Evaluations of herbicides, herbicide timing and herbicide combinations & sequencing for control of Bohemian Knotweed

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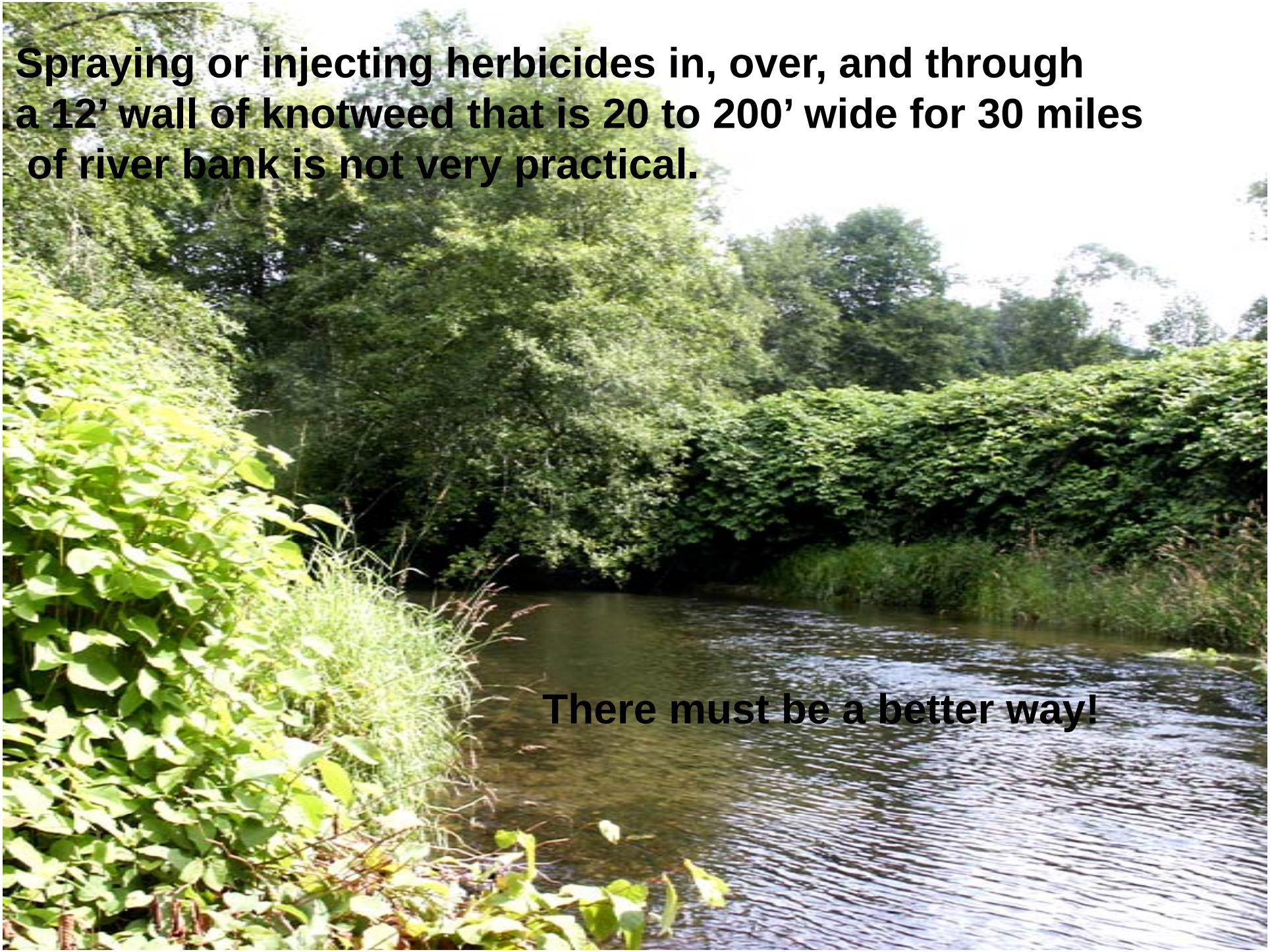
EXTENSION

World Class. Face to Face.


Spraying or injecting herbicides in, over, and through
a 12’ wall of knotweed that is 20 to 200’ wide for 30 miles
of river bank is not very practical.
There must be a better way!

