P and K Placement for Alfalfa

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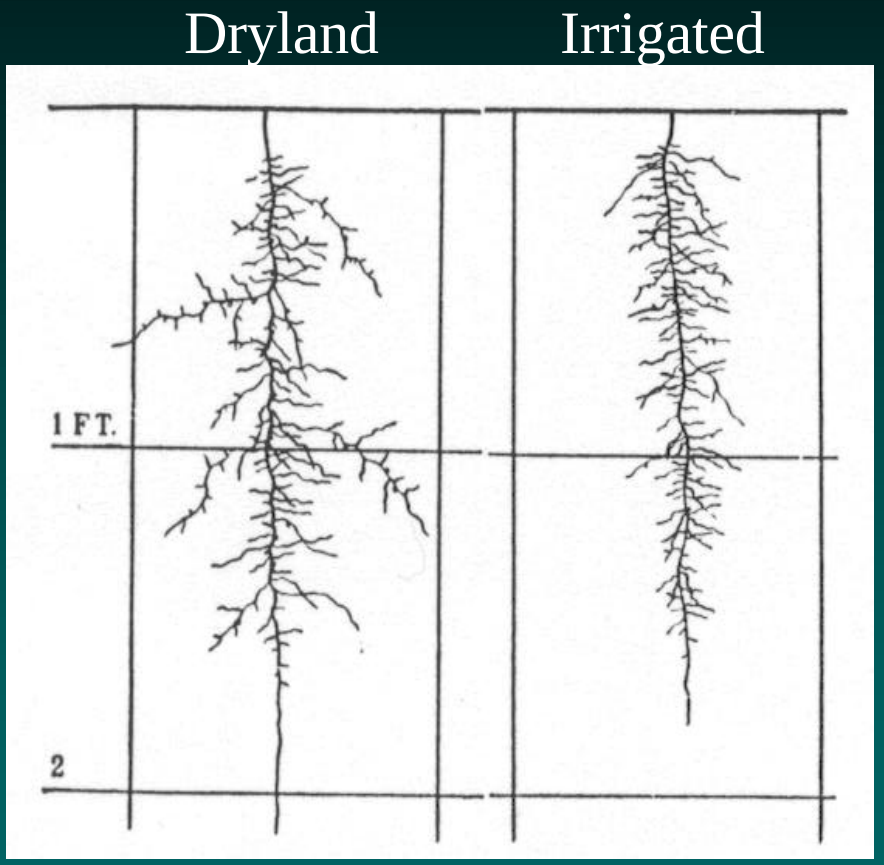
Potential use of fertilizer for forage production

"Despite the proven importance of forage crops . . . , growers seldom devote as much attention to the cultivation, fertilization, and conservation of their fodder crops as they do to their more readily marketable cash crops. . . . "

1974, J.D. Beaton, Cominco, Ltd.

Alfalfa root morphology

- Dryland
  - Deeper penetration
  - Fewer but longer laterals
  - More secondary branches
- Irrigated
  - Shallower
  - More but shorter laterals
  - Less secondary branches



(approx. 2 mo. after planting)

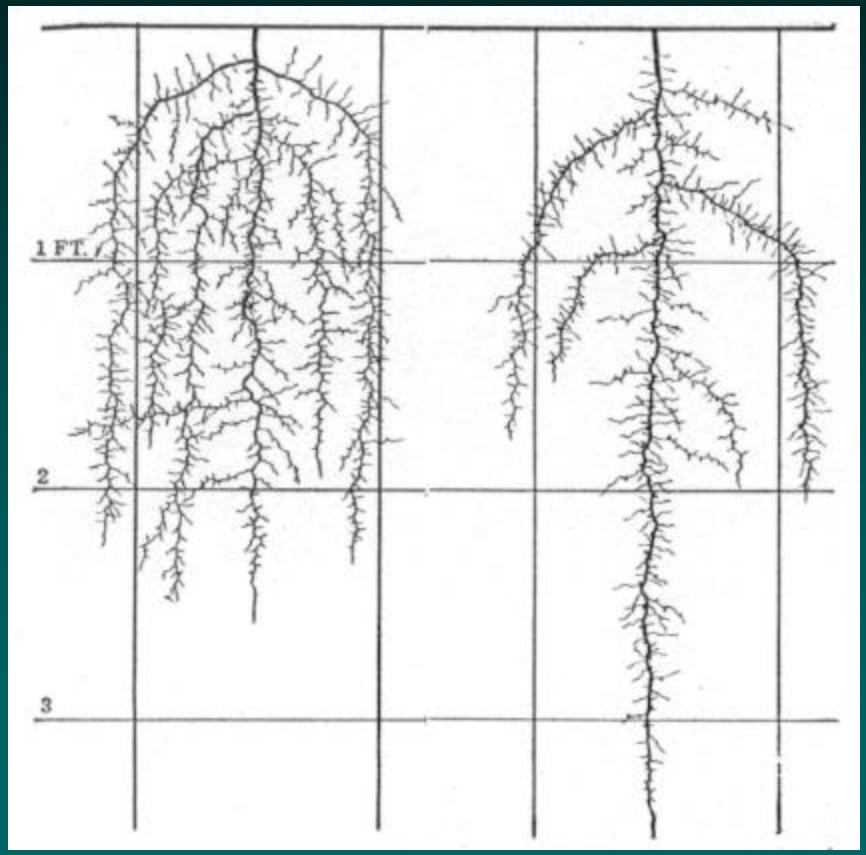
Weaver, 1926 (Nebraska)

