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APPENDIX 1: SOURCES & RESOURCES

This section lists manufacturers of equipment and products and sources of information which can facilitate your operations. We have tried to make this manual as comprehensive as possible, but invariably we may have left out some key contacts. Please contact us with any omissions; for inclusion in future versions. References used in the production of this manual are listed in Appendix 4.

As always, if a name of a supplier appears in our list, it should not be considered as an endorsement by Valent BioSciences. Rather, it is an industry-recognized supplier of the product or service.

Businesses move or merge, mail and electronic addresses change, new area codes appear and websites may change. At time of writing, every effort has been made to have up-to-date information. If you find that some of the information is outdated, please contact Valent BioSciences so we can update the information for the next release of the Manual.

ATOMIZERS

Hydraulic:

TeeJet Nozzles

Spraying Systems Company
200 W. North Ave.
Glendale Heights, Illinois USA 60139
Tel: 1 630 665-5000
Fax: 1 630 260-0842
Website: www.spray.com

Rotary:

Micron Sprayers (Micronair)

Bromyard Industrial Estate,
Bromyard, Herefordshire,
HR7 4HS, U.K.
Tel: +44 (0) 1885 482397
Fax: +44 (0) 1885 483043
Micronair
Bembridge Fort
Sandown, Isle of Wight, PO36 8QY
England
Tel: +44 1983 406111
Fax: +44 1983 404461



Photo Courtesy of the Micron Group

For local distributors, and further information about rotary atomizers and additional application equipment, please consult their website.

Website: <http://www.microngroup.com>

FLOW METERS

Crophawk flow monitors and data recording systems

Onboard Systems
13915 NW 3rd Court
Vancouver, WA 98685 USA
Toll free: 800-275-0883
Tel: 360 546 3072

Fax: 360 546 3073

Website: <https://www.onboardsystems.com>

Micronair flow monitoring turbines and recording systems: See Micronair, page 67.

DIFFERENTIAL GPS EQUIPMENT

MANUFACTURERS

Most DGPS manufacturers now provide a complete suite of aerial application control equipment, including DGPS linked flow controls, auto ON-OFF, granular metering gates, and fleet management software. Some companies, such as AG-NAV even provide spray optimization software and onboard meteorological systems.

AG-NAV

30 Churchill Drive

Barrie, Ontario, Canada L4N 8Z5

Toll free: 1-800-99-AG-NAV (24-628)

Tel: 905-764-3744

Fax: 905-764-3792

Website: <https://www.agnav.com>

DynaNav Systems Inc

730-11731 Baynes Road

Pitt Meadows Airport

Pitt Meadows, British Columbia

Canada V3Y 2B3

Toll free: 1 877 333 9626

Tel: 1 604 4645 009

Fax: 1 604 465 0084

Website: <http://www.dynanav.com>

SATLOC

Transland LLC

1206 Hatton Rd., Suite A,

Wichita Falls, Texas 76302

Tel: 1 940 687 1100

Fax: 1 940 687 1941

Website: <http://www.satloc.com/>

TracMap

15 East Gabilan St.,

Salinas CA 93901 USA

Toll Free: 1 888 656 3165

Tel: 1 831 800 6768

Website: www.tracmap.com

DROPLET ASSESSMENT TECHNOLOGIES

REMSpC's Stainalysis is available online free of charge.

To download the software, visit

<http://www.remspc.com/Stainalysis/>

COLOR TRACERS & DYES

Several manufacturers now produce dyestuff in powder or liquid formats specifically for spray pattern testing. Remember, when using dye to color the spray to facilitate droplet scanning and assessment, use a high rate of dye to ensure adequate coloring of the small droplets. Otherwise these small but important droplets will not be dark enough to provide a visible contrast for image detection and analysis by the scanning devices.

Powder dyes are generally less expensive than liquid dyes but must be thoroughly mixed with water before adding to the spray tank.

Liquid dyes are easier to use but may have some shipping restrictions.

