

Pesticide Resistance: Strategies for Prevention

Oregon Cranberry school

January 25, 2018

Bandon, OR

IPMSP

It all started with the IPMSP

- Grower-driven document
- Outlined needs of OR and WA cranberries
 - Pest management
 - Policy
 - Research
 - Etc.
- Resistance management was one of the identified needs

Integrated Pest Management Strategic Plan for Oregon and Washington Cranberries



Photo: Katie Murray

Summary of a workshop held on
April 7, 2017

Bandon, Oregon

Issued: October 2017

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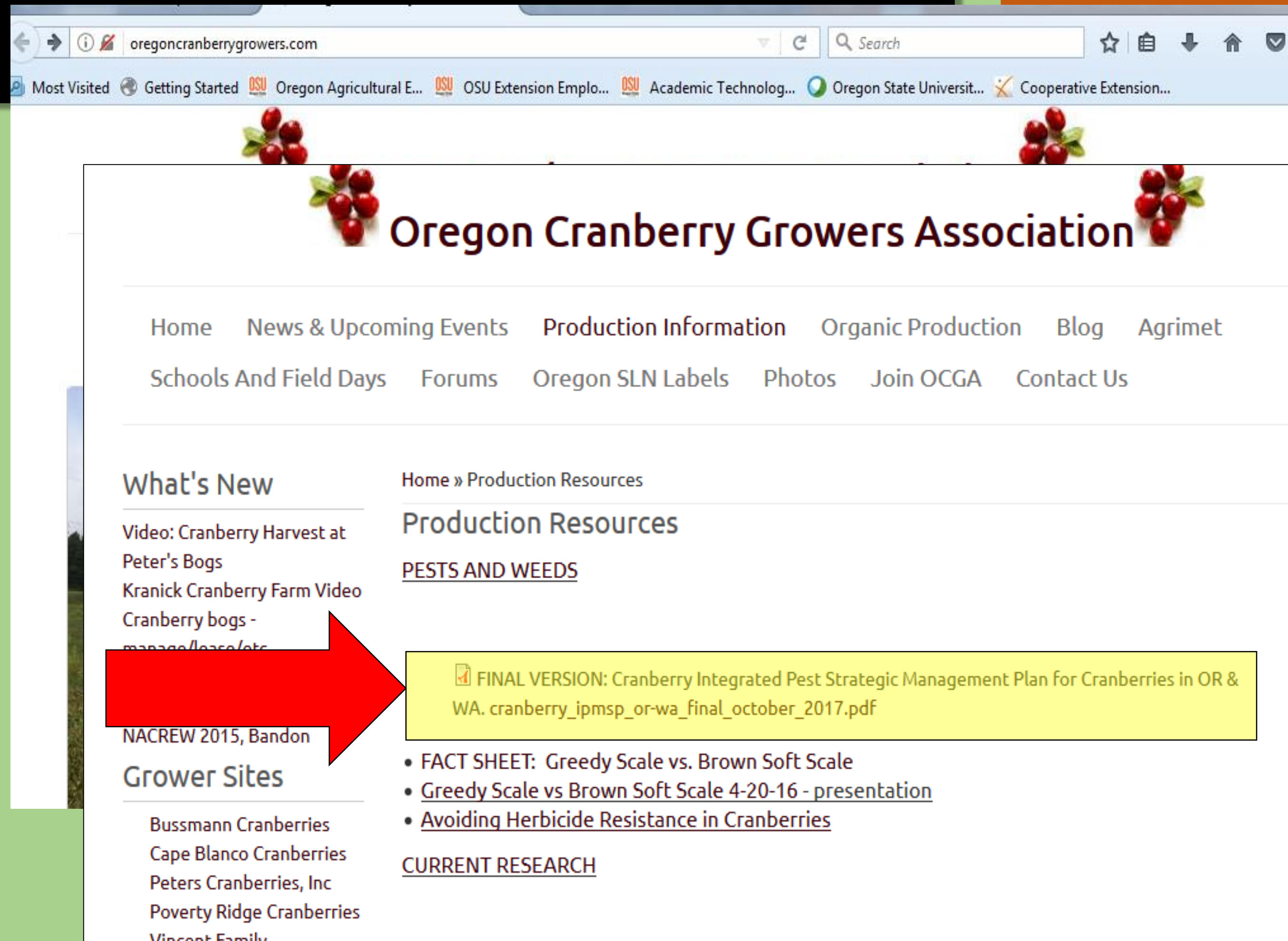
Integrated Plant Protection Center

