

Herbicide Persistence in Soil: When You Want it & When You Don't

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What is herbicide persistence?

- For a soil active herbicides like Chateau, GoalTender or Kerb they are applied to the soil to control germinating weeds for several weeks or months.

Metam sodium persistence?

- “VAPAM HL is applied 14 to 21 days before a new crop is planted.”

Relative persistence of fumigants and herbicides

	1-Oct	1-Nov	1-Dec	1-Jan	1-Feb	1-Mar	1-Apr	1-May	1-Jun	1-Jul	1-Aug	1-Sep	1-Oct	1-Nov
Fumigant	Red	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple
GoalTender	Black	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	White	White	White	White	White	White
Chateau	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Light Purple	Light Purple	Light Purple

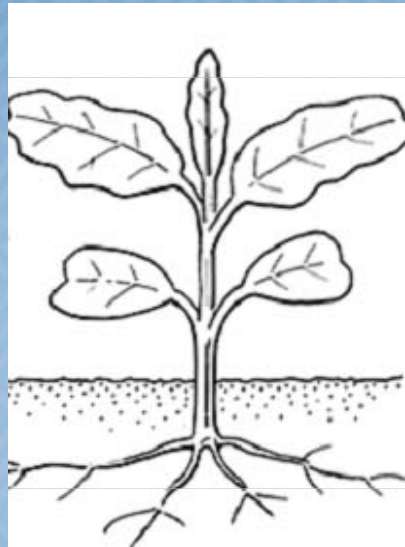
When herbicide persistence is desired and not desired

- **Desired:** For the crop season to selectively control weeds for the length of the crop cycle.
- **Not desired:** in rotational crops planted weeks or months after the initial herbicide application where persistent herbicide in the soil causes injury.
- **Note:** Spinach is very sensitive to soil active herbicides.

