STATE OF WASHINGTON
DEPARTMENT OF AGRICULTURE
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WASHINGTON STATE CARBOFURAN USE SUMMARY

- Carbofuran is a broad-spectrum carbamate pesticide that controls insects, mites, and nematodes.
- Carbofuran is a federal Restricted Use Pesticide (RUP) used to control soil and foliar pests of field, fruit, vegetable, and forest crops.
- Only two products containing carbofuran are registered for use in Washington State: Furadan 4F, a flowable liquid formulation and Furadan 15G, a granular formulation.
- Carbofuran is classified by formulation - the granular formulation (Furadan 15G) bears the signal word, "Warning" and the liquid formulation (Furadan 4F) bears the signal word, "Danger/Poison." Furadan 15G is classified toxicity class II – moderately toxic. Furadan 4F is classified toxicity class I – highly toxic. Carbofuran belongs to the carbamate chemical class.
- The available acute toxicity data on carbofuran indicates that it is highly toxic to both freshwater and esturarine fish.

Current Washington State Use Practices

CROP	WASS[1] 2002 EST. ACRES	EST. % ACRES TREATED	EST. LBS. A.I./ACRE	# OF APPS	EST. ACRES TREATED	EST. LBS. A.I. APPLIED
Alfalfa, hay [2]	490,000	< 5	0.25	1	24,500	6,125
Alfalfa, seed	12,000	< 5	0.25	2	500	250
Barley	350,000	< 5	0.20	2.0	17,500	7,000
Corn, grain & silage	130,000					
Corn, sweet	97,900					
Cranberry	1,600	No longer used on cranberry. See narrative.				
Oats	35,000	< 5	0.20	2.0	1,750	700
Potato, Irish [3]	163,000	7	0.25	1	11,410	3,000
Spinach, seed	1,500					
Wheat	2,420,000	< 5	0.20	2.0	121,000	48,400

[1] Washington Agricultural Statistics Service
[2] Commodities noted in **BLUE** have not had peer review input.
[3] USDA National Agricultural Statistics Service – 2003 crop data

MAJOR USES (listed alphabetically):

The major use listing supplies the most commonly used formulations of the active ingredient. No discrimination or endorsement is intended.

The pesticide labels take precedence over any information contained herein. It is the responsibility of the user to comply with the label directions provided.

The following pesticide use summary reflects the general pesticide practices for the listed commodities. The use information is not intended to reflect the pesticide application practices of any individual.

ALFALA, HAY:

- In 2002, approximately 490,000 acres of alfalfa hay were produced in Washington State. Grant County produces nearly one-quarter of the state's alfalfa hay crop.
- Carbofuran (Furadan 4F) may be applied at a rate of 0.25 to 1 pounds active ingredient per acre to control the following alfalfa insect pests:
    - ➨ alfalfa weevil
    - ➨ grasshopper
- Carbofuran should be applied only to pure stands of alfalfa and no more than once per season.

ALFALFA, SEED:

- Carbofuran (Furadan 4F) may be applied at a rate of 0.25 to 1 pounds active ingredient per acre to control the following alfalfa insect pests:
    - ➨ alfalfa weevil
        - Only two applications should be made per season.
    - ➨ alfalfa aphid and pea aphid
        - Carbofuran is used only pre-bloom.
        - Only two applications should be made per season.

BARLEY:

- Washington State had 350,000 acres in barley production in 2002. Barley production is concentrated in eastern Washington in Adams, Garfield, Lincoln, Spokane, and Whitman counties.
- Over 95 percent of the barley grown in Washington is spring barley, which is planted in early spring (generally April) and harvested in late July or August of the same year. Washington's winter barley is seeded in September or October and harvested in late July or August of the following year. Less than 5 percent is irrigated.
- End use for Washington barley is primarily feed (beef and dairy cattle, swine and poultry production) at 92 percent and malting (food, beer, beverages) at 8 percent.
- Because of the low economic return on small grains, chemicals are not used extensively for insect control. Insecticide applications are often limited to outbreak conditions or in response to threats of insect-vectored diseases.
- If used for insect pest control in alfalfa, carbofuran should be applied prior to heading and not applied more than two times per growing season.