2034 Cordley Hall, Oregon State University

Corvallis, OR 97331-2915

The IPMSP

You can
find it on
the Oregon
Cranberry
Growers
website



Is resistance something to worry about?

Pest	Product
Weevil in MA	Resistant to OPs, Concerns about Avaunt
Sparganothus fruitworm	Resistant to OP Concerns about Delegate
Tipworm	Suspected resistance to diazinon

Also:

- Curio
- Glyphosate
- Select, etc
- Poast
- Callisto
- ...

Black-headed fireworm

Dormancy/bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/development (June – September)	Harvest (Aug – Nov)
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Flooding

Cultural

Altacor
28

Altacor
28

Altacor
28

Diazinon
1A

Intrepid
18

Diazinon
1A

Avaunt
22

Intrepid
18

Imidan
1A

Intrepid
18

Imidan
1A

Pyganic, etc.
3A

Pyganic, etc.
3A

Pyganic, etc.
3A

Delegate
5

Delegate
5

Delegate
5

Entrust
5

Entrust
5

Entrust
5

Orthene
1B

Orthene
1B

Assail, etc.
4A

Admire Pro
4A

Bt
Biopesticide

Grandevo
Biopesticide

Growth Stages in Cranberry

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
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Pest Management

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
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Pest Management

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
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MOA #1

Pest Management

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
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MOA #1

MOA #1

MOA #1

Pest Management

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
	MOA #1	MOA #2	MOA #1	

Example 1: Fireworm Controls

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
Year 1	MOA #1		MOA #2	
			MOA #2	

Example 1: Fireworm Controls

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
Year 1	MOA #1		MOA #2	
			MOA #2	
Year 2	MOA #3		MOA #4	

Example 1: Fireworm Controls

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
Year 1	MOA #1		MOA #2	
			MOA #2	
Year 2	MOA #3		MOA #4	
Year 3		MOA #4	MOA #5	

Example 1: Fireworm Controls

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
Year 1	MOA #1		MOA #2 MOA #2	
Year 2	MOA #3		MOA #4	
Year 3		MOA #4	MOA #5	
Year 4	MOA #1	MOA #4	MOA #5	

Example 1: Fireworm Controls

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
Year 1	MOA #1		MOA #2 MOA #2	
Year 2	MOA #3		MOA #4	
Year 3		MOA #4	MOA #5	
Year 4	MOA #1	MOA #4	MOA #5	
Year 5	MOA #1	MOA #4 MOA #5	MOA #4	

Example 2: Fireworm Controls

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
Year 1	MOA #1		MOA #1	
Year 2		MOA #1	MOA #1	
Year 3	MOA #1		MOA #1	
Year 4	MOA #1		MOA #1	
Year 5	MOA #1		MOA #1	

Example 3: Fireworm Controls

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
Year 1		MOA #2	MOA #5	
		MOA #6	MOA #1	
Year 2	MOA #2	MOA #5	MOA #1	
Year 3	MOA #2		MOA #2	
Year 4	MOA #2	MOA #4	MOA #6	
Year 5		MOA #5		

Example 4: Fireworm Controls

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
Year 1	MOA #4	MOA #4	MOA #4	
Year 2	MOA #4	MOA #4		
Year 3	MOA #4		MOA #4	