Herbicides in the soil stunting spinach, onion and lettuce



Fate of herbicides applied to soil



Volatilization
&
codistillation

Photodecomposition



Herbicide

Uptake by
plants

Chemical
degradation

Adsorption
& desorption

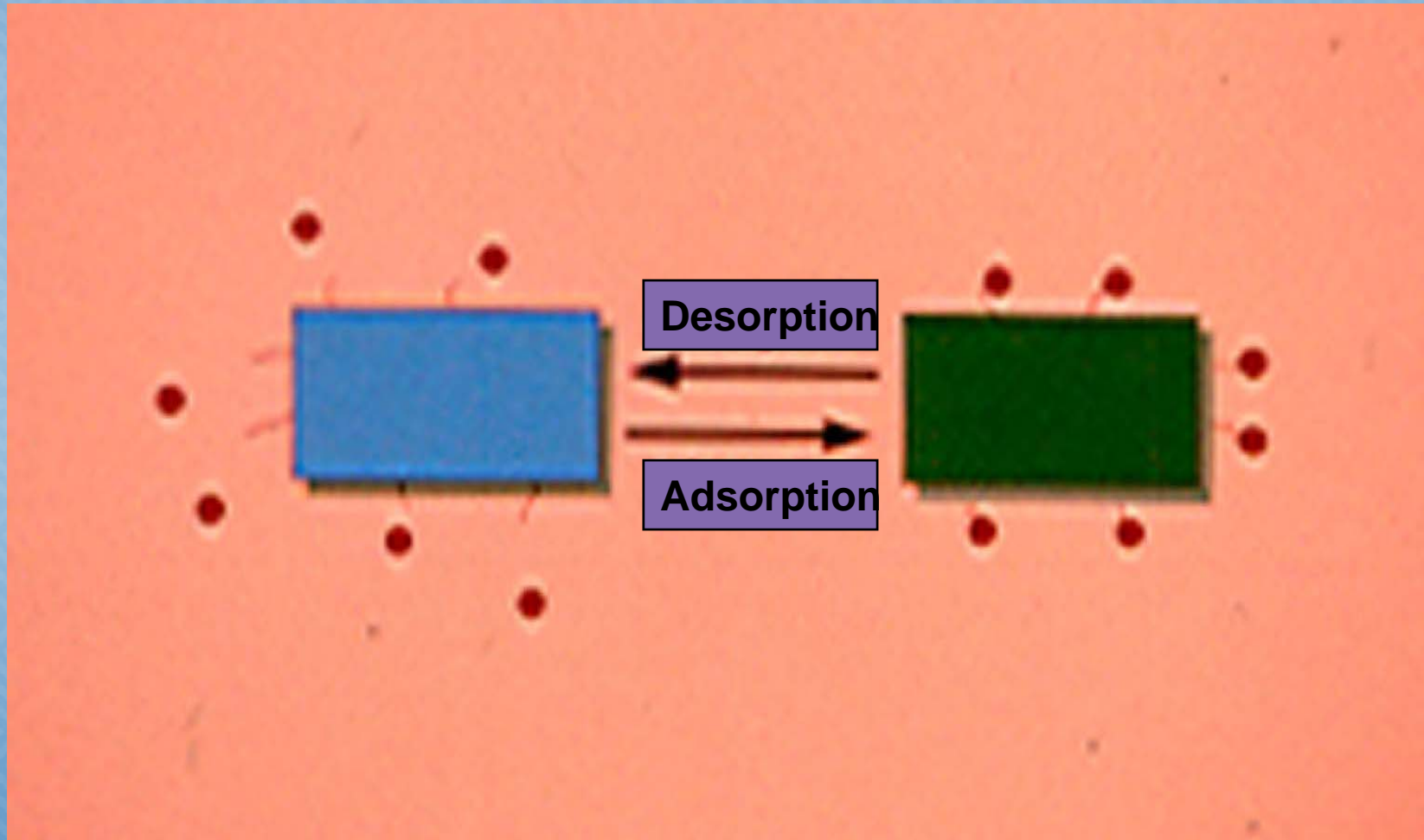
Leaching

Microbial
degradation

Physical removal

Degradation

Adsorption and desorption



Soil factors

- **Surface area of soil particles**
 - Sand 14 in² per gram of soil
 - Silt 70 in² per gram of soil
 - Clay 1.2 million in² per gram of soil
- **Bottom line: clay loam soils can adsorb a lot more herbicide than sandy loam soils.**

Prowl H₂O: rates by soil texture

Use Rates

Soil Texture	Broadcast Rate (pts/A)
Coarse	1.5
Medium	2.0 to 2.5
Fine	2.5 to 3.0

Herbicide degradation

- **Begins immediately after application & continues until the herbicide is gone**
- **All herbicides are degraded in the environment**
- **The degradation rate can vary among herbicides and environments**
 - **Dry/wet**
 - **Warm/cool**

Degradation processes

- **Sunlight (photochemical degradation)**
- **Chemical (in soil or water)**
- **Microbial (in soil or water)**
- **Metabolism (plant or animals)**

Degradation in sunlight

- UV radiation in sunlight breaks down the chemical bonds in the herbicide
- Happens on the surface of water or soil
- For example Devrinol, Prowl and Treflan are readily degraded by UV light.
- From the Devrinol label: **“Rainfall and/or overhead irrigation sufficient to wet soil to 1 inch depth should follow treatment within 24 hours.”**

Chemical Degradation

- Degradation in soil or water by non-biological factors such as water (hydrolysis).
- Caparol can be degraded by hydrolysis
- Metam sodium (Vapam, Sectagon) are activated by hydrolysis of metam sodium to the active molecule methyl isothiocyanate (MITC)

Microbial Degradation I

- **The most important degradation process for herbicides**
- **The structure of the herbicide molecule is changed by soil microbes**
 - **Microbe enzymes degrade the herbicide molecule**
 - **The microbes use the herbicide as food**
 - **Examples of common herbicides used here that are degraded by soil microbes**
 - **Caparol, Dacthal, Eptam, Kerb, Linuron, RoNeet, Treflan are degraded primarily by soil microbes**

Microbial Degradation II

- Highest microbial levels near the soil surface
- Factors affecting microbial activity & herbicide degradation
 - Temperature
 - Organic matter
 - Nutrient content
 - Soil pH
 - Soil moisture

The soil is a “tough” place to persist!



Degradation in plants (metabolism)

- Tolerant plants such as corn degrades atrazine and celery degrades Caparol so that the herbicide does not injure the crop.