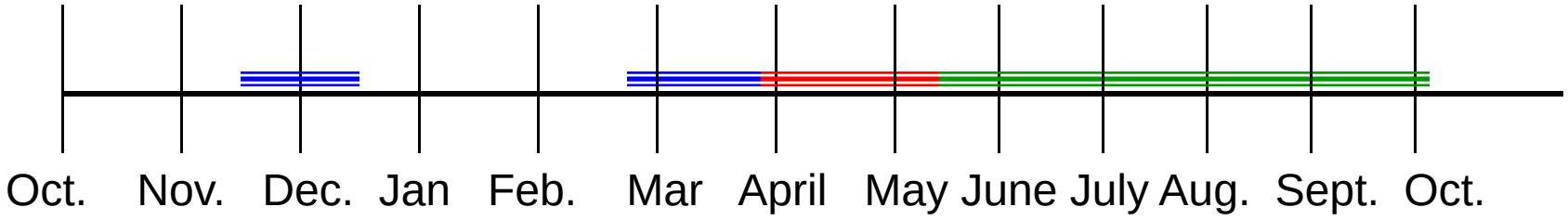
Project Goal

- Determine if there are any effective early season herbicides when the canopy is not so tall or when the plants are dormant?
- What are the most effective herbicides to use once plants have reach their full size?
- What herbicide combinations might make an reasonable management scenario?
- Do these herbicide treatments/residues affect riparian restoration effort?

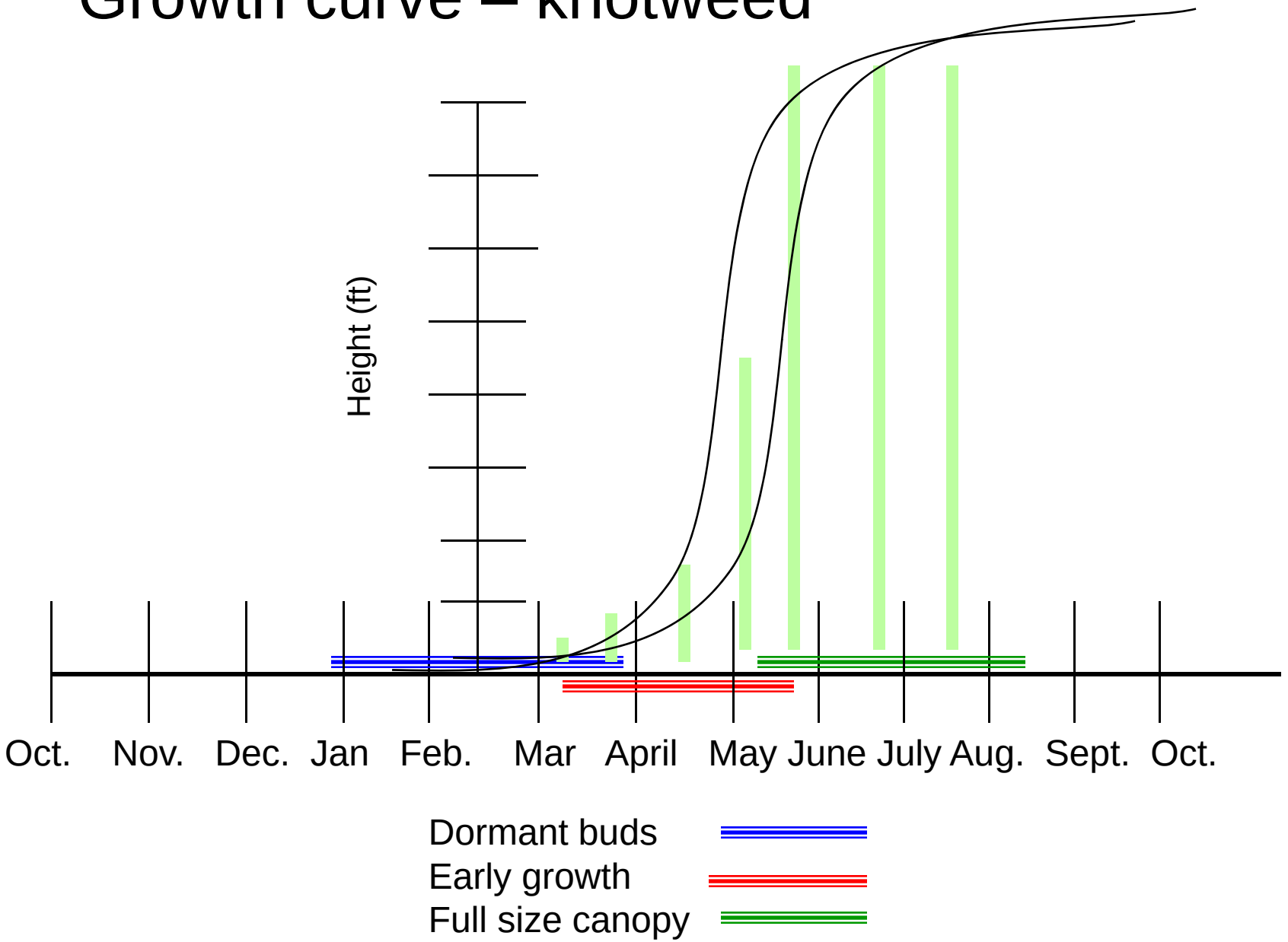
Numerous studies were conducted to:

Evaluate efficacy of herbicides applied @

- Dormant basal buds
- Early growing season / 0.2’ to 4’ canopy
- Full size canopy/ anthesis



