Weed Management in Vegetable Production

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Weed Management in Vegetable Production

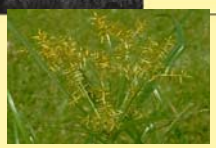
Thanks to Reid Smeda & Jay Chism
University of Missouri

Weed identification:

Strawberry or Rough cinquefoil?

Sweet corn or Johnson grass?

Weed classification



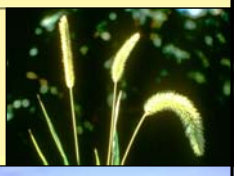
Sedges

Broadleaves

Grasses

Life Cycles of Plants

- **Annuals**
  - **Summer annuals**
  - **Winter annuals**
- **Biennials**
- **Perennials**



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Weed identification is the first step

- **Knowledge of the life cycle is key to understanding the control options**
- **Weeds mimic crops and long-term production of the same crops leads to specific weeds**
- **Weeds vector important diseases that are transmitted to vegetables**
- **Troublesome insects use weeds as alternative hosts (foxtail and crabgrass for corn leaf aphid)**

Weed Management

- Non Chemical
  - Cultural
    - Crop rotation
    - Proper row spacing
    - Mulch
    - Crop Management – Vigorous, healthy crops
  - Mechanical and Thermal
    - Cultivating
    - Mowing
    - Flame weeding
  - Biological
    - Cover Crops – Winter rye against some broadleaf weeds
- Chemical
  - Herbicides

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Weed Management

Table 17. Summary of Nonchemical Weed Management Practices

Cultural	
Land selection	Avoid fields with a history of weed problems.
Crop selection	Grow the most competitive crops in fields with histories of weed problems.
Crop rotation	Rotate between vegetables and non-row crops such as alfalfa. Rotate between vegetables in different botanical categories.
Adapted crop varieties	Select crop varieties adapted for your area.
Proper row spacings and plant densities	Use row spacings and plant densities that assure rapid crop canopy closure.
Correct planting times	Plant crops when soil temperatures favor rapid germination and emergence. Do not plant warm-season crops too early in the season.
Appropriate crop management	Vigorous, healthy crops are more competitive against weeds and insects.
Mulch	Natural mulches may be appropriate on small acreages. Synthetic (plastic) mulches are useful to manage weeds within the row in warm-season crops. Consider disposal problems when using plastic mulches.

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Weed Management

Table 15. Botanically Related Vegetables

Alliums	Corn	Cucurbits	Crucifers	Goosefoot Family	Legumes	Nightshade Family
Garlic	Dent corn	Cucumber	Cabbage	Beet	Dry bean	Eggplant
Onion	Sweet corn	Muskmelon	Cauliflower	Chard	Lima bean	Pepper
		Pumpkin	Broccoli	Spinach	Pea	Potato
		Summer squash	Brussels sprout		Snap bean	Tomato
		Watermelon	Horseradish		Soybean	
		Winter squash	Kale			
			Radish			
			Rutabaga			

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Mulching

- Suppresses weed emergence
- Reduces diseases.
- Reduces soil evaporation.
- Warms/cools the soil.

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Weed Management

Mechanical and Thermal	
Moldboard plowing	This can eliminate emerged annual weeds.
Rotary hoeing	This is useful to manage small-seeded weeds in large-seeded crops such as sweet corn, snap bean, lima bean, and pea.
Row cultivator	Dislodge or cover as many weed seedlings as possible. Avoid damaging crop root systems.
Mowing	Mow weeds as soon as flowers appear so no viable weed seed is produced.
Flame weeding	Flame weeding, or using a hot flame to kill weeds, is effective for stale seedbed weed removal or weeds that emerge before the vegetable crop. Flame weeding is effective for weed control in vegetables such as onions, parsnips, and carrots. Some growers have successfully used flame weeding on transplanted onions that are 8-10 in. tall. Sweet corn that has just emerged and potatoes up to 2 in. tall can be flame weeded.

Mechanical Control

Sanitation

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Cultivation

- Only effective on small weeds (buries, breaks, and exposes weeds)
- Technique will spread perennial weeds
- Best done in morning when soil moisture is moderate to low
- Will not remove weeds most competitive initially (in the row)
- Promotes soil compaction and erosion

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Hand-weeding

- Effective when repetitive but HARD WORK!