Alfalfa root morphology

- Dryland
  - Root system is more profusely branched
  - Branches reached same depth as tap root
  - Shallower root system
- Irrigated
  - Fewer branches
  - Greater rooting depth
  - Tap root is the dominant structure

Weaver, 1926 (Nebraska)

Dryland Irrigated



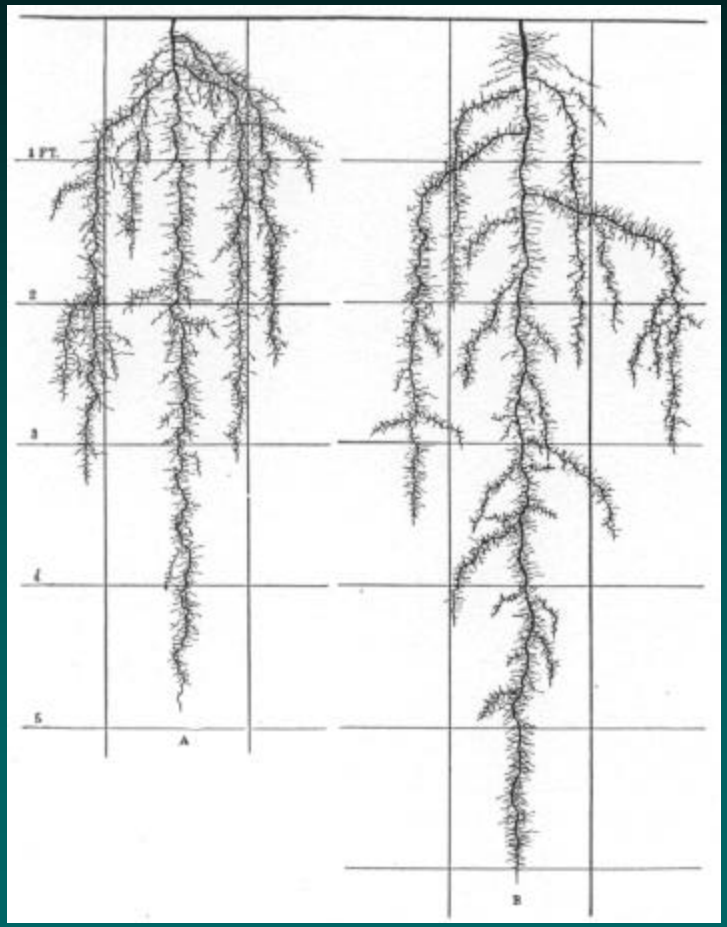
(approx. 3 mo. after planting)

Alfalfa root morphology

- Dryland
  - Greater number of branches in upper 1 ft. of soil
  - Maximum depth of 5 ft.
  - Roots oriented downward
- Irrigated
  - Fewer branches in upper 1 ft. of soil
  - Maximum depth of over 6 ft.
  - Greater lateral extent of root system

Weaver, 1926 (Nebraska)

Dryland Irrigated

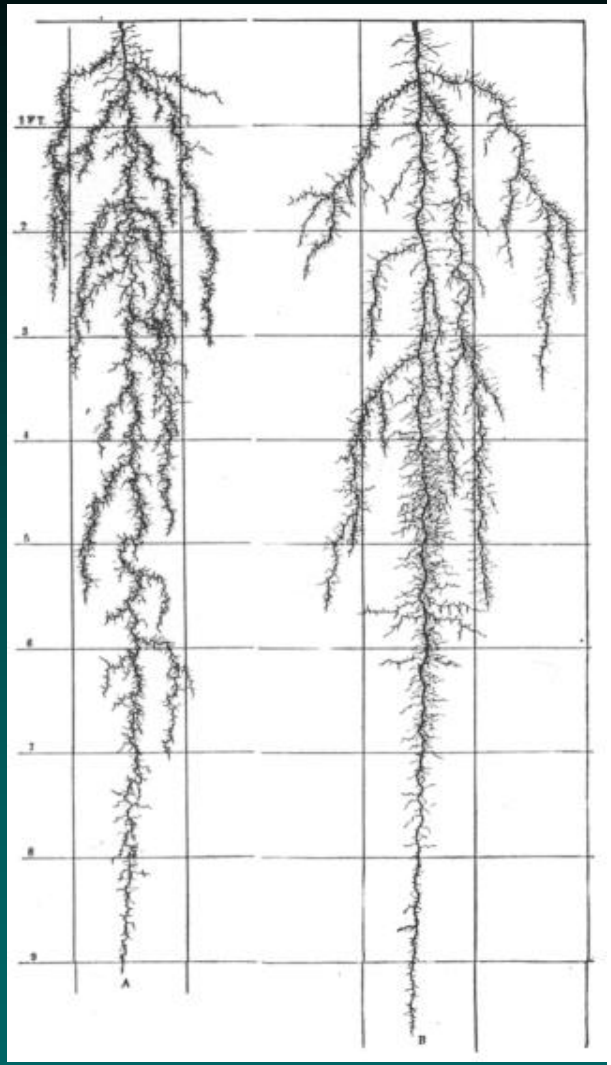


(end of first year)

