

# A GRANULAR FORMULATION OF OXYFLUORFEN (ROUT)

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The objective of Sierra Chemical's ornamental-herbicide research program encompassed the development of an herbicide product with an effectiveness/tolerance spectrum equal or superior to any product currently marketed. Strategy involved the combination of two unlike chemical structures with complementing activity. Specific combinations were evaluated to provide primary and backup candidates for product registration.

Target weed species for which control data was required included: common groundsel, prostrate spurge, and common chickweed. These weed species are noted for their prevalence and difficulty of control.

## MATERIALS AND METHODS

The experimental layout involved a randomized complete block (RCB) design with three replications of each treatment. Six one-gal. containers comprised a subplot for each ornamental species and chemical treatment. A typical research trial involved six to eight ornamental species.

Chemical applications were made with a high clearance (21-inch) linear drop spreader shielded to prevent particle drift and assure accurate, uniform product distribution.

Chemical treatments shown in Table 1 were applied at  
**Table 1.** Chemical treatments evaluated in Sierra's ornamental herbicide research trials (1983-1984).

Treatment number	Chemical treatment	Rate lbs a.i /A
1	Goal/Devrinol	2 + 1
2		4 + 2
3		6 + 3
4		8 + 4
5	Goal/Surflan	2 + 1
6		4 + 2
7		6 + 3
8		8 + 4
9	Goal/Lasso	2 + 2
10		4 + 4
11		6 + 6
12		8 + 8
13	OH-2 (Goal/Prowl)	2 + 1
14		8 + 4
15	Ronstar	4
16	Control	—

three-month intervals for a maximum of three successive treatment phases at each location. Each experimental treatment was applied at 1X, 2X, 3X, and 4X levels. Commercially-available standards for comparison included OH-2 (1X, 4X) and Ronstar (1X).

All experimental treatments were formulated on Floridin (-16+30) attapulgite clay (RVM). Formulations were based on a product rate of 100 lbs./A or 1 gm/ft.<sup>2</sup>

Selection of ornamental species for evaluation was based on those species of major economic importance in each geographical area. Six to eight ornamental species were evaluated at each of the following 14 locations:

D & M Nursery, Canby, OR  
Woodburn Nursery, Woodburn, OR  
J-Mar Nursery, Auburndale, FL  
Goochland Nursery, Pembroke, FL  
Scarf's Nursery, New Carlisle, OH  
Wolfe Nursery, Tyler, TX  
Greenleaf Nursery, El Campo, TX

Turkey Creek Nursery, Houston TX  
Zelenka Nursery, Grand Haven, MI  
Western Tree Nursery, Gilroy, CA  
Select Nursery, Fallbrook, CA  
El Modeno Nursery, Santa Ana, CA  
Powell Nursery, Thomasville, GA  
Pleasant Cove Nursery, Rock Island, TN

Test locations were selected to provide geographical spread assuring:

1. varying climatic conditions.
2. a wide range of potting media or soil types.
3. Accessibility to a wide spectrum of broad-leaved and grassy weed species.
4. a broad range of ornamental species.
5. trials in major production regions of the U.S.

Sierra Osmocote 18-6-12 was applied in accordance with label specifications in all container trails to standardize fertility practices.

## SUMMARIZATION OF RESULTS

Ornamental herbicide research trials were initiated during May, 1983. Weed control data were taken from May, 1983, through January, 1984 and includes two testing phases each of 3-mo. duration.

Goal/Devrinol and Goal/Lasso results are not discussed. Devrinol was not made available to Sierra by Stauffer Chemical; Goal/Lasso is currently on a registration hold.

**Weed control effectiveness.** Table 2 reflects the pooling of all weed data by weed species, ornamental species, location, and testing phase to provide a summary of weed control by chemical treatment.

- a. Treatments producing greater than 80% control at recommended rates:

Rout (Goal/Surflan)  
OH-2 (Goal/Prowl)

- b. Treatment providing less than 80% control at the recommended rates:  
Ronstar (4 lb. a.i./A)
- c. Rout (Goal/Surflan 2 + 1) produced 3 and 17% greater respective weed control than either OH-2 or Ronstar.

**Table 2.** Summary of percent container weed control from Phase I and II treatments at 14 locations

Chemical Treatment	(lbs. a.i./A)	Mean
Rout (Goal/Surflan)	2 + 1	84%
	4 + 2	97
	6 + 3	96
	8 + 4	98
OH-2	2 + 1	81
	8 + 4	99
Ronstar	4	67

Note 1) Weed control computed from total weed counts taken from 1 + 2 replications of each treatment  
2) Represents three-month residual data from each phase

**Ornamental tolerance.** A master summary of ornamental species involved in trials from Phases I, II and III are given in Table 3. It is important to note that the Rout label lists specific genus, species and cultivars for which 4X tolerance levels exist. Tolerant species were established from a minimum of two to a maximum of three successive treatment phases.

