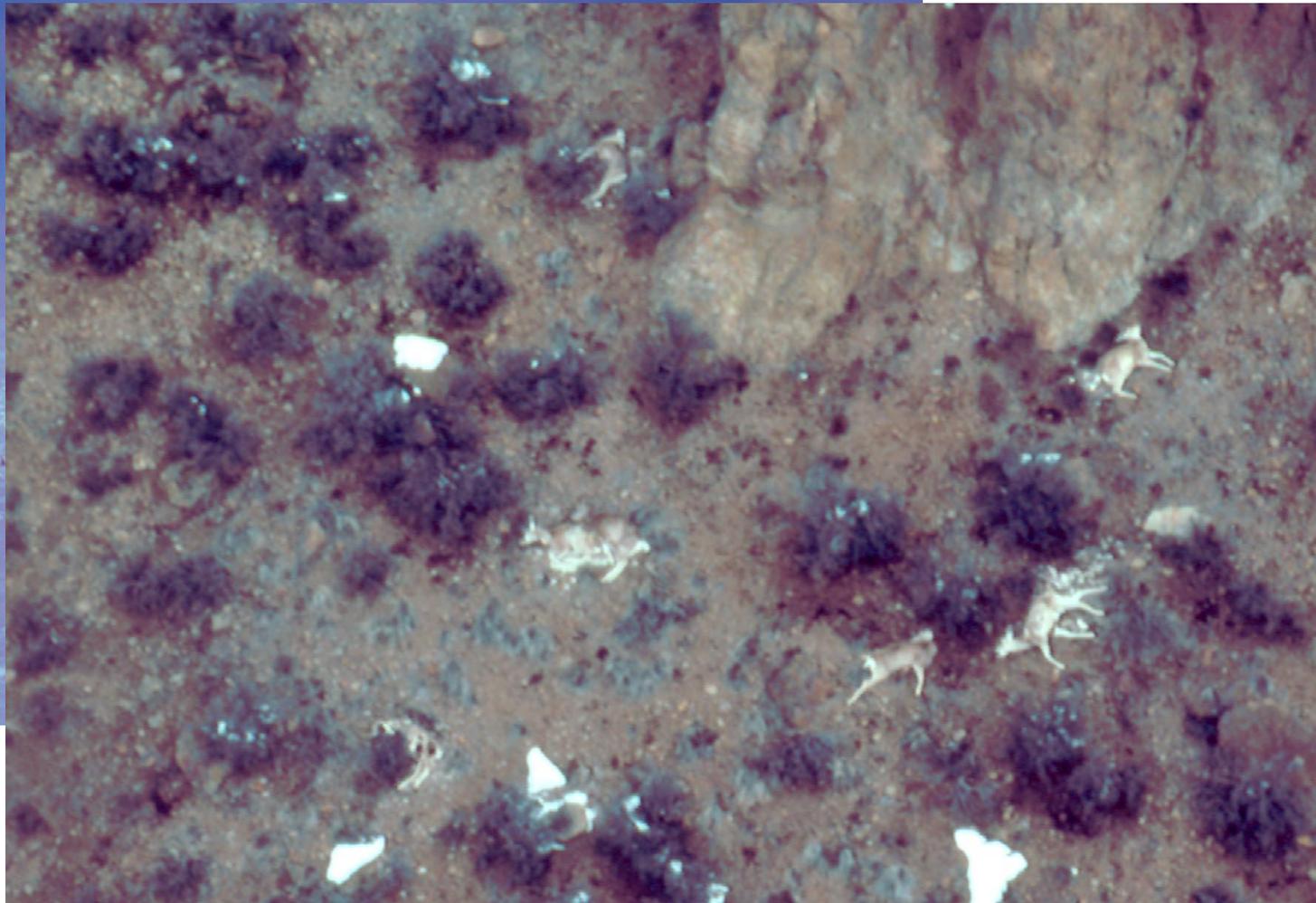
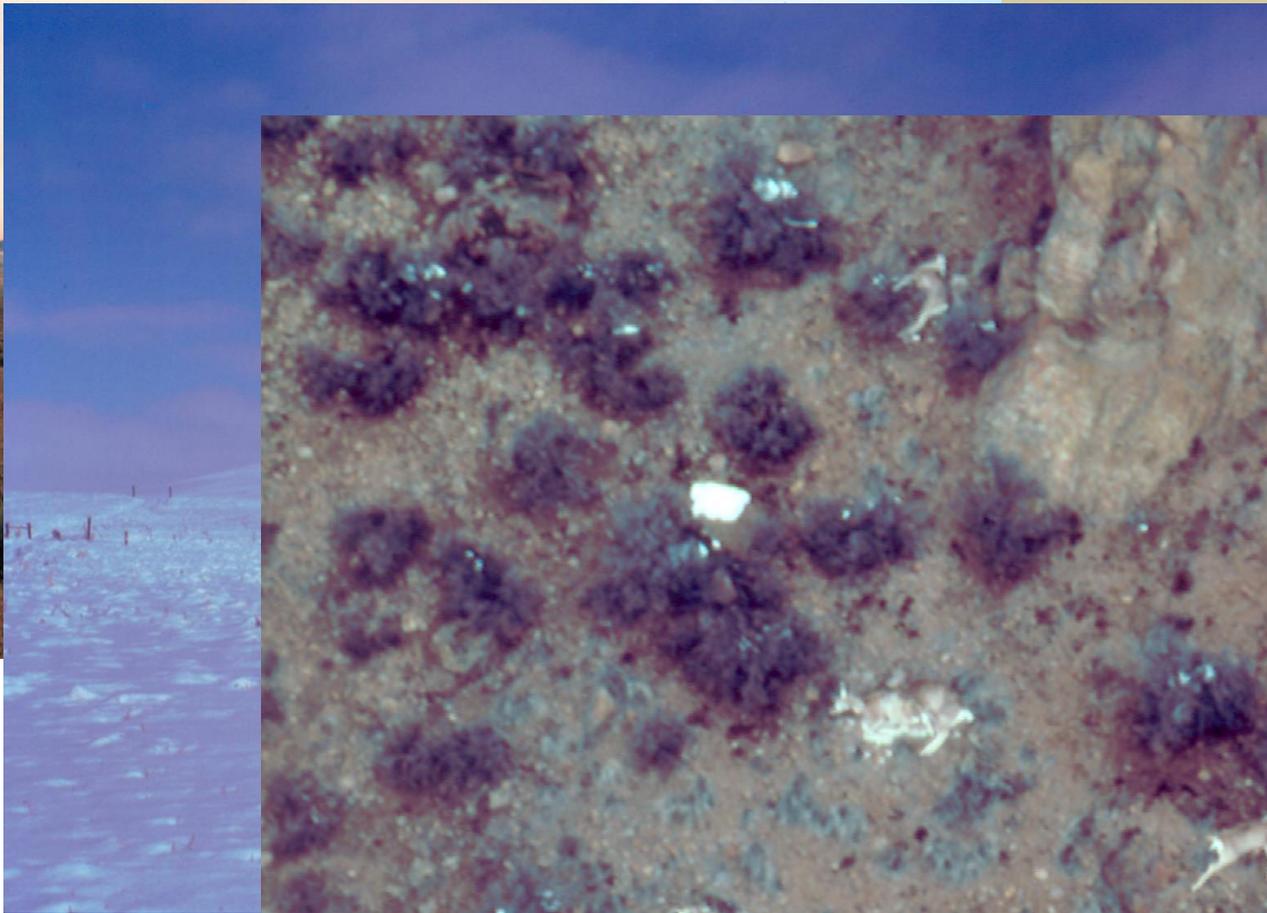