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Weed Management

Biological	
Cover crops	This is still experimental. Winter rye system is the most promising and most effective against small-seeded broadleaf weeds.
Insect or disease pests or weeds	No current systems use insects or diseases to manage weeds in common vegetables.

Cover Crops:

- Provide nitrogen
- Add organic matter
- Improve soil structure
- Provide weed control
- Conserve soil moisture
- Lower soil temperatures

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Good Cover Crops:

Non-legumes

Annual Ryegrass
Barley
Buckwheat (Summer)
Spring Oats
Winter Rye
Winter Wheat
Sudan grass (Summer)

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Good Cover Crops:

Legumes (fix nitrogen)

Alfalfa (excellent for loosening compacted soil)

Cowpeas

Hairy Vetch

Red Clover

White Clover

Berseem Clover

Austrian Winter Pea

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Chemical Weed Management

Weed Management Strategies (continued)

Table 21. Common Names of Registered Herbicides[1]

Common Name	Trade Name	Producer	HRAC Group[2]	Formulation
acetochlor	Surpass®, TopNotch®	Dow AgroSciences	K3	6.4EC, 3.2ME
acetochlor+atrazine	FulTime®, Keystone®, Keystone LA®	Dow AgroSciences	K3, C1	2.4+1.6ME, 3+2.25 SC, 4+1.5 SC
alachlor	Lasso®, Partner®	Monsanto	K3	4E, 65WDG
ametryn	Evik®	Syngenta	C1	76DF
atrazine	many	many	C1	many
atrazine+bentazon	Laddok S-12®	Sipcam	C1, C3	2.5+2.5S
atrazine+dimethenamid-P	Guardsman Max®	BASF	C1, K3	3.3+1.75L
atrazine+s-metolachlor	Bicep (II) Magnum®	Syngenta	C1, K3	3.1+2.4E
benefin	Balan®	United Agri-Products	K1	60DF
benzoic	Prefar®	Gowan	N	4E
bentazon	Basagran®	BASF	C3	4L
bromoxynil	Buctril®	Bayer Cropscience	C3	2E, 4EC
butylate	Sutan+ 6.7E®	Helm Agro	N	6.7E
carfentrazone	Aim®	FMC	E	40DF, 40EW
clethodim	Prism®, Select®, Select Max®	DuPont, Valent	A	0.94EC, 2EC, 0.97EC
clomazone	Command®	FMC	F3	3ME
clomazone+ethalfluralin	Strategy®	UAP/Platte	F3, K1	0.3+1.6 EC
clopyralid	Stinger®	Dow Agrosciences	O	3E
cycloate	Ro-Neet®	Helm Agro	N	6E
DCPA	Dacthal®	AMVAC		

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Chemical Weed Management

Preplant Incorporated

Devrinol – tomato and strawberries

Preemergent Surface Applied

atrazine – sweet corn

Postemergent

Basagran – nut sedge

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Chemical Weed Management

What are the issues with Herbicides?

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Chemical Weed Management

Chemical Drift
Spray Tank Residuals
Groundwater Contamination

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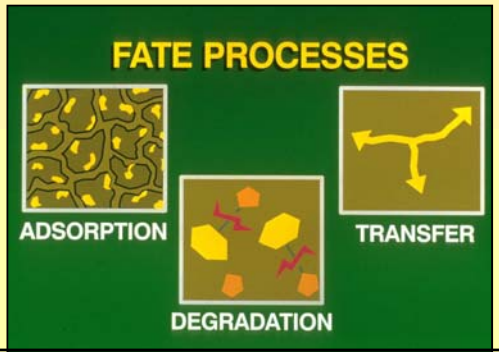
Chemical Weed Management



Livestock Injury

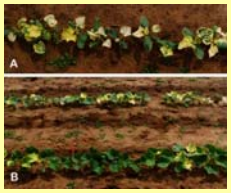
Buffer Strips

PHI and REI

Table 20. Preharvest Intervals (Days) and Entry Intervals (Hours) for Herbicides

Issues of Chemical Weed Management

- Farmers worry about residuals
  - Atrazine = following year
  - Sencor = 18 months