Methods of reducing herbicide carryover I

- Use the lowest rate possible
- Apply in bands rather than broadcast
- Till the field to dilute the herbicide within the soil
- If dry, irrigate the field to increase microbial degradation
- Plant a cover crop to increase degradation of the herbicide by the cover crop eg. rye.
- Manage soil pH with appropriate inputs
- In some cases activated charcoal can be applied to adsorb excess herbicide.

Methods of reducing herbicide carryover II

- **Use transplants rather than direct seeded crops especially lettuce**

Common herbicides and plantback intervals for common crops

Months to plantback											
Crop	Balan	Caparol	Dacthal	Devrinol	Goal	Kerb	Linuron	Metam sodium	Prefar	RoNeet	Treflan
Broccoli - seed		10	0	0	4	3 to 7	12	14-21 days	0		0
Broccoli - transplant		10	0	0	0-1	3 to 7	12	14-21 days	0		0
Cabbage - seed		4 to 5	0	0	3	3 to 7	12	14-21 days	0		0
Cabbage - transplant		4 to 5	0	0	0-1	3 to 7	12	14-21 days	0		0
Carrot	10	10	8	12	3	3 to 5	0	14-21 days	0		0
Cauliflower-transplant		10	0	0	0-1	3 to 7	12	14-21 days	0		0
Celery-transplant		0	8	2	1	3 to 5	0	14-21 days	0		0
Cilantro		10	8	12	2	12	12	14-21 days	0		5
Dry onion	10	8	0	12	6	3 to 7	12	14-21 days	0		5
Green onion	10	8	0	12	6	3 to 7	12	14-21 days	0		5
Kale		10	8	12	4	12	12	14-21 days	0		0-process
Lettuce	0	10	8	2	4	0	12	14-21 days	0		5
Parsley		0	8	12	4	12	0	14-21 days	0		5
Peas		5	8	12	2	12	12	14-21 days	4		0
Spinach	10	10	8	2	4	3 to 7	12	14-21 days	4	0	12 to 20
Strawberry		10	0	0	1	12	12	14-21 days	4		5

Breeding for herbicide tolerance in lettuce

- Beiquan Mou, USDA ARS Salinas has backcrossed tolerance to sulfonyl urea herbicides into lettuce – similar to the “Clearfield” and “ExpressSun” systems.
- Express (tribenuron) has been our herbicide of choice.

TRT	Herbicide	Form	Rate
1	Express	75 DF	0.075 oz
2	Express	75 DF	0.16 oz
3	Express	75 DF	0.33 oz
4	Londax - PRE	75 DF	0.75 oz
5	Londax - POST	75 DF	0.75 oz
6	Kerb	3.3 SC	2.9 pt
7	Control		0.0