Example 5: Fireworm Controls

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
Year 1		MOA #5	MOA #2	
		MOA #5	MOA #2	
Year 2	MOA #3		MOA #5	
			MOA #5	
Year 3	MOA #4	MOA #5	MOA #4	
Year 4	MOA #4	MOA #5	MOA #4	
Year 5		MOA #4	MOA #5	

Fungicides

Fruit Rot & Twig blight

Dormancy/bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/development (June – September)	Harvest (Aug – September)
		Abound 11		
		Abound 11		
	Bravo, Echo M5	Bravo, Echo M5	Bravo, Echo M5	
		Indar, Proline 3		
		Indar, Proline 3		
	Dithane, Manzate M3	Dithane, Manzate M3	Dithane, Manzate M3	
		Kocide, ManKocide M1		

Example 1: Fungicide program

Dormancy/bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/development (June – September)	Harvest (Aug – September)
Year 1	MOA #1	MOA #2		
		MOA #2		
Year 2	MOA #1	MOA #2	MOA #2	
		MOA #2		
Year 3				
Year 4	MOA #1	MOA #2		
		MOA #3		
		MOA #4		

Example 2: Fungicide program

Dormancy/bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/development (June – September)	Harvest (Aug – September)
Year 1		MOA #2	MOA #2	
Year 2				
Year 3		MOA #2	MOA #2 MOA #2	
Year 4				
Year 5		MOA #4	MOA #4	

Example 3: Fungicide program

Dormancy/bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/development (June – September)	Harvest (Aug – September)
Year 1	MOA #2	MOA #1	MOA #2	
Year 2		MOA #2	MOA #2	
Year 3	MOA #1	MOA #1		
Year 4			MOA #2	
Year 5	MOA #1			

Example 4: Fungicide program

Dormancy/bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/development (June – September)	Harvest (Aug – September)
Year 1	MOA #1		MOA #2	
	MOA #1		MOA #2	
			MOA #5	
Year 2			MOA #2	
			MOA #2	
Year 3	MOA #1		MOA #2	
			MOA #2	
			MOA #5	
Year 4	MOA #1		MOA #2	
			MOA #2	
			MOA #5	

Example 4: Fungicide program

Dormancy/bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/development (June – September)	Harvest (Aug – September)
Year 1	MOA #1	MOA #2	MOA #2	
	MOA #1	MOA #5		
Year 2	MOA #1	MOA #2	MOA #2	
	MOA #1	MOA #2		
Year 3	MOA #2	MOA #1	MOA #2	
			MOA #2	
			MOA #5	
Year 4	MOA #1	MOA #1	MOA #2	
	MOA #1		MOA #5	
Year 5	MOA #1	MOA #3	MOA #5	
		MOA #4		
		MOA #3		

Fruit Rot & Twig blight

Dormancy/bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/development (June – September)	Harvest (Aug – September)
		Abound 11		
		Abound 11		
	Bravo, Echo M5	Bravo, Echo M5	Bravo, Echo M5	
		Indar, Proline 3		
		Indar, Proline 3		
	Dithane, Manzate M3	Dithane, Manzate M3	Dithane, Manzate M3	
		Kocide, ManKocide M1		

Herbicides

Grass-specific herbicides

	Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
YR 1				SelectMAX	
				SelectMAX	
YR 2				Select2EC	
YR 3				SelectR2EC	
				SelectR2EC	
YR 4	Select 2 EC			Select 2 EC	

Grass-specific herbicides

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
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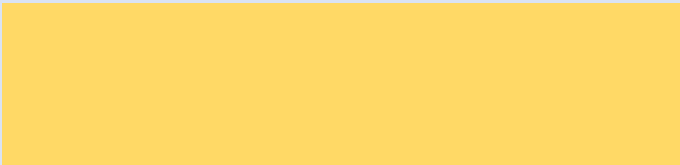
YR 1