**Table 3.** Summary of ornamental species evaluated in Phases I, II, III trials.

Description	Rout
Total species tested	94
Species failing tolerance criteria	8
Species requiring additional test data <sup>1</sup>	8
Total species recommended for labelling	78

<sup>1</sup> Species failing to survive environmental conditions irrespective of chemical treatment

## DISCUSSION

**Rout component characteristics:** Oxyfluorfen (Goal) was developed by Rohm & Haas for selective preemergence weed control in agronomic, horticulture, fruit tree, and tropical plantation crops. Oxyfluorfen (Goal) is a diphenyl ether compound with the chemical name 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene.

Oxyfluorfen is extremely active at low rates (0.25 to 2 lbs. a.i./A) on a wide range of annual broadleaf and grass weeds;

high levels of activity have been achieved from both preemergence and postemergence applications. The primary mode of action of oxyfluorfen is as a contact herbicide with light being required for herbicidal activity; very little translocation occurs from either root or foliar application. Oxyfluorfen is very resistant to removal by rain. Further, it is strongly adsorbed on soil and shows negligible leaching characteristics. Photodecomposition of oxyfluorfen on soil is slow. Volatilization occurs to a limited extent and is the basis for label precautions restricting use in enclosed structures and during periods of leaf bud break.

The water solubility of oxyfluorfen is  $< 0.1$  ppm at  $25^{\circ}\text{C}$ . For comparison, the water solubility of Lasso, another ornamental herbicide, is 242 ppm. Lasso has an average soil residual of six to eight wks. in container-grown ornamentals while Goal (oxyfluorfen) has an average soil residual of eight to 12 wks. This low water solubility assures that the activity ingredient remains in the upper  $\frac{1}{8}$  to  $\frac{1}{4}$  in. of soil surface, where many weed seeds germinate, providing long-term weed control residual.

$\text{LD}_{50}$  is defined as the *lethal dosage* required to kill 50% of a test population and is expressed as mg/kg of body weight. The acute oral  $\text{LD}_{50}$  of the 2EC formulatin is  $> 5,000$  mg/kg. For comparison the acute oral  $\text{LD}_{50}$  of 2,4-D ranges between 300-1,000 mg/kg.

Oryzalin (Surflan) was developed by Elanco for selective preemergence weed control in agronomic and horticultural crops, non-bearing trees and vineyards, and cropland areas. Oryzalin (Surflan) is a dinitroaniline compound with the chemical name 3,5,-dinitro- $\text{N}^4$ ,  $\text{N}^4$ -dipropylsulfanilamide. Oryzalin is very active at rates from  $\frac{1}{2}$  to 4 lbs. a.i./A on annual grass and broad-leaved weeds. The primary mode of action of oryzalin has not been fully established; however, it is known to affect physiological growth processes associated with seed germination. It does not, however, directly inhibit seed germination. There is no significant adsorption or translocation of oryzalin in tolerant species (soybean). Oryzalin leaches to a limited extent under natural rainfall conditions; oryzalin is adsorbed on soils high in organic matter and clay content.

Photodecomposition of oryzalin does occur in treated soil; volatilization from soil surfaces is minimal. The water solubility of oryzalin is 2.5 ppm. The acute oral  $\text{LD}_{50}$  is 10,000 mg/kg.

**Characteristics of RVM Attapulgit Clay as a Carrier for Rout Herbicide:** Generally agricultural and horticultural pesticides are applied as either liquid sprays, dusts, or granules. Several advantages are claimed for the use of granular formu-

lations over conventional liquid spray or dust formulations.

1. Absence of drift away from the target during application.
2. Good penetration of foliage, ensuring that the majority of granules reach the soil surface.
3. Reduction of handling hazards through using solid granules rather than liquid sprays or finely-divided powders.
4. Spills easier to deal with.

The solid granular formulations, as used for Rout Ornamental Herbicide, consist of biologically active chemicals mixed with a biologically inert carrier. The inert carrier for Rout is a naturally occurring, porous material mined in the southeastern U.S. and is termed attapulgite clay. Basically, two types or grades of attapulgite clays are used as pesticide carriers, LVM and RVM. LVM (low volatile matter) is calcined or heated during manufacture; RVM (regular volatile matter) is dried. The designations, therefore, refer to the amount of volatile matter remaining in the clay following manufacture.

RVM clays are somewhat soft and tend to disintegrate readily in water, while the LVM materials are sand-like and resist disintegration. RVM granules generally exhibit 85-90% breakdown in water while LVM granules disintegrate only 10-15%.

Each 50-lb. bag of Rout herbicide contains approximately 57,500,000 RVM attapulgite clay granules of the -16+30 mesh. This translates to approximately 18 granules/inch<sup>2</sup> of treated surface area, which provides ample numbers of chemically-impregnated particles to stop weeds.

Rout herbicide is formulated at a 3% a.i./A composite concentration (2% oxyfluorfen, 1% oryzalin); 100 lbs. of product equals 2 lbs. of oxyfluorfen (Goal) + 1 lb. of oryzalin (Surflan) per treated acre.

Rout forms a dispersion in the presence of water; when applied granules receive rainfall, or are irrigated, the clay particles disperse, moving laterally on the soil surface to form a very thin film known as herbicide barrier.

## CONCLUSIONS

Rout represents the first commercial product of its kind combining both oxyfluorfen (Goal) and oryzalin (Surflan) into one attapulgite clay formulation for long-residual, broad-spectrum weed control in ornamental nurseries.