2012.03 - Treatment #1

Express 75WG

0.0035 lb ai/Ac

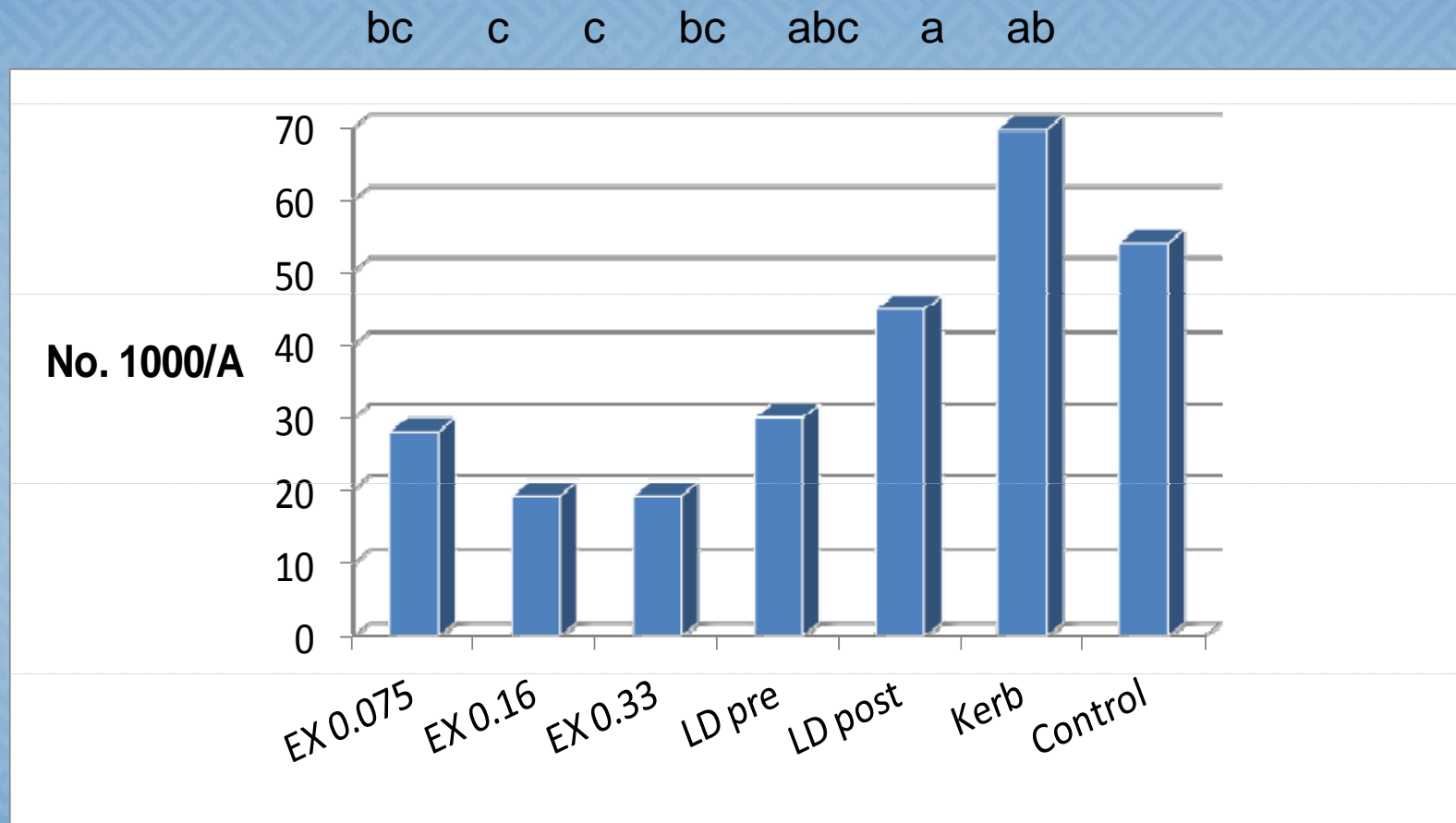
R-11 NIS @ 0.25%

Post Emergence

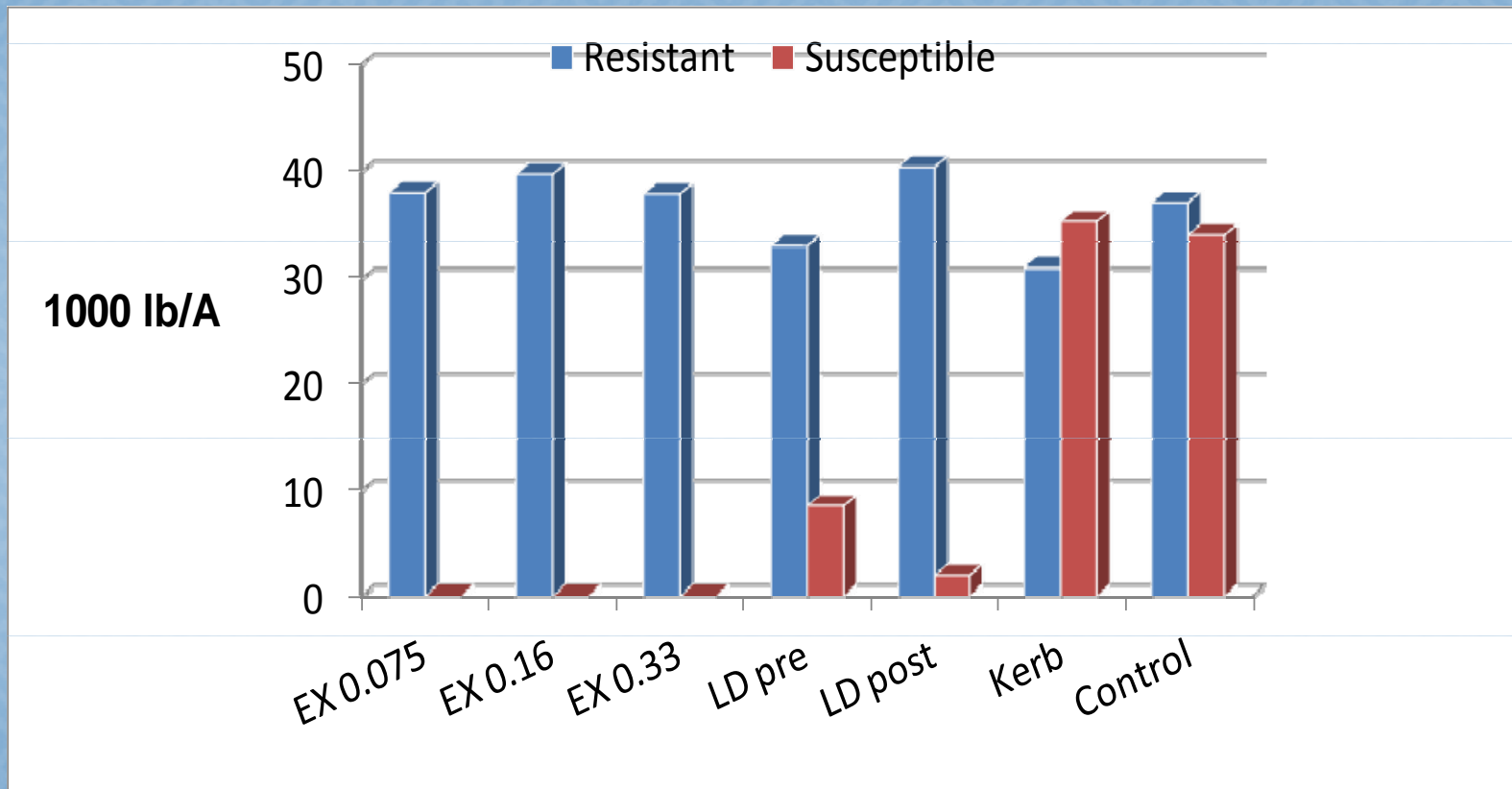
Bed #2

(R) Redleaf - (S) Butter Head
MS09-0696 Lolla Rossa

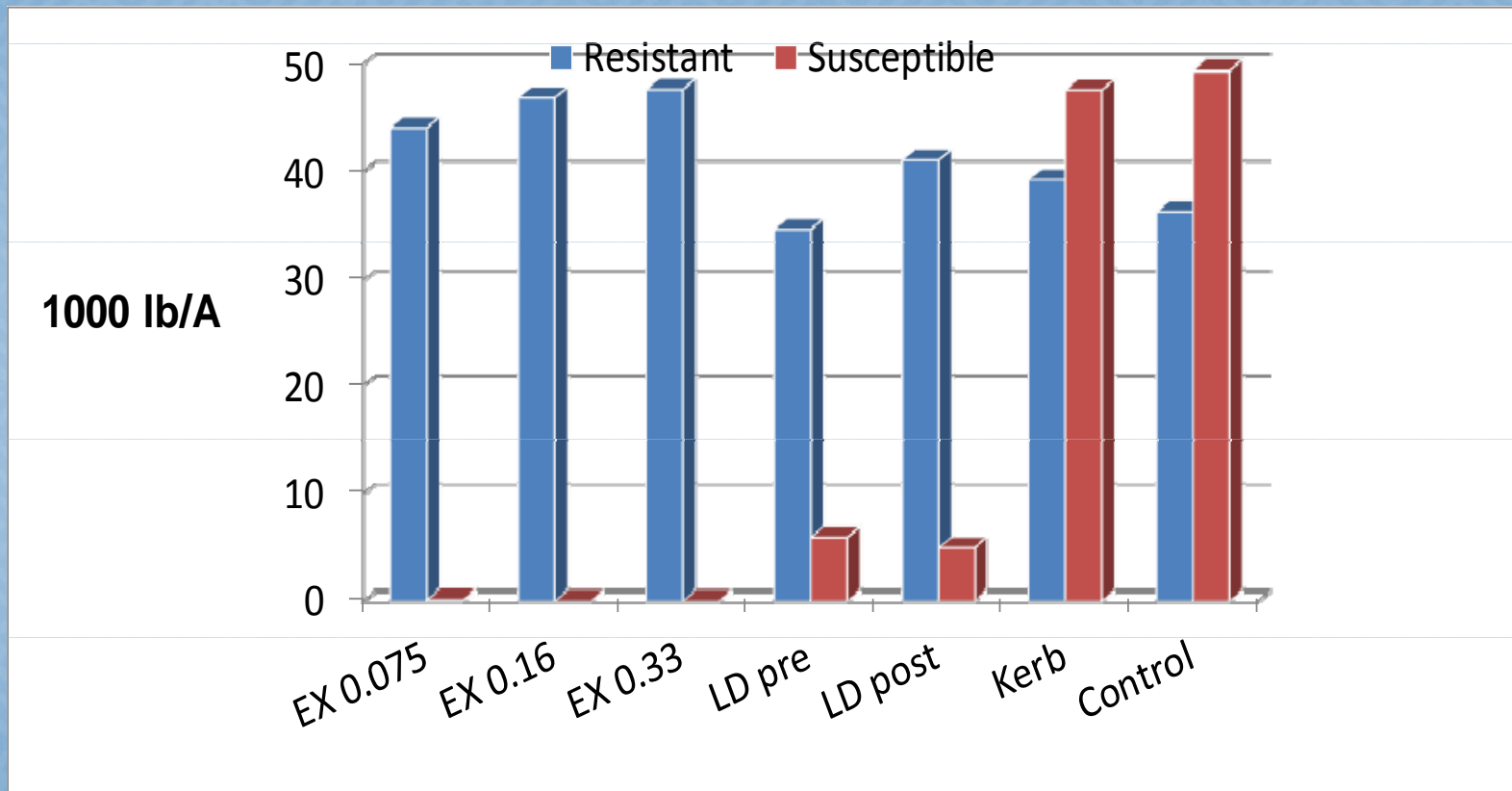
Sowthistle densities



Romaine #1 yield



Crisphead #1 yield



Summary – IDBR1

- ❖ The resistance gene is protecting lettuce stand and yield
- ❖ Weed control with Express is good and it controls weeds that Kerb does not control.
- ❖ Tribenuron/lettuce has been submitted to IR-4 (PCR 10873) and is a “B” priority. DuPont will not support so we need another sponsor. We need a sponsor to go for an “A” priority.

Question – Does Express carryover?