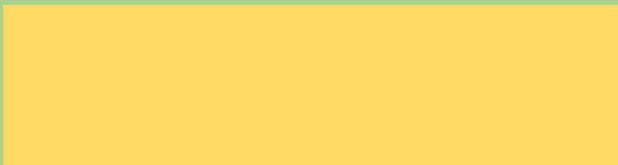
YR 2



YR 3



YR 4



Grass-specific herbicides

Dormancy/ bud-break (Nov – April)	Shoot elongation (April-May)	Bloom (May – June)	Fruit set/ development (June – Sept)	Harvest (Aug – Nov)
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YR 1

SelectMax

YR 2

Poast

SelectMax

Select 2 EC

YR 3

SelectR 2 EC

YR 4

Poast



We create chemistry

Group 1 Herbicide

SPECIMEN

Poast[®]

herbicide

For broad-spectrum, postemergence selective control of annual and perennial grass weeds in select crops and other use sites

Active Ingredient:

sethoxydim: 2-[1-(ethoxymino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one*	18.0%
Other Ingredients:	82.0%
Total:	100.0%

* Equivalent to 1.5 pounds of sethoxydim per gallon formulated as an emulsifiable concentrate
Contains petroleum distillate

EPA Reg. No. 7969-58

EPA Est. No.

KEEP OUT OF REACH OF CHILDREN
WARNING/AVISO

GROUP 1 HERBICIDE



SELECTMAX[®]

HERBICIDE
WITH INSIDE TECHNOLOGY™

Active Ingredient	By Wt
*Clethodim	12.6%
Other Ingredients	87.4%
Total	100.0%

Contains Petroleum Distillates

*(E)-2-[1-[[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one

Contains 0.97 lbs clethodim per gal

EPA Reg. No. 59639-132

EPA Est. 5905-GA-01

KEEP OUT OF REACH OF CHILDREN
CAUTION

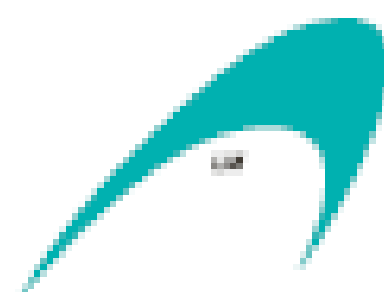
SEE BELOW FOR ADDITIONAL PRECAUTIONARY STATEMENTS AND FIRST AID

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS & DOMESTIC ANIMALS

PULL HERE TO OPEN ►

GROUP 11 FUNGICIDE



Abound®

Flowable Fungicide

syngenta.

Broad spectrum fungicide for control of
plant diseases

Active Ingredient:

Azoxystrobin methyl (E)-2-[2-[6-(2-cyanophenoxy)

pyrimidin-4-yloxy]phenyl]-3-methoxyacrylate* 22.0%

Other Ingredients:

77.1%

Total:

100.0%

Contains 2.08 lb of active ingredient per gallon

*IUPAC

KEEP OUT OF REACH OF CHILDREN.

CAUTION

See additional precautionary statements and directions for use
inside booklet.

Reformulation is prohibited. See individual container labels for repackaging
limitations.

EPA Reg. No. 100-1098

EPA Est. 100-NE-001

SCP 1098A-L1L 0216
4063215

1 gallon
Net Contents



GROUP 15 HERBICIDE

Devrinol®

50-DF Selective Herbicide – Dry Flowable

*For use on certain Nuts, Small Fruits,
Vegetables and Tobacco*

ACTIVE INGREDIENT:

Napropamide 50%

OTHER INGREDIENTS: 50%

TOTAL 100%

**KEEP OUT OF REACH OF CHILDREN
CAUTION**

FIRST AID

IF SWALLOWED:

- Call a Poison Control Center or doctor immediately for treatment advice.
- Have person sip a glass of water if able to swallow.
- Do not give anything by mouth to an unconscious person.
- Do not induce vomiting unless told to by a Poison Control Center or doctor.