Growth curve – knotweed



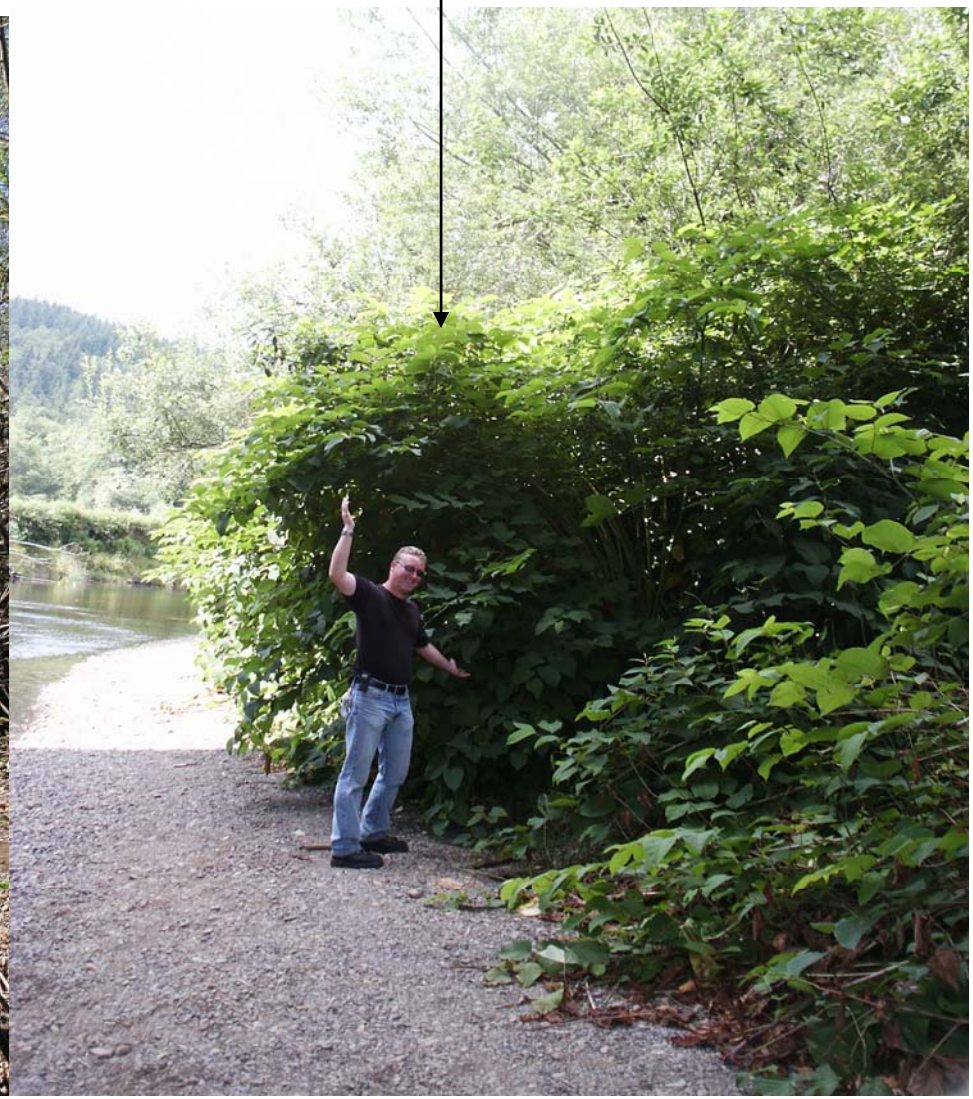
Dormant Buds

Early growth

Mature Canopy

Early season target window

Traditional target window



Three set of Herbicides trials

Dormant basal buds - 2006/2007

Aminopyralid - Milestone

Triclopyr - Renovate

Early growing season - 2005/ 2006/2007

Imazapyr - Habitat

Glyphosate - Aquamaster

Aminopyralid - Milestone

Triclopyr - Renovate

Full canopy/Anthesis - 2005/2006/2007

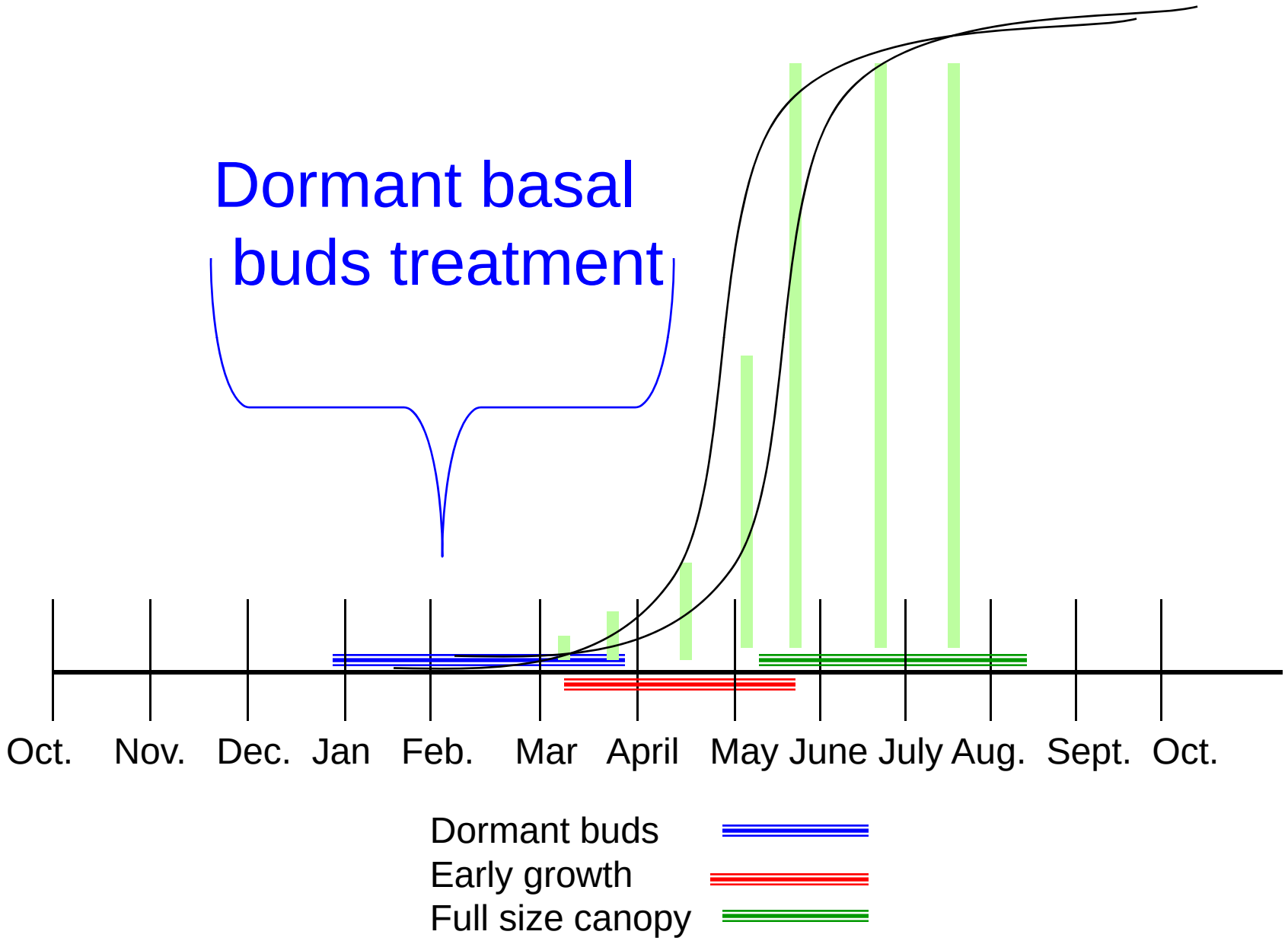
Imazapyr - Habitat

Glyphosate - Aquamaster

Imazamox – Clearcast

Aminopyralid - Milestone

Triclopyr - Renovate


Dormant basal buds treatment
Oct.
Nov.
Dec.
Jan
Feb.
Mar
April
May
June
July
Aug.
Sept.
Oct.
Dormant buds
Early growth
Full size canopy

Dormant basal buds treatment

Dormant (March) application of herbicides for Bohemian Knotweed control – Naselle River, 2006

Treatment	Stems/m^2 14 MAT
Renovate 10 % V/V @ 20 gpa (1.95 gal/ac)	23 ab
Renovate 20% V/V@ 20 gpa (3.9 gal/ac)	12 ab
Renovate 40% V/V @ 20 gpa (7.8 gal/ac)	7 ab
Renovate 10% V/V+ Agridex 10% V/V @ 200 gpa (5 gal/ac)	1 b
Milestone 7 FL OZ/A	15 ab
Milestone 14 FL OZ/A	17 ab
Control	33 a

Great treatment

Pre-treatment 1 MAT 3 MAT

Dormant application of herbicides for Bohemian Knotweed control – Naselle R, 2006	
Treatment	% control 18 MAT
Renovate 10% V/V+ Agridex 10% V/V @ 200 gpa (5 gal/ac)	89 b
Renovate 10% V/V+ Agridex 1% V/V @ 200 gpa (5 gal/ac)	100 b
Milestone 14 FL OZ/A @ 20 gpa	57 b
Control	0 a

Treated 4/12/06, 2-6” organic stem/leaves litter over soil at site, shoots just emerging