Dyestuffs traditionally used for these purposes are no longer in production or are now restricted to industrial uses only. It is recommended that you consult with the manufacturers about your specific needs.

BASF Chemical:

Turf Mark® 10059 Spray Indicator

Website: <https://betterturf.basf.us>

Available from numerous online suppliers

Milliken Chemical:

Blazon® Turf Dye
 920 Milliken Rd.,
 Spartanburg South Carolina,
 USA 29303
 Toll free: 1 800 910 5592
 Fax: 866 503 2430
 Website: <https://chemical.milliken.com>

Sensient Colors:

SensiPro™ Application Colorant
 Sensient Technologies Corporation
 World Headquarters
 777 East Wisconsin Avenue
 Milwaukee, Wisconsin 53202-5304 USA
 Tel: 1 414-271-6755
 Website: www.sensientindustrial.com

Blazon Turf Dye

Milliken Chemical: North America, Europe

Sensi-Pro, powder & liquid

Sensient Colors, Global

Turf Mark, various powder & liquid

BASF Chemical: Global

SPRAY DEPOSIT CARDS & PAPERS***Kromekote Cards***

Kromekote® paper has been used for many years by printers for brochures and calendars etc. It is recommended to use card stock that is glossy on both sides to prevent card warping in moist environments; this will be referred to as Kromekote C/2S.

Since spread factors will vary depending upon the quality of 'Kromekote' cardstock used, it is preferred to use only one supplier for spray cards, or at least determine the brand name and

specifications of the cardstock that is used so that you will have consistency in your card stock.

Many print shops carry coated card stock, and will be able to cut it to size. For typical Btk spray deposit analysis, 2" x 3" to 3 X 5" (5 cm X 7.5 cm to 7.5 cm to 12 cm) Kromekote cards are an ideal size.

Request "coated card stock, coated two sides."

Water Sensitive Cards

Manufactured by Syngenta and currently available from numerous sources, including online discount suppliers. A universal supplier is TeeJet Technologies, a business division of Spraying Systems. Also numerous local pesticide equipment dealers and related retail outlets also carry a supply of water sensitive papers. (Gempler's, Sprayer Depot, etc.)

TeeJet Technologies,
 200 W. North Ave
 Glendale Heights, Illinois
 USA 60139
 Tel: 1 630 665 5000
 Fax: 1 630 665 529
 Website: www.Teejet.com (Search Tech Support> Nozzle Technical Information>Calibration/ Adjustment Accessories)

Numerous local pesticide equipment dealers and related retail outlets also carry a supply of water sensitive papers. (Gempler's, Sprayer Depot, etc.)

PUMP SEALS

The following companies are major manufacturers of mechanical pump seals; these suppliers can direct you to distributors for service in your area.

FlowServe®, Inc.
 5215 N. O'Conner Blvd., Ste 2300
 Irving Texas USA 75049
 Tel: 1 972 443 6500
 Fax: 1 972 443 6800
 Website: www.flowserve.com

APPENDIX 1: SOURCES & RESOURCES

John Crane® Inc.
227 West Munroe St.
Suite 1800
Chicago, Illinois USA 60606
Tel: 1 312 605 7882
Website: www.johncrane.com

US Seal Manufacturing™
400 Apgar Dr #A,
Somerset, New Jersey
USA 08873
Toll free: 1 800 243 5489
Tel: 1 732 667-1100
Fax 1 877 849 7325
Website: www.ussealmfg.com

SPILL NOTIFICATION

Chemtrec Spill Notification Network (800) 424-9300

Chemtrec (Chemical Transportation Emergency Center) is a public service of the Manufacturing Chemist Association to deal with chemical transportation emergencies.

In the event of chemical transportation emergency, Chemtrec provides immediate advice for those at the scene of emergencies, then promptly contacts the shipper of the chemicals for more detailed assistance and appropriate follow-up.

APPENDIX 2: PRODUCT CONTAINERS AND DIMENSIONS

**DRUM**

Outside Diameter:	23 ¼"
Outside Height:	34 ¾"
Color:	Blue
Body:	High molecular weight polyethylene with ultraviolet light protection.