IF IN EYES:

ENGINEERING CONTROLS STATEMENT

When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS. Pilots must use an enclosed cockpit that meets the requirements in the Worker Protection Standard.

User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This product is toxic to fish. Do not apply directly to water or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment washwaters or rinsate.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.


Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation. Do not allow people or pets to enter the treated area until dusts have settled.


VALENT®

**SELECT®**

2 EC HERBICIDE

Bv Wt.

Toxicity	Herbicide	Rate per acre	MAX	PHI (days)	REI	HRAC	
	† Callisto	Up to 8 fl. oz.	16 fl. oz.	45	12 hrs.	27	Adjuvant use is recomn
	Casoron 4G	Up to 100 lbs.	100 lbs.	See note	12 hrs.	20	Apply early spring or po
	Curio	0.5 fl. oz.	1 fl. oz.	60	12 hrs.	2	24(c) for WA and OR o
	Devrinol 2-XT, Devrinol DF-XT	See label	See label	See note	24 hrs.	15	Special timing and soil label for additional wee
	Evital 5G	80 to 160 lbs.	1 app	See note	12 hrs.	12	Apply once in early spr
	Glyfos, Roundup	Dilution rates vary	See label	30	See Label	9	Wipe over tops of weed
	Poast	0.5 to 2.5 pts.	5 pts.	60	12 hrs.	1	No chemigation. Use 1.
	Quinstar 4L	8.4 fl. oz.	16.8 fl. oz.	60	12 hrs.	26	Follow label directions.
	Select	6 to 8 fl. oz.	32 fl. oz.	30	24 hrs.	1	No chemigation allowed (Select) in the finished
	Select Max	9 to 16 fl. oz.	64 fl. oz.				
	Stinger	2.67 to 8 fl. oz.	16 fl. oz.	60	12 hrs.	4	Not within 5 feet of any
	Weedar 64	2.4 pts.	1 app	30	48 hrs.	4	Wipe over tops of weed

Toxicity	Fungicide	Rate per acre	MAX	PHI (days)	REI	FRAC	
	Abound	6 to 15.4 fl. oz.	92 fl. oz.	3	4 hrs.	11	See label regarding res

Winfield Solutions, LLC

P.O. Box 64589

St. Paul, MN 55164-0589

Form 1462-D Made in U.S.A.

1/0925/2

GROUP**1****HERBICIDE**

SELECTMAX[®]

HERBICIDE
WITH INSIDE TECHNOLOGY™

Active Ingredient	By Wt
*Clethodim	12.6%
Other Ingredients	87.4%
Total	100.0%

Contains Petroleum Distillates

*(E)-2-[1-[[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one

Contains 0.97 lbs clethodim per gal

EPA Reg. No. 59639-132

EPA Est. 5905-GA-01

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE BELOW FOR ADDITIONAL PRECAUTIONARY STATEMENTS AND FIRST AID

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS & DOMESTIC ANIMALS CAUTION

Causes moderate eye irritation. Avoid contact with eyes, skin or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum or using tobacco. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Harmful if swallowed.

FIRST AID

FIRST AID (continued)

If inhaled:

Move person to fresh air.

If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible.

Call a poison control center or doctor for further treatment advice.

HOT LINE NUMBER

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-892-0099 for emergency medical treatment information.

NOTE TO PHYSICIAN

Ingestion of this product or subsequent vomiting can result in aspiration of light hydrocarbon liquid, which can cause pneumonitis. If ingested, probable mucosal damage may contraindicate the use of gastric lavage.

PERSONAL PROTECTIVE EQUIPMENT (PPE):

Some materials that are chemical-resistant to this product are listed below. If you want more options, follow the instructions for category G on an EPA chemical resistance category selection chart.

Applicators and other handlers must wear: long-sleeved shirt and long pants, chemical-resistant gloves such as barrier laminate or viton ≥14 mils, shoes plus socks and protective eyewear.

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining PPE. If there are no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

USE, SAFETY RECOMMENDATIONS