- Carbofuran (Furadan 4F) may be applied to control the following barley insect pests:
    - barley thrips
        - Treat with carbofuran (Furadan 4F) at a rate of 0.125 to 0.25 pounds active ingredient per acre.
    - cereal leaf beetle
        - These insects are easily controlled by parasitoids therefore carbofuran is not typically used.
        - Carbofuran (Furadan 4F) may be applied at a rate of 0.25 pounds active ingredient per acre when insects appear.
    - cutworm and armyworm
        - Carbofuran (Furadan 4F) may be applied at a rate of 0.125 to 0.25 pounds active ingredient per acre.
        - Damage often occurs in the early spring to young plants.
    - grasshopper
        - Carbofuran (Furadan 4F) may be applied at a rate of 0.125 to 0.25 pounds active ingredient per acre.

CORN, GRAIN & SILAGE:

- In 2002, 130,000 acres of field corn were planted. Of that acreage, 70,000 acres were harvested for grain and 60,000 acres were cut for silage. Most corn is grown in the following eastern Washington counties: Franklin (11,700 acres), Grant (30,000 acres) and Yakima (25,000 acres).
- Western Washington counties produce 34,000 acres of corn with the following acres cut for silage: Whatcom (16,000 acres), Skagit (7,200 acres) and Snohomish (5,500 acres).
- Carbofuran (Furadan 4F) may be applied to control the following grain & silage corn pests:
    - corn rootworm larvae
        - Carbofuran (Furadan 4F) may be applied at a rate of 0.075 pounds active ingredient per 1,000 row feet.
        - Furadan 4F is applied at planting as band over the row or by side-dressing. It may also be applied post-emergence as a basal spray.
    - grasshopper
        - Carbofuran may be applied at a rate of 0.125 to 0.25 pounds active ingredient per acre.
    - seed corn maggot
        - The most severe damage from seed corn maggot occurs in cool, moist seasons.
        - Carbofuran (Furadan 4F) may be applied at planting as an in-furrow treatment at a rate of 0.075 pounds active ingredient per 1,000 row feet.
    - wireworm
        - Crop rotation is the most effective long-term control of wireworm. Two to three years of alfalfa may significantly reduce wireworm populations in most infested fields.
        - Carbofuran (Furadan 4F) may be applied at planting as an in-furrow treatment at a rate of 0.075 pounds active ingredient per 1,000 row feet.

CORN, SWEET:

- In 2002, Washington State harvested 97,900 acres of sweet corn were harvested (2,600 acres for the fresh market and 95,300 picked for processing). Grant (33,000 acres), Benton (15,000 acres) and Franklin (18,000 acres) counties are Washington State's leading producers of sweet corn for processing.
- While many counties decreased sweet corn acreage in 2002, Yakima County increased sweet corn production 3-fold, going from 2,700 acres in production to 8,900 acres.
- Carbofuran (Furadan 15G) may be applied at a rate of 1.20 pounds active ingredient per 1,000 row feet to control the following sweet corn pests:
    - armyworm
        - Carbofuran (Furadan 15G) may be applied at planting at a rate of 1.20 pounds active ingredient per 1,000 row feet to provide a 4 –6 week control.
        - There are typically two overlapping generations of armyworm per season.
    - corn rootworm larvae
        - Carbofuran (Furadan 15G) may be applied at planting at a rate of 1.20 pounds active ingredient per 1,000 row feet to provide a 4 –6 week control.
        - If significant numbers of adult beetles are observed feeding and laying eggs in unprotected sweet corn plantings at emergence, this may justify a post-emergence insecticide treatment. Once the eggs have hatched and the larvae have penetrated into the corn seedlings, they are very difficult to control.
    - cutworm
        - Historically, cutworms are a problem in early, spring-seeded fields.
        - Carbofuran (Furadan 15G) may be applied at planting at a rate of 1.20 pounds active ingredient per 1,000 row feet to provide a 4 –6 week control.
    - grasshoppers
        - Carbofuran may be applied at a rate of 0.125 to 0.250 pound active ingredient per acre.
        - Carbofuran may not be applied more than 4 times per season.
    - seed corn maggot
        - Carbofuran (Furadan 15G) may be applied at planting as an in-furrow treatment at a rate of 1.20 pounds active ingredient per 1,000 row feet to provide a 4 to 6 week control.
        - Carbofuran may not be applied more than once per season.
        - Seed corn maggot is typically abundant during or following a wet cycle, primarily in the spring. Infestation is most common in fields containing a high amount of residue from a previous crop or where manure has been spread.
    - wireworm
        - Carbofuran (Furadan 15G) may be applied at planting at a rate of 1.20 pounds active ingredient per 1,000 row feet. Applications may be made as a covered band or in-furrow.