Alfalfa root morphology

- Dryland:
  - Depth of over 9 ft.
  - Roots oriented downward
  - Little lateral extension
- Irrigated
  - Depth of nearly 10 ft.
  - Greater lateral extent

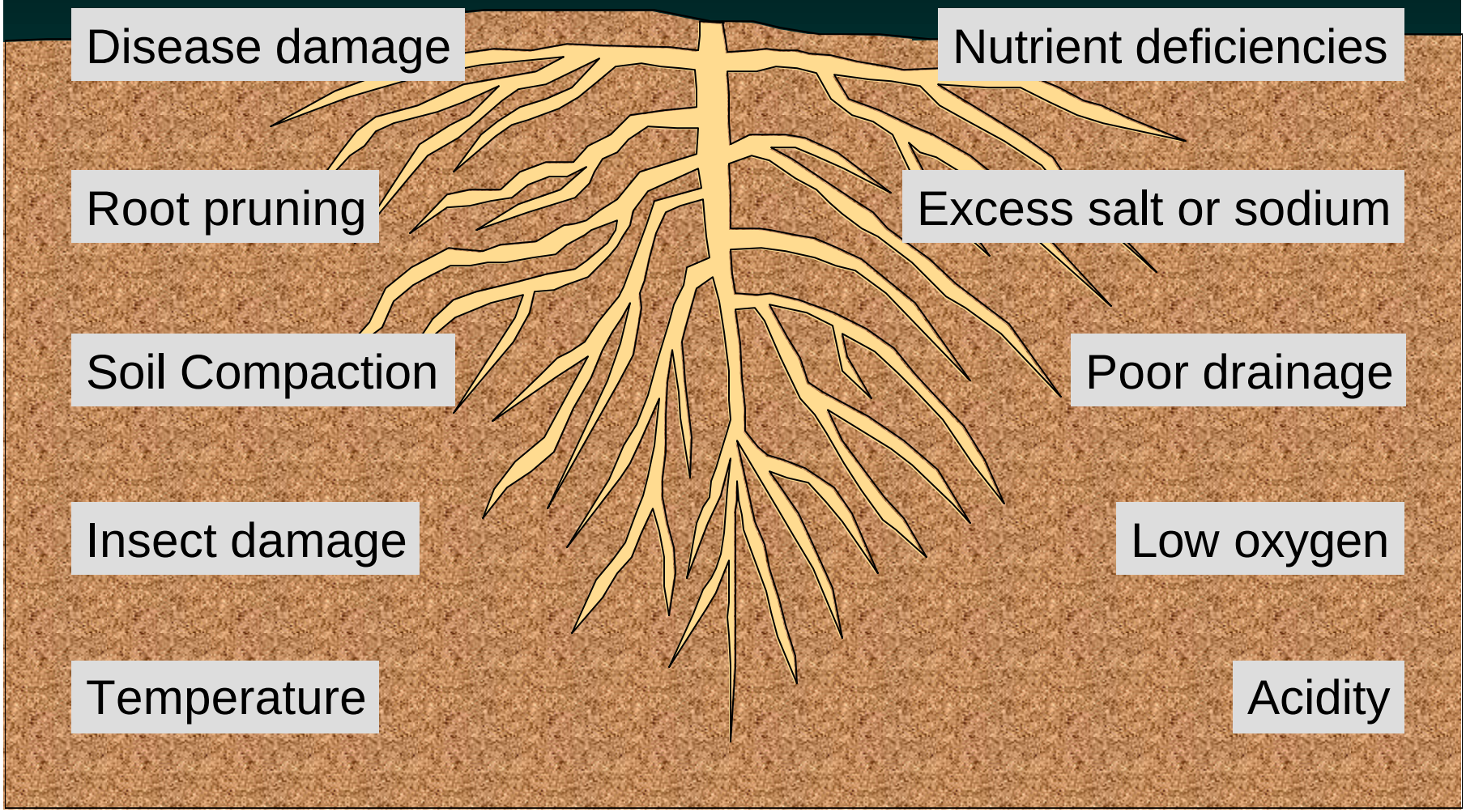
Dryland Irrigated



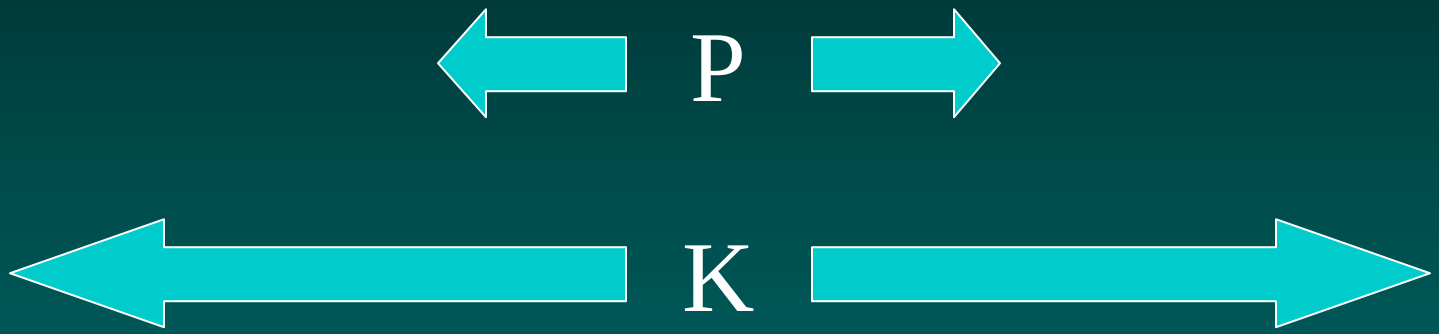
(July 10, second year)