**MINI BULK**

Capacity:	275 gallons 1000 litres
Length:	47 ¼"
Width:	40"
Height:	45 ¾"
Color:	White
Body:	Blow molded high density polyethylene
Cage:	¼" solid rod steel
Filling port:	6"
Discharge Valve:	2" ball style valve. NPT threading
Stacking:	2 high

**BULK TANKER**

Capacity:	Up to 7,000 gallons
Tank Length:	43'
Tank Height:	12'
Unloading:	Center or rear

APPENDIX 3: INSECT PESTS CONTROLLED WITH FORAY BTK

Foray Biological Insecticide (Btk) is registered for use on a wide variety of major and minor forest Lepidoptera pests in many countries around the world. Table 1 shows a list of the most common forest Lepidoptera against which Foray has been successfully used.

Table 1. Most common pests Foray is used to control

COMMON NAME	LATIN NAME	MAIN HOST(S)
Eastern Spruce Budworm	<i>Choristenaurea fumiferana</i>	Balsam Fir (<i>Abies balsamea</i>), White Spruce, Black Spruce, Red Spruce (<i>Picea</i> spp.)
Western Spruce Budworm	<i>Choristenaurea occidentalis</i>	Primarily Douglas-fir (<i>Pseudotsuga menziesii</i> var. <i>glauca</i>), true firs (<i>Pseudotsuga</i> spp.), Larch (<i>Larix</i> sp.), Spruce (<i>Picea</i> spp.)
Jack Pine Budworm	<i>Choristenaurea pinus pinus</i>	Jack Pine (<i>Pinus banksiana</i>), Scots Pine (<i>Pinus sylvestris</i>)
Pine Moth (or Pine Lappet Moth)	<i>Dendrolimus pini</i>	Scots Pine (<i>Pinus sylvestris</i>), occasionally other conifers such as Fir (<i>Abies</i>), Spruce (<i>Picea</i>) and Larch (<i>Larix</i>)
Douglas-Fir Tussock Moth	<i>Orgyia pseudotsugata</i>	Douglas-Fir (<i>Pseudotsuga menziesii</i>), Grand Fir (<i>Abies grandis</i>), Subalpine Fir (<i>Abies lasiocarpa</i>), White Fir (<i>Abies concolor</i>), and less frequently on Ponderosa pine (<i>Pinus ponderosa</i>), Eastern Larch (<i>Larix occidentalis</i>)
Gypsy Moth	<i>Lymantria dispar</i>	Most species of Oak (<i>Quercus</i>), as well as Apple (<i>Malus</i>), Basswood (<i>Tilia</i>), Willow (<i>Salix</i>), and many other species of trees and shrubs. It is estimated that Gypsy Moth will feed upon over 500 species of trees shrubs and vines.
Eastern Hemlock Looper	<i>Lambdina fiscellaria fiscellaria</i>	Balsam fir (<i>Abies balsamea</i>), Hemlock (<i>Tsuga canadensis</i>) and occasionally Spruce (<i>Picea</i>), and Larch (<i>Larix</i>)