- Damage is more common in spring planted crops where the soil has a high organic content. Wireworms do not significantly damage older plants.

CRANBERRY:

- Carbofuran is no longer used in Washington State to control root weevil (including black vine weevil and strawberry root weevil).

OAT:

- In Washington State, oats are produced primarily as a cover crop, for stand establishment in alfalfa, for hay, and for export to Japan.
- Washington State had 35,000 acres in oat production in 2002 with 10,000 acres harvested for grain. Oat is grown in many Washington counties, but concentrated production is located in Klickitat County (eastern Washington).
- Because of the low economic return on small grains, chemicals are not used extensively for insect control. Simple economics precludes many growers' use of seed or foliar treatments. Insecticide applications are often limited to outbreak conditions or in response to threats of insect-vectored diseases.
- If used for insect pest control in oat fields, carbofuran should be applied prior to heading and not applied more than two times per growing season.
- Forage treated with carbofuran may not be fed to livestock.
- Carbofuran (Furadan 4F) may be applied to control the following alfalfa insect pests:
  - ➨ barley thrips
    - Treat with carbofuran (Furadan 4F) at a rate of 0.125 to 0.25 pounds active ingredient per acre.
  - ➨ cereal leaf beetle
    - These insects are easily controlled by parasitoids.
    - Carbofuran (Furadan 4F) may be applied at a rate of 0.25 pounds active ingredient per acre when insects appear.
  - ➨ cutworm and armyworm
    - Carbofuran (Furadan 4F) may be applied at a rate of 0.125 to 0.25 pounds active ingredient per acre.
    - Damage often occurs in the early spring to young plants.
  - ➨ grasshopper
    - Carbofuran (Furadan 4F) may be applied at a rate of 0.125 to 0.25 pounds active ingredient per acre.

POTATO (IRISH):

- The majority of potato acreage is located in eastern Washington in the following counties: Franklin (37,000 acres), Grant (36,500 acres), Benton (30,000 acres), Adams (27,000 acres), Walla Walla (12,000 acres), Lincoln (4,500 acres), Yakima (2,300 acres), Klickitat (1,700 acres) and Kittitas (500 acres). Most of the eastern Washington potato production contracted for processing (chipping, fries, etc.)
- The principal potato producing counties in western Washington are Skagit (9,000 acres) and Whatcom (2,600 acres). Potatoes production in western Washington (approximately 12,000 acres) is for the fresh market.

- Potatoes are usually grown in a four-year rotation (one in four) with wheat, alfalfa, and corn.
- Recent changes in insecticide use and new products coming on the market has left most carbofuran use as foliar applications for control of Colorado potato beetle and flea beetle. Applications to control these pests would occur during the main growing season – May through August/September.
    - ➨ Colorado potato beetle (CPB)
        - Carbofuran (Furadan 4F – WA Special Local Need #WA-91006) may be applied as a foliar treatment from planting to 4-inch rosette at a rate of 3 pounds active ingredient per acre.
        - Carbofuran (Furadan 4F) may also be applied as a foliar treatment at a rate of 0.5 to 1 pound active ingredient per acre.
        - CPB can cause complete defoliation and nearly complete crop loss if allowed to reproduce unchecked. Most beetle populations in the Pacific Northwest are still susceptible to almost all labeled products. However, CPB has the potential to develop very high levels of resistance to almost all classes of chemicals. Growers should use care in rotation of chemical modes of action. This is critical to slow the rate of development of insecticide resistance.
    - ➨ flea beetle
        - Carbofuran (Furadan 4F – WA Special Local Need #WA-91006) may be applied as a foliar treatment from planting to 4-inch rosette at a rate of 3 pounds active ingredient per acre.
        - Carbofuran (Furadan 4F) may also be applied as a foliar treatment at a rate of 0.5 to 1 pound active ingredient per acre.
- Carbofuran (Furadan 15G) may be used to control to control the following potato insect pests:
    - ➨ aphid
        - Carbofuran (Furadan 4F – WA Special Local Need #WA-91006)
    - ➨ leaf hopper
    - ➨ wireworm (suppression only)
- Carbofuran may not be applied by chemigation.