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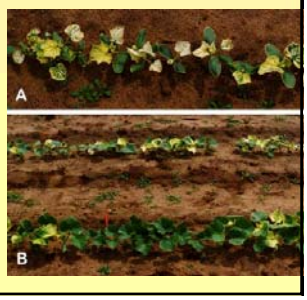
Issues of Chemical Weed Management

Herbicide residual

- **Metolachlor (Dual) – 90 day preharvest interval for tomato**
- **Wrong rate or wrong follow up crop**



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Issues of Chemical Weed Management

Weed Management Strategies (continued)

Table 18. Label Restrictions (in Months) on Rotating to Vegetable Crops

Herbicide	Tomato	Pea	Snap Bean	Sweet Corn	Pumpkin	Melon	Cole Crops
Soybean Herbicides							
Backdraft*	18-26V	18	11	18	18	18	18-26V
Boundary*	12	8	12	12	12	12	12
Broadstrike Treflan*	26+FB	26+FB	26+FB	18	26+FB	26+FB	26+FB
Canopy XL*	12	30	30	18	18	18-30	30
Classic*	15	FB	FB	FB	FB	FB	FB
Command*	9	A1	9	9	A1	9	V
Domain*	NNY	NNY	NNY	NNY	NNY	NNY	NNY
Dual (II) Magnum*	AT	AT	AT	AT	NNY	NNY	V
Extreme*	18-40+FB,V	18-40+FB,V	18-40+FB,V	18-40+FB,V	18-40+FB,V	18-40+FB,V	18-40+FB,V
First Rate*	30	9	9	18	30	30	30
Flex Star*	18	10	10	18	18	18	18
Gauntlet*	NNY	NNY	NNY	18	NNY	NNY	NNY
Pursuit DG*	40+FB	4	4	18	40+FB	40+FB	40+FB
Pursuit Plus*	40+FB	4	4	18	40+FB	40+FB	40+FB
Python*	26	4	4	10.5-18V	26	26	26
Raptor*	9	A1	A1	9	9	9	V
Reflex*	18	10	18	10	18	18	18
Sencor*	4	8	12	12	12	12	12
Scepter*	18	18	11	18	18	18	18
Spartan*	12	12	12	18	12	12	12V
Squadron*	18	18	11	18	18	18	18
Synchrony STS*	9[1]	15	15	15	15	15	15
Tri-Scept*	18	18	11	18	18	18	18
Valor*	12+FB	12+FB	12+FB	4	12+FB	12+FB	12+FB
Corn Herbicides							

Issues of Chemical Weed Management

- **Glyphosate and some other herbicides are cheap, but have long-term costs**

RESISTANCE!!!!!

Resistance Cost

Avoid Pesticide Resistance

- **Rotate families of pesticide**
- **Use pesticides only when necessary**

HRAC

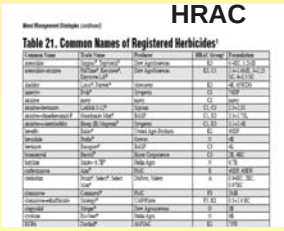
Table 21. Common Names of Registered Herbicides[1]

Issues of Chemical Weed Management

- Will the herbicide work on my weeds?
- Weather Impact
  - Most POST herbicides not effective under 50 degrees
  - Many require a 2-hour rain-free interval
- Multiple cropping systems
  - Residuals don't work that great.
- Weed resistance –
  - Rotate MOA – Table 21 on page 40 of MVPG

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Chemical Weed Management

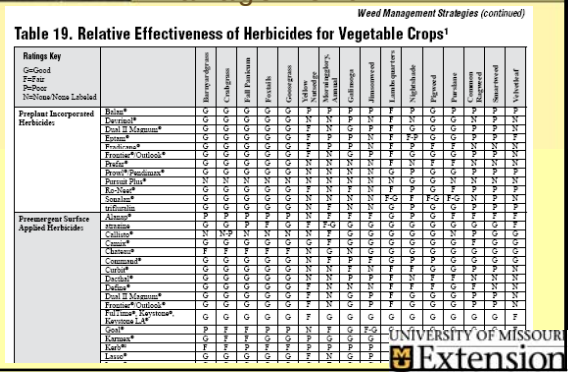
Weed Management Strategies (continued)

Table 19. Relative Effectiveness of Herbicides for Vegetable Crops[1]