- ❖ The system will not work unless rotational crops can be planted immediately after the lettuce harvest
- ❖ We seeded beans, broccoli, carrot, lettuce, onion, spinach & tomato immediately following lettuce harvest.
- ❖ No reduction in vegetable stand or dry weights were observed.

New on the horizon for lettuce: Dual Magnum

- ❖ Dual Magnum will be submitted to the US EPA In November 2012 for approval of a tolerance on transplanted lettuce.
- ❖ Approval expected in 18 months
- ❖ When we have a tolerance I plan to conduct some large scale evaluations.
- ❖ Syngenta will need to decide if Dual Magnum is labeled as a section 3 or 24c SLN

Update on Kerb I

- ❖ *Dow AgroSciences has invested significantly to protect the Kerb label and its uses. DAS will continue to invest to regain the leaf lettuce uses. We're conducting all EPA requested trials to generate new data, and also some additional tests which were not originally required. All studies are complete and will be submitted to USEPA in Q1 2013.*



Update on Kerb II

- *Regaining the leaf lettuce label has two parts:*
- *1. A cancer reclassification of propyzamide and its metabolites is needed in order to obtain additional room in the risk cup. This will make it possible to register leaf lettuce.*
- *2. EPA must establish a propyzamide tolerance for leaf lettuce. This is expected to occur in mid to late 2014, following successful cancer reclassification.*