Weaver, 1926 (Nebraska)

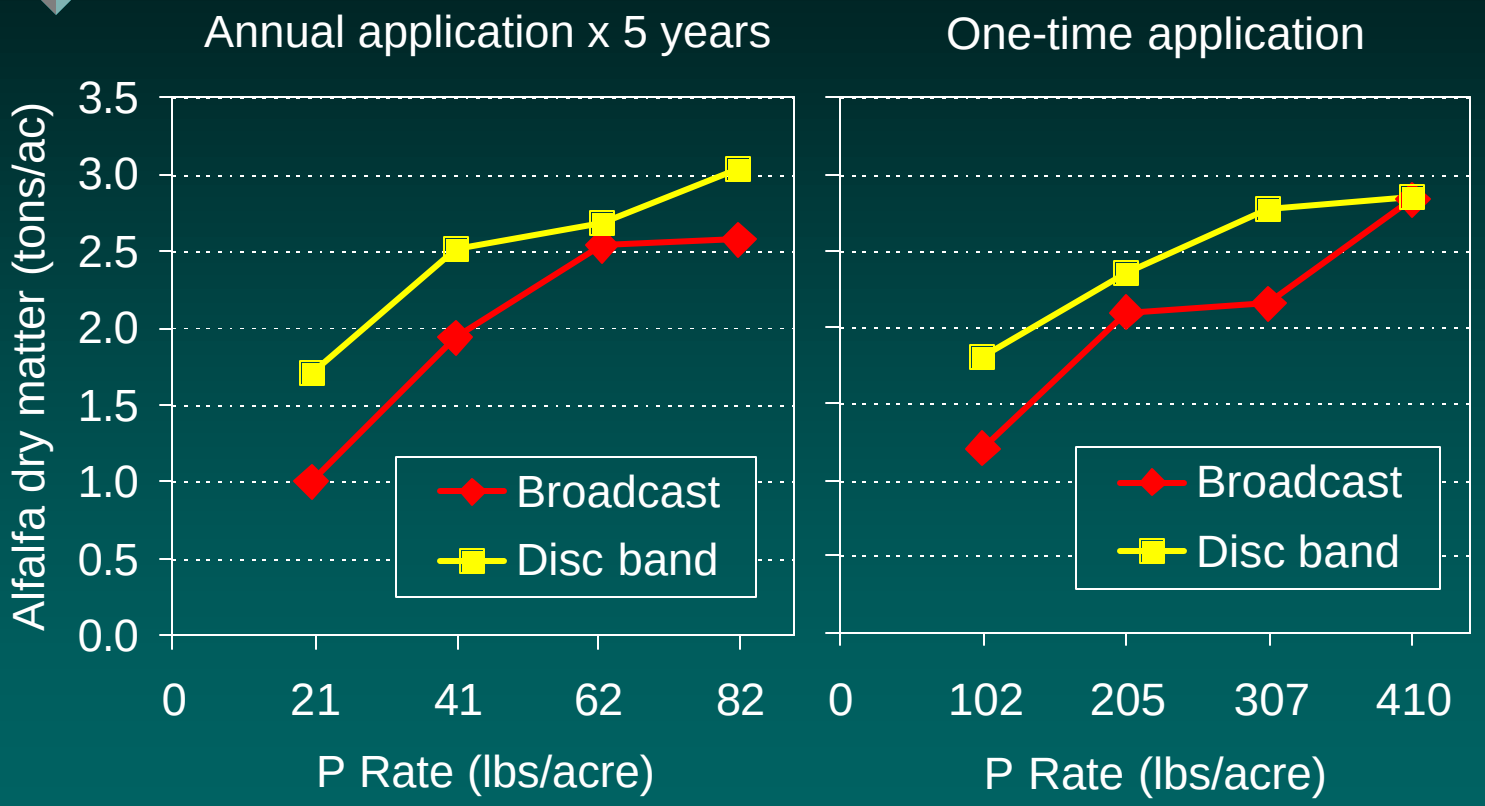
Factors restricting root growth reduce nutrient uptake