Great treatment

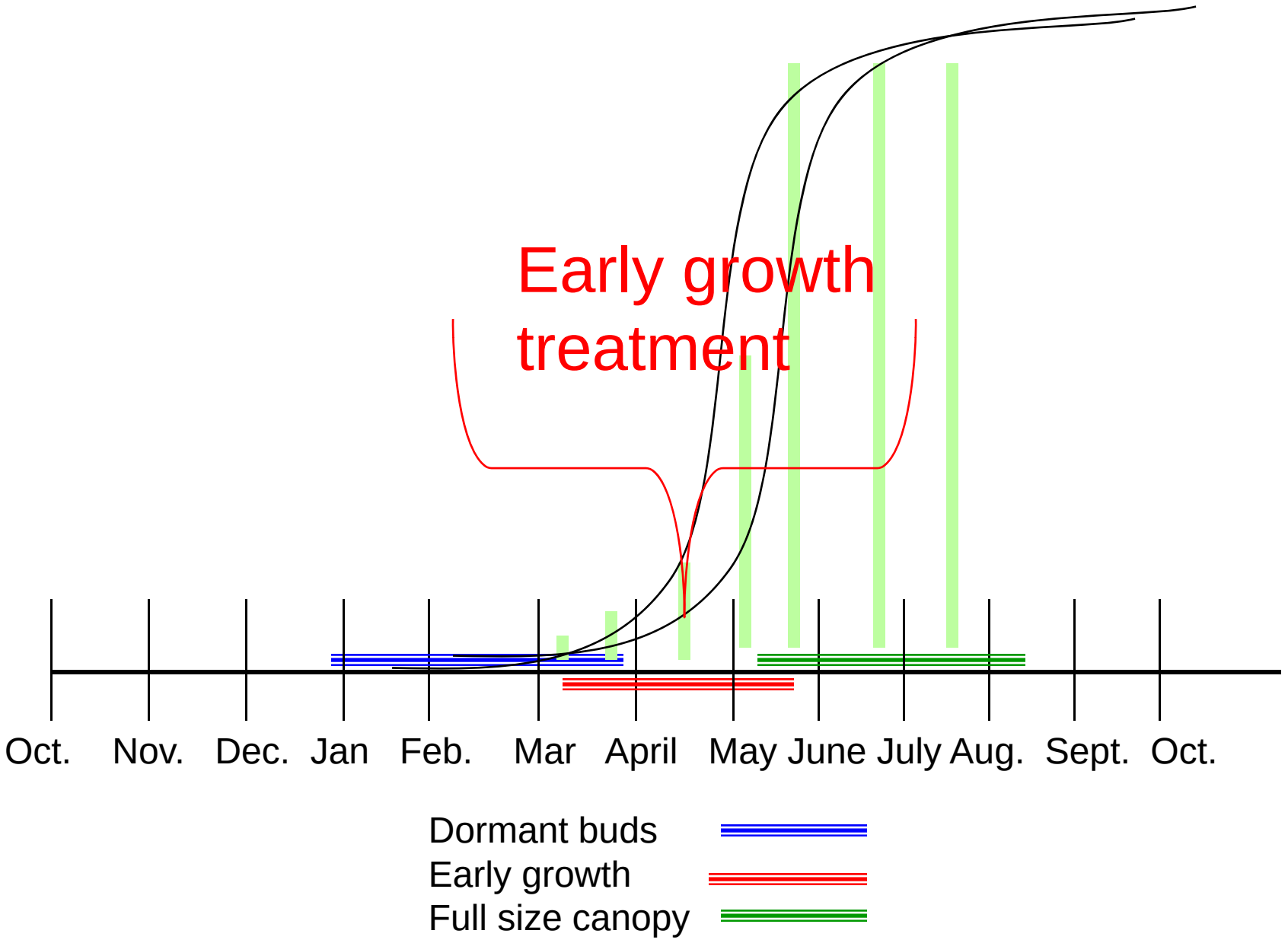
Summary: Dormant season timing

- 5 gal/ac Renovate applied early spring resulted in excellent long term control

- In 2007, we refined the rates to stay within the label (2 gallons Renovate/ac)

  Four separate experiments assessing - timing, carrier, spray volume: Nothing worked!!

Therefore – although dormant bud applications of Renovate were very effective the rates required for efficacy are off label.


Early growth
treatment
Oct.
Nov.
Dec.
Jan
Feb.
Mar
April
May
June
July
Aug.
Sept.
Oct.
Dormant buds
Early growth
Full size canopy

Early growing season herbicides

2005 (Mid- May - 8 to 10': too big to be considered early season)

Imazapyr - Habitat
Glyphosate - Aquamaster
Triclopyr - Renovate

2006 (Mid April to Mid May - 0.5 to 6')

Imazapyr – Habitat
Glyphosate - Aquamaster
Aminopyralid – Milestone
Triclopyr – Renovate

2007 (Mid April -0.2' to 2')

Aminopyralid – Milestone
Triclopyr – Renovate

Early growing season herbicides

2005 (Mid- May - 8 to 10': too big to be considered early season)

Imazapyr - Habitat

Glyphosate - Aquamaster

Triclopyr - Renovate

Herbicide efficacy comparison – Late-spring application 2005*

Treatment	% control 12 MAT		% control 29 MAT	
1% Habitat 5/23/05 (12 pt/a)	100	a	99	a
0.5% Habitat 5/23/05 (6 pt/a)	99	a	99	a
1% Habitat 8/3/05 (12 pt/a)	100	a	99	a
0.5% Habitat (6 pt/a) + 2% (2 gal/a) Aqua-Master 5/23/05	98	a	73	a
5% (5 gal/a) Aqua-Master 5/23/05	81	a	26	b
2% (2gal/a) Renovate 5/23/05	58	a	7	b

Great data but plants too big.