Ratings Key G=Good F=Fair P=Poor N=None/None Labeled		Barnyardgrass	Crabgrass	Fall Panicum	Foxtails	Goosegrass	Yellow Nutsedge	Morningglory, Annual	Galinsoga	Jimsonweed	Lambsquarters	Nightshade	Pigweed	Purslane	Common Ragweed	Smartweed	Velvetleaf
Preplant Incorporated Herbicides	Balan*	G	G	G	G	G	P	P	P	P	P	P	G	P	P	P	P
	Dacthal*	G	G	G	G	G	N	N	P	N	P	N	G	G	N	P	N
	Dual II Magnum*	G	G	G	G	G	F	N	G	P	F	G	G	G	N	P	N
	Eptam*	G	G	G	G	G	F	P	P	N	F	F-P	G	G	P	P	P
	Prefar 4E*	G	G	G	G	G	F	P	P	N	F	P	F	F	N	N	N
	Prowl H2O*	G	G	G	G	G	F	N	G	P	F	G	G	G	P	P	N
	Python*	G	G	G	G	G	N	N	N	N	F	N	F	F	N	N	N
	Pursuit Plus*	N	N	N	N	N	N	N	N	N	N	G	G	N	N	N	N
	Reflex*	G	G	G	G	G	P	N	P	N	F	P	G	F	P	P	P
	Sonalan*	G	G	G	G	G	N	N	N	N	F-G	F	F-G	F-G	N	P	N
	trifluralin	G	G	G	G	G	N	F	N	N	G	P	G	G	P	P	P
Preemergent Surface Applied Herbicides	Aatrex*	F	P	F	F	P	N	F	F	F	G	P	G	F	F	F	F
	atrazine	G	G	F	F	G	F	F-G	G	G	G	G	G	G	G	G	F
	Callisto*	N	N-P	N	N	N	N	F	G	G	G	G	G	M	P	G	G
	Canopy*	G	G	G	G	G	G	F	G	G	G	G	G	G	F	G	G
	Chateau*	F	F	F	F	F	N	G	N	G	G	G	G	G	G	G	G
	Command*	G	G	G	G	G	N	P	P	P	G	P	G	G	G	G	G
	Curbit*	G	G	G	G	G	N	F	N	F	F	G	G	G	P	P	N
	Dacthal*	G	G	G	G	G	N	N	P	P	F	N	F	F	N	N	N
	Define*	G	G	G	G	G	F	N	N	N	F	N	F	G	F	P	N
	Dual II Magnum*	G	G	G	G	G	F	N	G	P	F	G	G	G	P	P	N
	Frontier* Outlook*	G	G	G	G	G	F	N	G	P	F	G	G	G	P	P	N
	FulTime*, Harvicon*, Keystone LA*	G	G	G	G	G	F	G	G	G	G	G	G	G	G	G	F
	Goal*	P	F	F	P	P	N	F	G	F-G	G	G	G	G	F	F	F
	Karmex*	G	F	F	G	G	P	G	G	G	G	G	G	G	F	F	F
	Kerb*	F	F	P	F	F	P	P	P	P	F	P	F	F	P	P	P
	Lasso*	G	G	G	G	G	F	N	G	P	F	G	G	G	P	P	N

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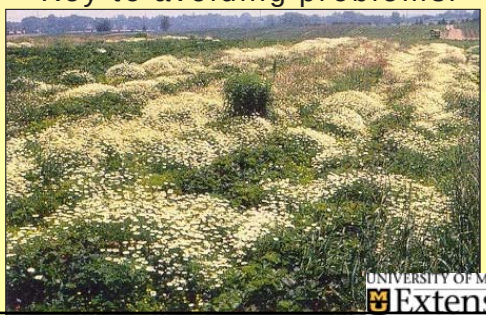
Chemical Weed Management

Key to avoiding problems!