Relative Nutrient Mobility



Banded P increases alfalfa yields

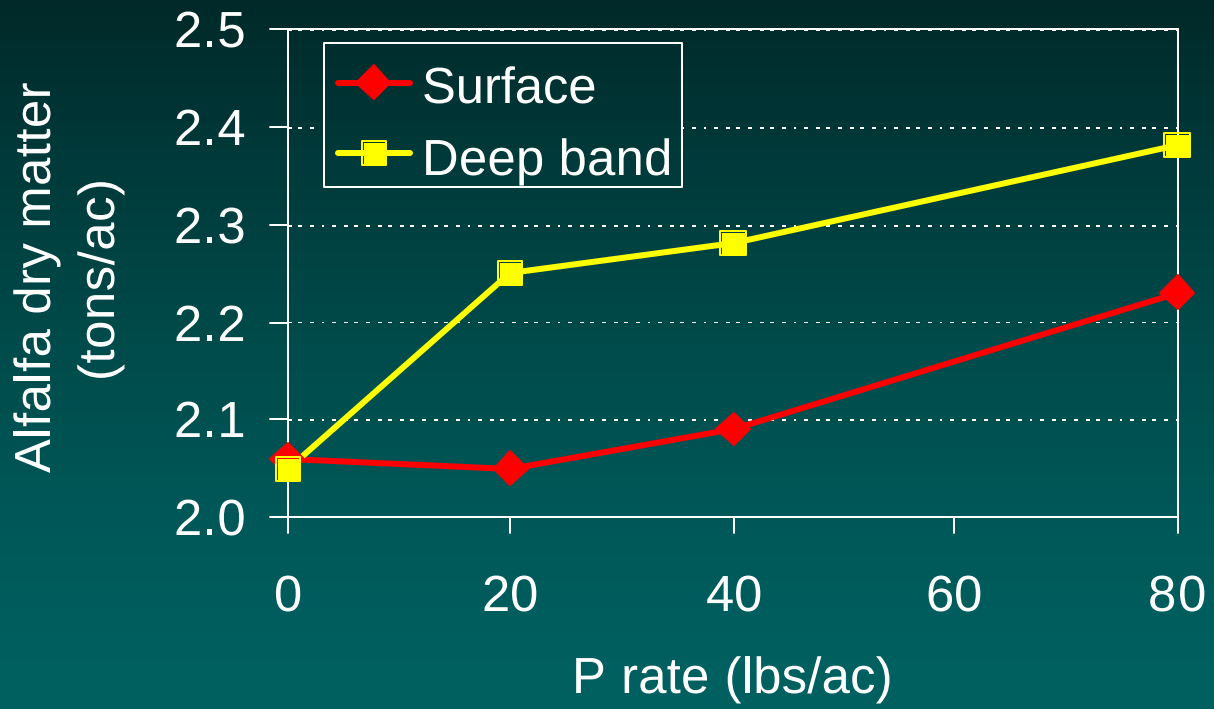


Disc band applied by coulter-type disc drill 2-in deep x 6 in apart.
Yields averaged over 5 years. Mahli et al, Alberta, 1992-1996

Response to P placement in Alberta

- Stand damage was minimized by disc coulter.
- Advantage of banding was greatest at low rates.
- Advantage of banding averaged 840 lbs/ac over five years and four P rates.
- Banding had higher energy cost, but averaged $22 to $26/ac more profit than broadcast.

Banded P improves dryland alfalfa



Goos et al., N. Dakota, 1982-83
Deep band applied by thin-profile knife, 4-in deep x 12 in apart.
Total of two cuttings; average of two sites.

Response to P placement in N. Dakota

- Stand disturbance had no effect on yield at two of three sites.
- Stand disturbance reduced yield in an older thinner stand at a third site.
- Stand disturbance effect observed only in first cutting following application.

P application methods influence established alfalfa

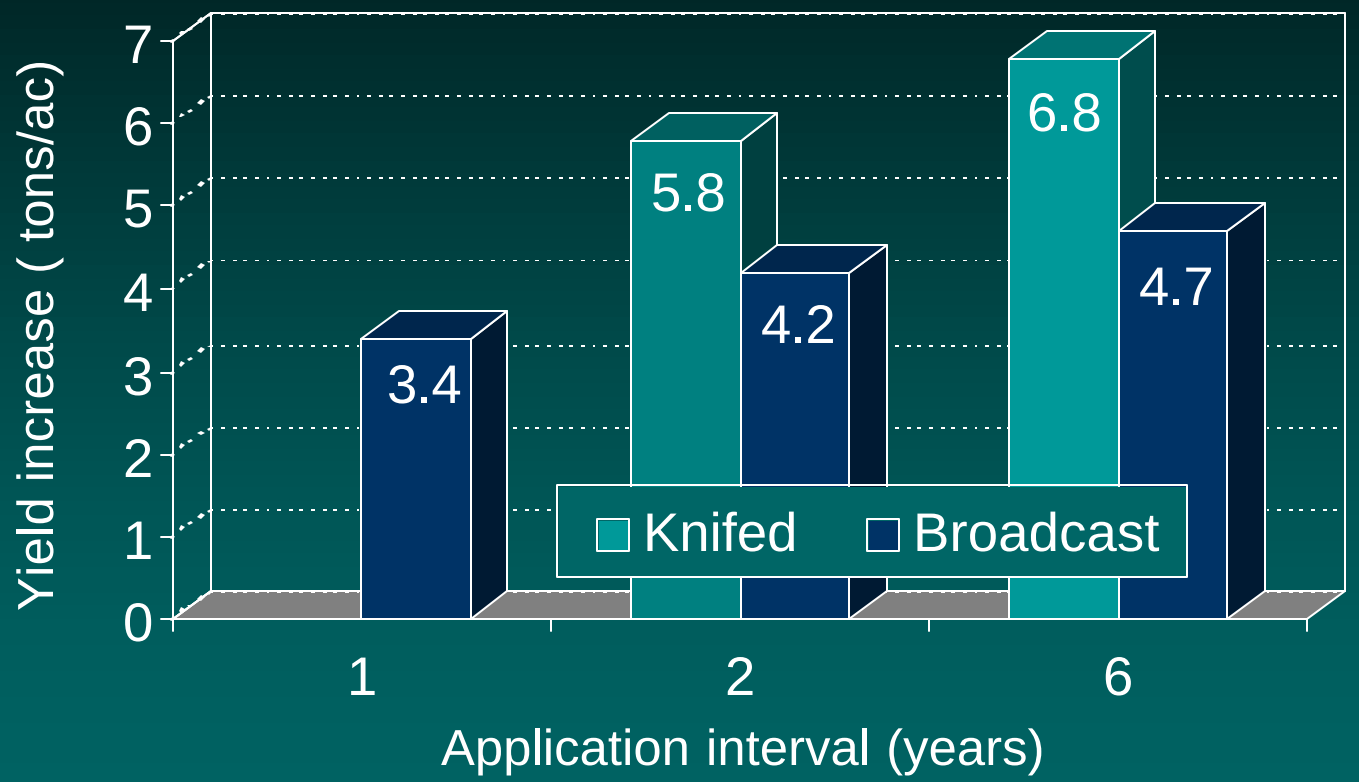
P method	Fall	Spring
	Average yield per harvest (12% moisture)	
Check (no P)	1.93	
Disk drill (no P)	2.00	1.97
Disk drill	2.19	2.15
Surface band	2.23	2.16
Topdress	2.17	2.14