Early growing season herbicides

2006 (Mid April to Mid May - 0.5 to 6')

Imazapyr – Habitat

Glyphosate - Aquamaster

Aminopyralid – Milestone

Triclopyr – Renovate

2006 early growth studies

- Site one - Applications made April 12 or May 1
  - Habitat 6 pt/a
  - Aquamaster 2 gal/a
  - Milestone 7 and 14 oz/a
  - Renovate 1 gal/a
- Site two - Applications made May 5 or May 18
  - Habitat 6 pt/a
  - Aquamaster 5 gal/a
  - Milestone 7 and 14 oz/a
  - Renovate 1 gal/a
- Site three - Application made May 18
  - Habitat 6 pt/a
  - Aquamaster 5 gal/a
  - Milestone 7 and 14 oz/a


Site One - April 12, 2006


Site One
April 26, 2006 – 2 WAT

Site one- April 26, 2006 – 2 WAT

Site one- September 2006 – 4 MAT

Almost all plots had too much regrowth to be considered efficacious .


Site two – September 26, 2006 – 5 MAT

Early growth treatment effect 2006

Treatment	% Shoots re-sprouting 5 MAT	
	Site 1	Site 2
Habitat - V. Early	14 e	9 c-f
Habitat - Early	7 e	2 def
Rodeo - V. Early	38 cde	38 b
Rodeo - Early	25 de	16 bcd
Milestone 7 oz/a -V. Early	72 a-d	23 bc
Milestone 7 oz/ac - Early	46 b-e	21 bcd
Milestone 14 oz/a - V. Early	62 a-d	12 cde
Milestone 14 oz/a - Early	31 cde	1 ef
Renovate - V. Early	87 ab	65 a
Renovate - Early	80 abc	30 bc

Site 1 - V. Early April 12, Early May 1 – Plants @ 2-6’ & 3-8’at application
Site 2 – V. Early May 15, Early May 30 - Plants @1-5’ & 6-10’ at application

Early season treatment 2006

Treatment - Application time	Site 2 % control 14 MAT
Habitat – 5/15	47
Habitat – 5/30	75
Rodeo - 5/15	25
Rodeo - 5/30	82
Milestone 7 oz/a -5/15	7
Milestone 7 oz/ac -5/30	32
Milestone 14 oz/a - 5/15	74
Milestone 14 oz/a - 5/30	69
Renovate - 5/15	2
Renovate - 5/30	8

Plants were 1-4' for the May 15th application
Plants were 6-8' for the May 30th application


Site Three September 2006
5 MAT

Early season treatment 2006 *
Site 3

Treatment	% control 15 MAT
Habitat 6 pt/a	80
Aqua-Master 5 gal/a	71
Milestone 7 oz/a	76

*Applied May 18, 2006, Plants 4’ to 10’ tall at application.

Early growing season herbicides

2007 (Mid April -0.2’ to 2’)

Aminopyralid – Milestone

Triclopyr – Renovate

Early season treatment 2007

	Crush site		Uncrushed site	
Treatment	% control 5 MAT		% control 5 MAT	
Control	0	d	0	c
Renovate 2.5 gal/ac	30	c	24	c
Renovate 5 gal/ac	59	b	35	ab
Milestone 14 oz/ac	97	a	72	a
Renovate 2.5 gal/ac Milestone 14 oz/ac	-		81	a

Applied 4/16/07 plants @ 0.5’ to 2’