## MULE DEER MANAGEMENT AREA SIX

(TOTAL AREA - 6,896 SQUARE MILES)



Information from Ken Gray, NV Dept of Wildlife





## 41,000 acres of kochia seeded on crucial deer winter range

25% increase in adult deer winter survival where forage kochia was planted after fire destroyed traditional ranges.

**The strategic use of forage kochia:**

- can provide forage and habitat for livestock and wildlife, and**
- can reduce grazing pressure on sensitive rangelands.**



Wild horses grazing forage kochia



# Establishing and Managing forage kochia

## Four keys to successful establishment

1. Seedbed needs to be disturbed.





# Establishing and Managing forage kochia

**Seedbed needs to be disturbed**



**Only light disturbance is needed – harrow, etc**



# Establishing and Managing forage kochia

## Seedbed needs to be disturbed



## Radical treatment required



# Establishing and Managing forage kochia

## Four keys to successful establishment



1. Seedbed needs to be disturbed.
2. Use current years seed and require a recent germ test.
3. Seed December through February
  - Mixed grass/forage kochia for winter grazing
  - Rate = 1 to 2 lb PLS/A for Immigrant
  - Rate = 2 to 4 lb PLS/A for Snowstorm
  - Rate = 3 to 6 lb PLS/A for fire breaks
4. Recommend broadcast – DO NOT bury seed deeper than  $\frac{1}{4}$  to  $\frac{1}{2}$  inch
  - Can go on top of snow