P applied in one application of 300 lbs P_2O_5/ac.
Average of 3 sites over 3 years. Number of harvests dependent on available moisture.
From Bauder et al., Montana State Univ., 1991-1994.

Response to P placement in Montana

- Effect of stand disturbance inconsistent across sites – some yield reductions, some increases.
- Addition of P more than compensated for damage caused to stand by banding.
- Yield and response to P limited by lack of available water for hay production.
- Surface band was as effective as subsurface

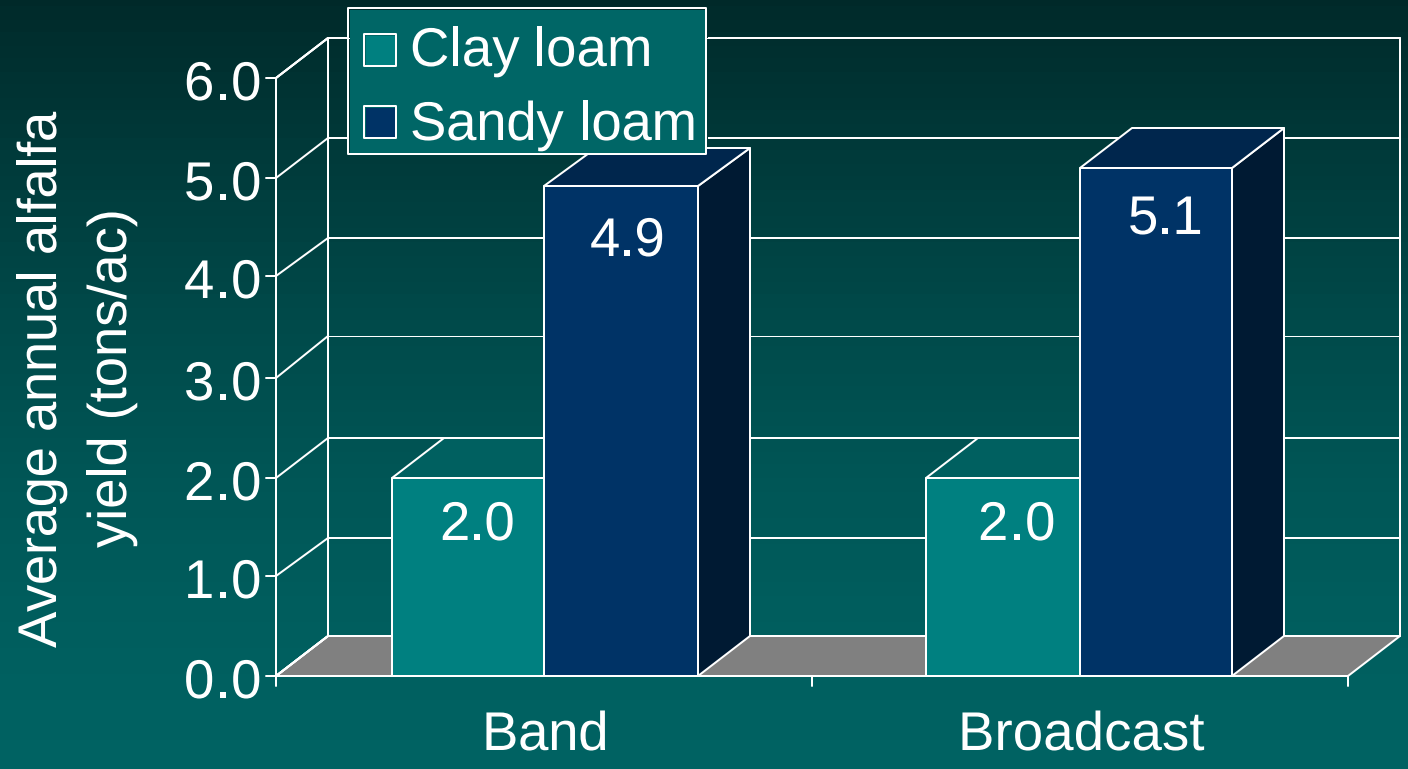
Banded P increases alfalfa yields.