Looked promising

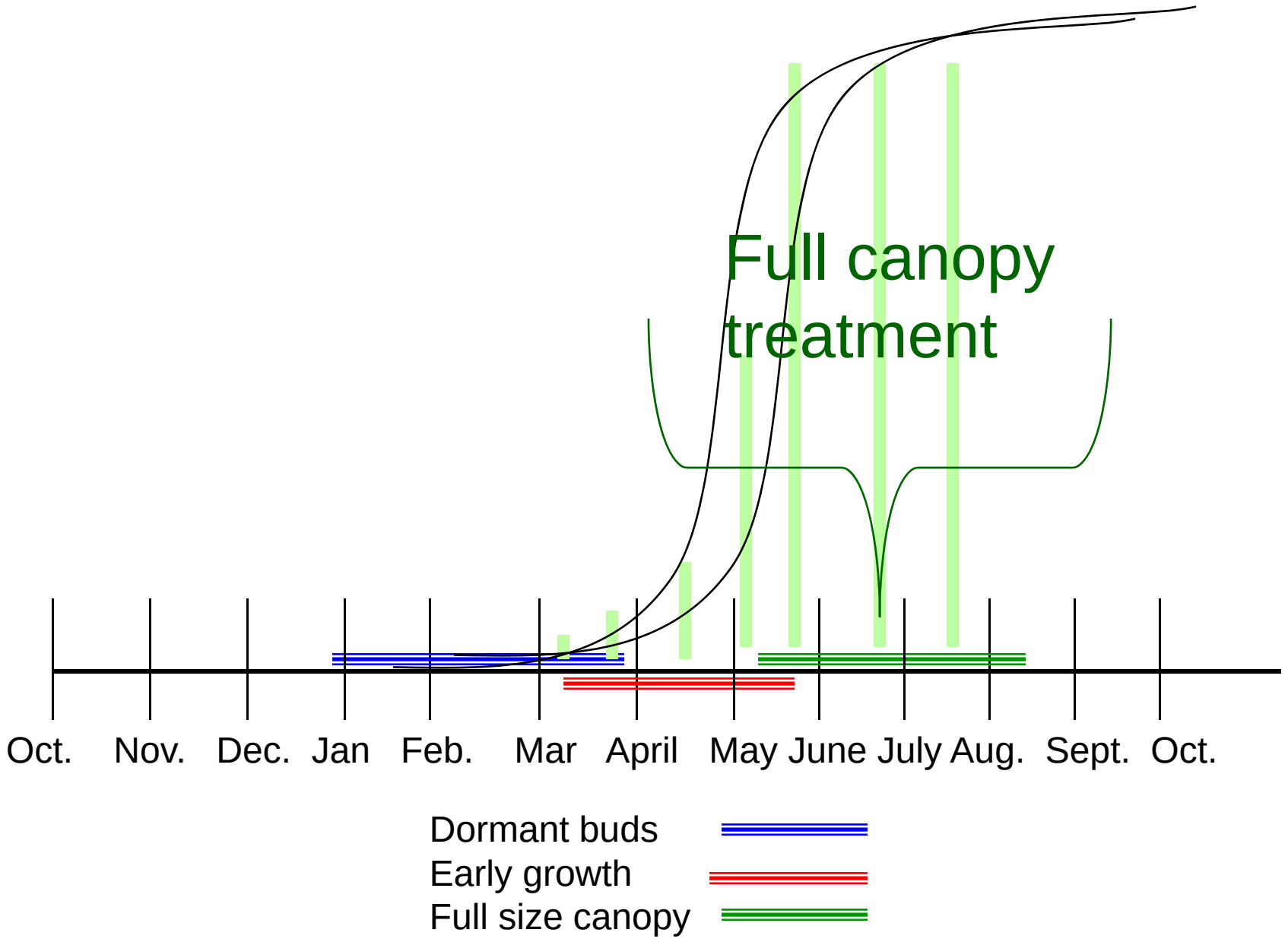
Summary: Early spring growth

- Rapid and non-uniform growth makes exact timing problematic

- Small window for control with Milestone at 14 oz/ac ?

- If plants are rapidly growing early season timings were not as effective as mid season.

- If plants are close to full size then most herbicides were reasonably effective


Full canopy treatment
Oct.
Nov.
Dec.
Jan
Feb.
Mar
April
May
June
July
Aug.
Sept.
Oct.
Dormant buds
Early growth
Full size canopy

Summer treatment Bohemian Knotweed

Treatment	% control 14 MAT
Habitat 4 pt/a	96 a
Aqua-Master 3 gal/a	98 a
Milestone 7 oz/a	32 b

*Applied August 7, 2006, Plants 8’ to 12’ tall at application.

Himalayan Knotweed
Fall treatment

Treatment	% control 1 YAT
Habitat 3 pt/a	100
Milestone 7 oz/a	100
Rodeo 2 gallons/a +Milestone 7 oz/a	100
Milestone 14 oz/a	98

*Applied October 2, 2006 Plants 6-7’ tall at application.

Summary: Summer/fall timing

- Bohemian: glyphosate or imazapyr excellent results
- Himalayan: easy to control with most herbicides

Do these herbicide treatments/residues affect future riparian restoration effort?

- To assess for residual herbicide activity across plots with high rates of imazapyr and triclopyr

  – *In situ* seed (grass, radish and alfalfa) germination bioassays were conducted post: no treatment effect for any herbicide

  – Willow whips were stuck in plots and assessed for grow-out : no treatment effect for any herbicide

Seedling emergent – 3 to 12 MAT

Bioassays – Annual Rye Grass, Alfalfa, Radish


Conclusions

Renovate for dormant buds to very early shoot emergence

- Excellent activity of high rates in March (bud swell), but rates off label

Milestone for early shoot elongation 1” to 16” ?