NOTE: Insecticides used to control pests in potatoes are rotated for resistance management. Some fields may not have any insecticides applied, for example, potatoes grown for the fresh pack market. Other fields may receive only at-plant applications while fields producing long-season storage potatoes may receive 6 - 8 foliar applications during a 4 - 5 month growing season.

SPINACH, SEED:

- There are approximately 1,500 acres of spinach seed grown in western Washington State. Skagit County alone produces over 1,000 acres of spinach seed.
- Spinach seed is the most economically important small-seeded vegetable crop seed grown in western Washington.
- Spinach seed is an annual crop direct-seeded between late March and mid-May. It is harvested in July and August.
- Carbofuran may be applied at as a seed-furrow treatment at planting to control the following spinach seed insect pests:
    - ➨ European cranefly ("leather jackets")
        - Carbofuran (Furadan 15G) may be applied at a rate of 0.063 pounds active ingredient per 1,000 linear row feet.
        - No more than 1.95 pounds active ingredient per acre may be applied.
        - European cranefly is particularly damaging to seeding vegetables.
    - ➨ Springtail
        - Carbofuran (Furadan 15G – WA Special Local Needs #WA-860012) may be applied at a rate of 0.063 pounds active ingredient per 1,000 linear row feet.
        - No more than 1.95 pounds active ingredient per acre may be applied.
        - Springtails feed on germinating seeds or roots of small plants. Infestation is usually localized.
- Treated cops, crop residues or seed millings may not be used for food or feed.

WHEAT:

- Washington State produced 2.42 million acres of wheat (spring & winter) in 2002. Spring wheat acreage was 620,000 acres and winter wheat acreage was 1.8 million acres. Common white winter wheat makes up 61 percent of all wheat grown in Washington State.
- Whitman County is the largest wheat producer in Washington State with 493,500 acres planted in 2002.
- The southeast area of Washington State (Asotin, Columbia, Garfield, Walla Walla and Whitman counties) produces the majority of wheat with 919,600 acres planted in 2002.
- The east central area of Washington State (Adams, Douglas, Franklin and Grant counties) has dropped to second in wheat production with 744,900 acres planted in 2002.
- Generally one application of a given pesticide is made per year. Planting dates vary throughout the year, depending on the environmental influence and geographic location of the field. This creates a wide fluctuation in timing of pesticide applications. The timing provided in this summary represents the time of year when these pesticides may be applied. Herbicides are always used in a wheat cropping system.
  NOTE: The crop table on page 1 lists acreage for both winter and spring wheat produced in Washington State.
- Because of the low economic return on small grains, chemicals are not used extensively for insect control. Economics precludes many growers' use of seed or foliar treatments. Insecticide applications are often limited to outbreak conditions or in response to threats of insect-vectored diseases.