Total P_2O_5 applied=600 lbs

From Mullen et al., Oklahoma State Univ., 2000.

P & K Placement in Manitoba



P rates are 18, 34, & 71 lbs P_2O_5/ac; K rates are 45 & 89 lbs K_2O/ac.
Simons et al., Manitoba, Canada, 1989-1992.

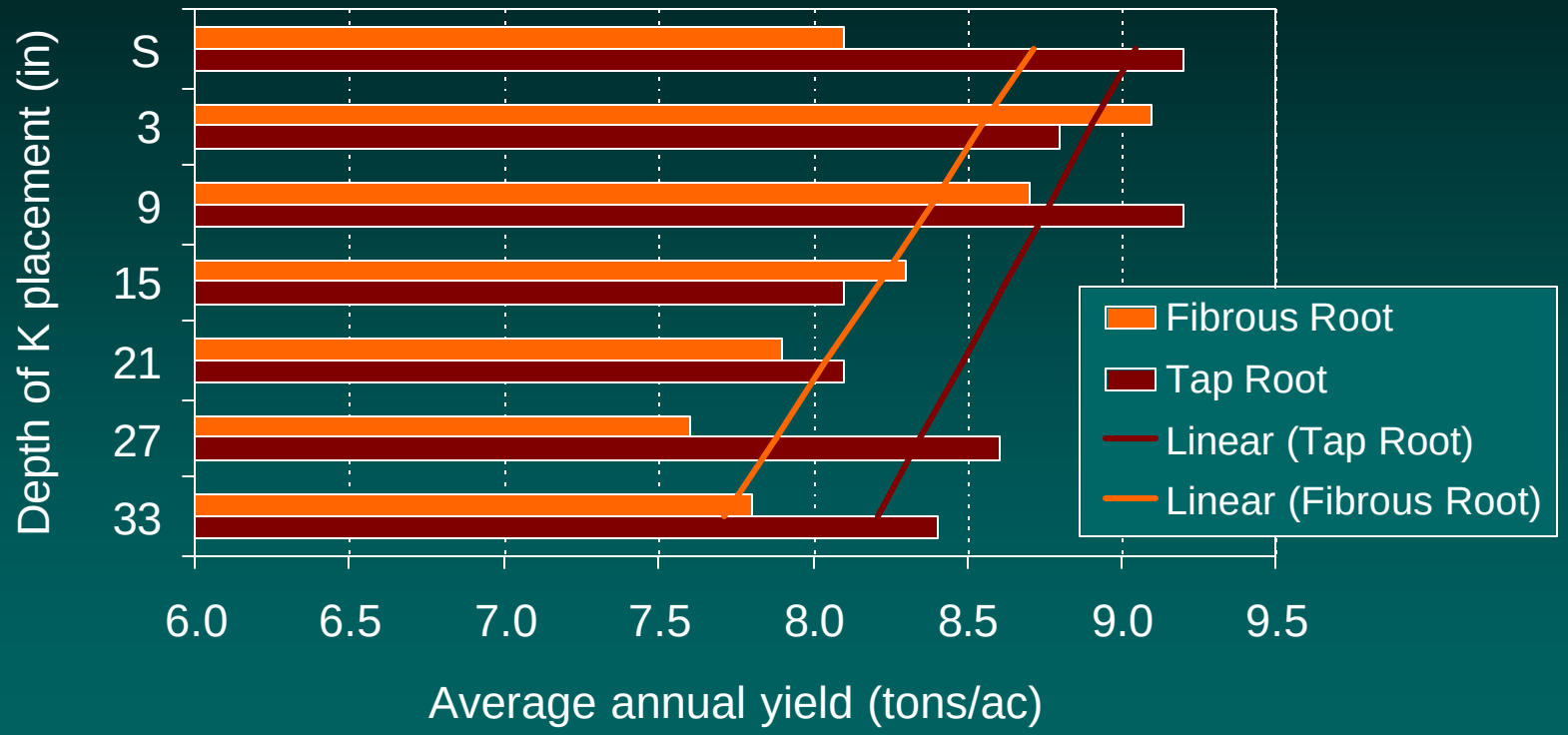
P & K Placement in Manitoba

Average of band & broadcast treatments; average of K rates (45 & 89 lbs K_2O/ac).
Simons et al., Manitoba, Canada, 1989-1992.