- Good to excellent activity at 14 oz/a rate, Site-preparation may affect results
    - Multi-year, multi-site data pending

Habitat, Milestone, Renovate or Rodeo during rapid stem elongation 1’ to 6’

- None of the herbicides provide any lasting control

Habitat at the end of the majority of shoot growth

- Good to excellent activity

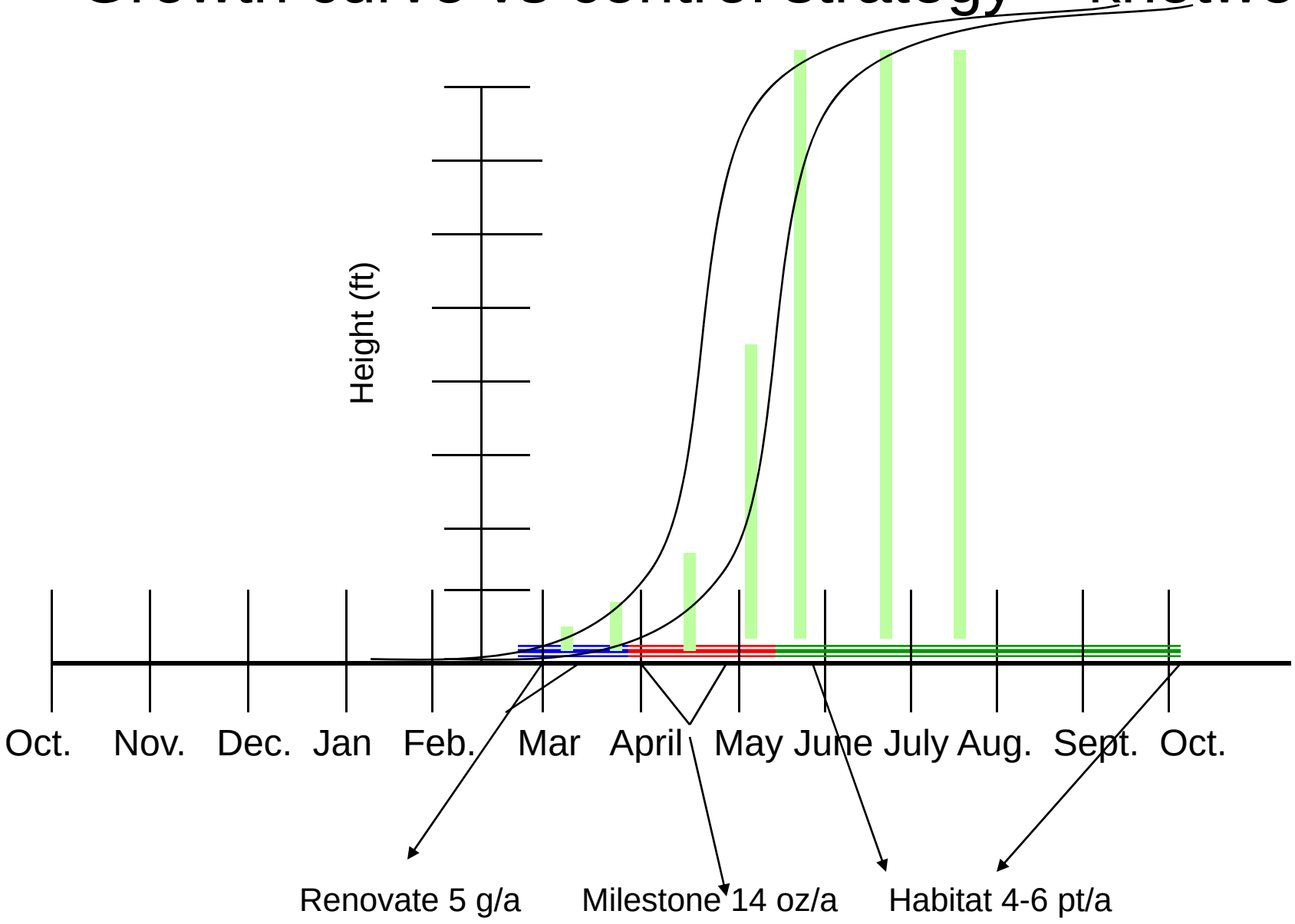
Habitat or Rodeo from bloom to fall

- Good to excellent activity, Habitat has in general provided best level of control

Two stage– multi-herbicide management plan

- Stage one – April/early May Spray with Milestone along Riparian edge & to create spray alleys in big stands.
- Stage two – June to October spray with Habitat

Growth curve vs control strategy – knotweed



Research for 2008: Development an alternative management strategy for Bohemian Knotweed

- Early season Milestone when plants are 0.5-2’ tall
  - First wave of attack.
  - Spray alleyways to allow access during mid-season
  - First 20-30’ along the bank spraying out of boat or ATV
- Mid-season follow-up with imazapyr.