- If used for insect pest control in wheat, carbofuran should be applied prior to heading and not applied more than two times per growing season.
- Carbofuran (Furadan 4F) may be applied to control the following alfalfa insect pests:
    - barley thrips
        - Treat with carbofuran (Furadan 4F) at a rate of 0.125 to 0.25 pounds active ingredient per acre.
    - cereal leaf beetle
        - These insects are easily controlled by parasitoids therefore carbofuran is rarely used.
        - Carbofuran (Furadan 4F) may be applied at a rate of 0.25 pounds active ingredient per acre when insects appear.
    - cutworm and armyworm
        - Carbofuran (Furadan 4F) may be applied at a rate of 0.125 to 0.25 pounds active ingredient per acre.
    - grasshopper
        - Carbofuran (Furadan 4F) may be applied at a rate of 0.125 to 0.25 pounds active ingredient per acre.
    - Russian wheat aphid
        - Carbofuradan (Furadan 4F) may be applied at 0.167 to 0.25 pound active ingredient per acre plus methyl parathion at a rate of 0.25 to 0.75 pound active ingredient per acre.
        - Carbofuran should be applied before heads emerge from boot.
        - Russian wheat aphids secrete a toxin that causes leaf rolling and white (warm weather) or purple (cool weather) streaking on the leaves. Whole fields can be lost if infestations are not detected and controlled early.

PRODUCT NAMES & LABELED CROP:

PRODUCT NAME	CROP
FURADAN 15G INSECTICIDE/NEMATICIDE	CRANBERRY
FURADAN 15G INSECTICIDE/NEMATICIDE	FOREST NURSERY/SEED ORCHARD
FURADAN 15G (SLN: SPINACH SEED CROP)	SPINACH SEED CROP
FURADAN 4F (SLN: POTATOES)	POTATO
FURADAN 4F INSECTICIDE/NEMATICIDE	ALFALFA
FURADAN 4F INSECTICIDE/NEMATICIDE	BARLEY
FURADAN 4F INSECTICIDE/NEMATICIDE	CORN (FIELD)
FURADAN 4F INSECTICIDE/NEMATICIDE	CORN (SWEET)
FURADAN 4F INSECTICIDE/NEMATICIDE	FOREST PLANTATION
FURADAN 4F INSECTICIDE/NEMATICIDE	NURSERY
FURADAN 4F INSECTICIDE/NEMATICIDE	OAT
FURADAN 4F INSECTICIDE/NEMATICIDE	ORNAMENTAL
FURADAN 4F INSECTICIDE/NEMATICIDE	POPCORN
FURADAN 4F INSECTICIDE/NEMATICIDE	POTATO
FURADAN 4F INSECTICIDE/NEMATICIDE	SOYBEAN
FURADAN 4F INSECTICIDE/NEMATICIDE	SUNFLOWER
FURADAN 4F INSECTICIDE/NEMATICIDE	WHEAT

References:

2003 Farm Chemicals Handbook, Meister Pro Information Resources
2003 Pacific Northwest Insect Management Handbook, Extension Services of OSU, WSU, and UI

Schreiber, Alan and Laurie Ritchie. "Washington Minor Crops." 1994. Food and Environmental Quality Lab, Washington State University.

2004 Washington State registered pesticide labels

CDMS Label Database: http://www.cdms.net/manuf/manuf.aspwebsite
ExToxNet Pesticide Information Profiles: http://ace.orst.edu/info/extoxnet/pips/pips.html
Greenbook, Chemical & Pharmaceutical Press Inc.: http://www.greenbook.net/
National Agricultural Statistics Service – Agricultural Chemical Use Database: http://www.pestmanagement.info/nass/
National Pesticide Use Database: http://www.ncfap.org/database/default.php
Pesticide Action Network Pesticide Database: http://www.pesticideinfo.org/index.html
U.S. Department of Agriculture National Agricultural Statistics Service: http://www.usda.gov/nass/
U.S. Department of Agriculture Pest Management Centers Crop Profiles: http://www.pmcenters.org/cropprofiles/
U.S. Department of Agriculture Crop Profiles: http://pestdata.ncsu.edu/cropprofiles/
Washington 2003 Annual Bulletin, Washington Agricultural Statistics Service , http://www.nass.usda.gov/wa/annual03/content3.htm
Washington State Pesticide Management Practices: http://www.tricity.wsu.edu/~cdaniels/wapiap.html
WSU PICOL Label/Crop Profile Database: http://picol.cahe.wsu.edu/LabelTolerance.html
WSU Pesticide Notification Network, http://ext.wsu.edu/pnn/user/blank.php

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