Response to P & K Placement in Manitoba

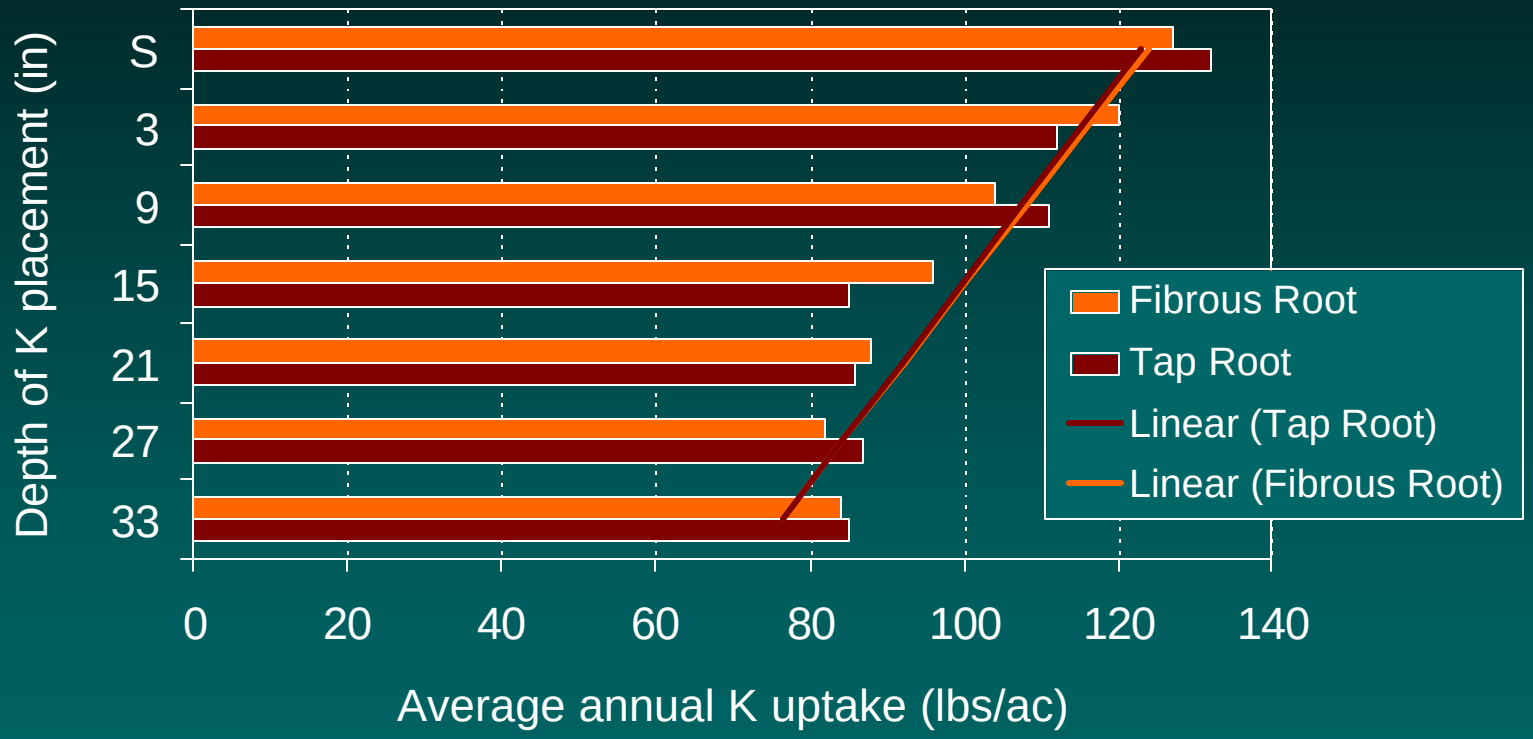
- Small overall K response ~ 0.1 tons/ac
- Significant K response at higher P rates
- K inhibited grass population
- Subsurface banding was not superior to broadcasting.

Response to K Placement in Wisconsin



Average of two soil types, total 5 site years
K rate is 210 lbs/ac
Univ. of Wisconsin, 1983

Response to K Placement in Wisconsin



Average of two soil types, total 5 site years
K rate is 210 lbs/ac
Univ. of Wisconsin, 1983

Response to K Placement in Wisconsin

- Alfalfa yield and K uptake was greatest for surface and shallow placements
- K uptake from surface and shallow placements increased with time indicating increasing root density

Banding increases fescue yield

N	P_2O_5	Placement	Yield
--------- lbs/ac ---------			tons/ac
120	40	Broadcast	1.2
120	40	Dribble band	1.6

Lamond et al., Kansas.
Fertilizer is 10-34-0 + 28-0-0

N-P-K placement influences tall fescue yield

Placement	Yield (tons/acre) 3-year average
Broadcast	1.7
Knifed	2.3

Kansas, 1980-1982

Fertilizer is 100 lbs N/ac, 40 lbs P_2O_5/ac, and 40 lbs K_2O/ac applied as 10-34-0, 28-0-0, and 0-0-10

Broadcasting

- Lowest cost
- Rapid
- Suitable for applying high rates for building low soil tests.
- Response dependent on adequate moisture for shallow root growth.
- Surface broadcasting may strand nutrients in low rainfall, dryland conditions.

Banding

- Less convenient, greater energy cost
- P response can compensate for root pruning
- Usually produces greater yields, profit
- Apply when stand is dormant
- Use implements that minimize stand damage
- Effect of stand loss greater in thinner stands
- Effect of stand damage decreases with time

Summary

- Soil moisture, root growth, and stand age influence the choice of nutrient application methods.
- Banding P – surface or subsurface – can be more efficient in perennial crops, as has been shown for row crops.
- Banding K does not seem to offer an advantage over broadcasting.