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Chemical Weed Management

Waiting can cost you

- **PRE = before emergence**
- **POST = at the labeled size**
- **It's cheaper to use the right rate at the right time than to re-apply after a failure**

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Critical weed-free period

- **Period during crop production when weeds are most likely to reduce yield or harvest**

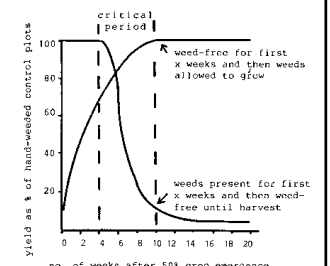

FIGURE 3. The critical period of weed competition in onions (after Hewson & Roberts, 1971)

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Herbicides

- **Effective under proper conditions, but should not be considered the only option**
- **Can cause irreparable damage**
- **Biggest problems in using:**
  - **Applied at wrong time, improper calibration, did not control target weed (weed ID critical), user did not read the fine print (LABEL)**

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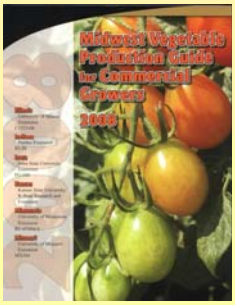
Chemical Weed Management

- Where to start?
- Read the Label!!



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Chemical Weed Management Options

Sweet Corn
- Atrazine and 2,4-D (Early Planting)
  - Cut off date is June 12th
- Late season planting
  - Limit atrazine to ½ pound
    - Good on ragweed
    - Late germinating grasses are a concern
  - Include Dual Magnum to suppress grasses
    - Has limited carry-over
    - Use maximum rate allowed

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Chemical Weed Management Options

- Cost per Acre
  - Atrazine – $4 – 6.50
  - 2,4-D - $1 - 2.00
  - Dual Magnum - $40 – 46.00

Atrazine Restrictions

Many herbicides labeled for corn contain atrazine. Observe the follow
1. On highly erodible soils with low residue, do not apply more tha before corn emerges.
2. On all soils, do not apply more than 2 lbs. a.i. atrazine per acre in
3. On all soils, do not apply more than 2.5 lbs. a.i. atrazine per acre
4. Check www.atrazine-watershed.info or call (800) 355-3014 for a the use of any material containing atrazine.

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Chemical Weed Management Options

Melons and Cucurbits

Curbit (pre) and Sandea (Crop at 2-5 leaf)

-direct seeded apply within 2 days

- transplants –

apply as banded spray between rows

- Sandea - blw control 1-3" Good on nutsedge and cocklebur
- Curbit – good on grasses and small broadleaves for 3-4 weeks

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Chemical Weed Management Options

- Cost per Acre
  - Sandea - $20 - 40.00
  - Curbit - $20 - 30.00
  - Poast + COC - $9 -14.00

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Chemical Weed Management Options

Tomato

Peppers

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Fruiting crops & plastic mulch programs

- Preplant
  - Command (peppers)
  - Dual M II (tomatoes)
  - Prowl
  - Sandea (?)
- May combine with a burndown
  - glyphosate
  - paraquat
- Postemergent
  - Sandea & a grass herbicide (Poast or Select)
  - Sencor (as above)
  - Could use a shielded application of glyphosate, paraquat or Aim

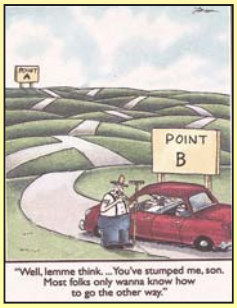
Limitations for small area applications of herbicides with residual activity

- Correct coverage (of soil surface) with bigger droplet size
- Complete coverage on row middles (up to edge of plastic)
- Getting the correct amount of product on a given area
- Drift if not using shields

Comments from 4 growers

- Weeds were more trouble the last two years because of all the rain. Usually one or two shots of glyphosate keeps or row middles in good shape
- We sprayed our fields up to four times this year with glyphosate. 'The boys' sometimes put a preplant herbicide in, but its mostly glyohosate.
- I mow my row middles (for tomatoes) and when the crabgrass got bad, sprayed with glyphosate. The crabgrass laid down like a mulch mat.
- I spray with glyphosate right when the melons are ready to run off the plastic, and then again (if needed) just in the (row middle) centers a week or so later. I'm used to seeing a little leaf yellowing on the vines & know they'll grow out of it

Questions?


POINT
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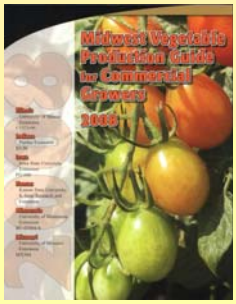
"Well, lemme think. ... You've stumped me, son. Most folks only wanna know how to go the other way."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