# Establishing and Managing forage kochia

**Recommended to broadcast – DO NOT bury seed deeper than ¼ to ½ inch**





# Establishing and Managing forage kochia

**Mixed with grass for grazing**

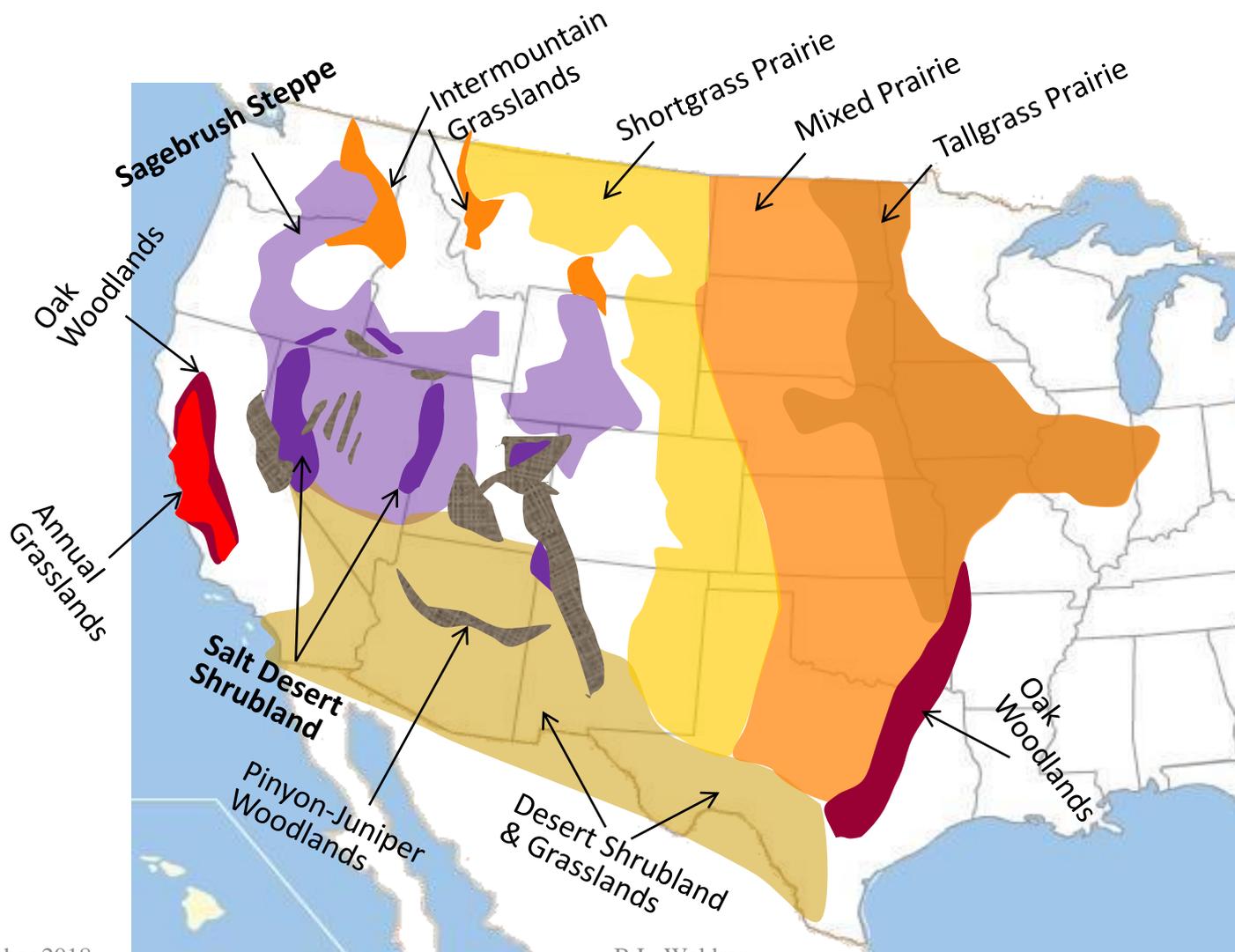


**Monoculture for fire break**





# Will forage kochia grow in the Central Coast Rangelands?



December 2018

B.L. Waldron

A.S. Kuchler 1964. Potential natural vegetation of the conterminous United States. American Geographical Soc. Publ. #36.



# Will forage kochia grow in the Central Coast Rangelands?



L. Wald



Forage kochia  
(*Bassia prostrata*)

“Professor Weed”  
or  
“Miracle Plant”





# QUESTIONS?

**Thank you for your time.**

- **Forage kochia can reduce size and frequency of wildfire.**
- **Forage kochia improves carrying capacity and nutritional content of rangelands.**
- **'Snowstorm' is a new taller, higher yielding, protein-rich forage kochia.**
- **Forage kochia can be used to rehabilitate degraded rangelands.**