APPENDIX 3: INSECT PESTS CONTROLLED WITH FORAY BTK

COMMON NAME	LATIN NAME	MAIN HOST(S)
Western Hemlock Looper	<i>Lambdina fiscellaria lugubrosia</i>	Primarily Western Hemlock (<i>Tsuga heterophylla</i>), Sitka Spruce (<i>Picea sitchensis</i>), Pacific Silver fir (<i>Abies amabilis</i>), Western Red Cedar (<i>Thuja plicata</i>) and Douglas-fir (<i>Pseudotsuga menziesii</i> var. <i>glauca</i>)
Nun Moth	<i>Lymantria monacha</i>	Spruce (<i>Picea</i>), Pine (<i>Pinus</i>). Fir (<i>Abies</i>), Larch (<i>Larix</i>) Oak (<i>Quercus</i>), Maple (<i>Acer</i>), Birch (<i>Betula</i>), Ash (<i>Fraxinus</i>) and sometimes, fruit trees
Pine Processionary Moth	<i>Thaumetopoea pityocampa</i>	Pine (<i>Pinus</i> sp.), Cedar (<i>Cedrus</i> sp.) and occasionally European Larch (<i>Larix decidua</i>)
Forest Tent Caterpillar	<i>Malacosoma disstria</i>	Sugar Maple (<i>Acer saccharum</i>), Red Oak (<i>Quercus rubra</i>), Trembling Aspen (<i>Populus tremuloides</i>), White Ash (<i>Fraxinus americanus</i>), White Birch (<i>Betula papyrifera</i>), fruit trees and others

Foray also controls other lepidopteran defoliators. For formulation, region-specific labels, and application recommendations for other forest Lepidoptera, contact your local Valent BioSciences Forest Health representative.

APPENDIX 4: REFERENCES

Otvos, I.S. and S. Vanderveen. 1993. Environmental report and current status of *Bacillus thuringiensis* var. *kurstaki* use for control of forest and agricultural insect pests. Forestry Canada and Provincof British Columbia, Ministry of Forests; Victoria, B.C. 81 pp.

Gypsy Moth Management in the United States: A Cooperative Approach. Final Supplementary Environmental Impact Statement., Vols 1-4. United States Department of Agriculture Forest Service ; Animal and Plant Health Inspection Service. Newtown Square, PA NA-MB-01-12 August 2012

(All volumes can be viewed and downloaded at <http://na.fs.fed.us/pubs/detail.cfm?id=5251>)

Bacillus thuringiensis: Biology, Ecology and Safety. Glare, T and O'Callaghan, M. John Wiley & Sons Chichester UK. 2000 ISBN 0-471-49630-8

World Health Organization Bacillus Thuringiensis Environmental Health Criteria #217 Geneva 1999.

ISBN 92 4 157217 5

Reardon, R., N. Dubois, and W. McLane. 1994 *Bacillus thuringiensis* for managing Gypsy Moth: A review. USDA Forest Service, National Center of Forest Health Management, Morgantown, W.V. 32 pp. Gypsy Moth Management in the United States: a cooperative approach. Environmental Impact Statement, Vols I-V, USDA, Forest Service and APHIS.

Kreutzweiser, D.P., S.S. Capell, and D.R. Thomas.

1994. Canadian Journal of Forest Research 24: 2041-2049 Aquatic insect responses to *Bacillus thuringiensis* var. *kurstaki* in a forest stream. Phero Tech Inc. and Deloitte & Touche. 1994. A risk assessment of European Gypsy Moth in British Columbia. Report prepared for the B.C. Ministry of Forests, Agriculture Canada, and the B.C. Ministry of Agriculture, Fish and Food. 73 pp. Reardon, R. and A.E. Hajek. 1995. Gypsy Moth News 39: 3-4 Entomophaga maimaiga in North America: A review.

Richardson, J.S. and C.J. Perrin. 1994. Canadian Journal of Fisheries and Aquatic Science 51: 1037-1045 Effects of the bacterial insecticide *Bacillus thuringiensis* var. *kurstaki* (Btk) on a stream benthic community.

Health Risk Assessment of the Proposed 1997-1998 Control Programme for the White-Spotted Tussock Moth in the Eastern Suburbs of Auckland, NZ. A report to the Ministry of Forestry. Public Health Protection Service, Auckland Healthcare Services Limited. September, 1997, 79pp.

Reardon, Richard C. 1996. Appalachian Integrated Pest Management Gypsy Moth Project: Summary and Bibliography. USDA Forest Service. Forest Health Technology Enterprise Team. NA-TP-05-96. 47pp.

D.R. Miller, R.C. Reardon and M.L. McManus (1995) An Atmospheric Primer for Aerial Spraying of Forests USDA Forest Service-Pub FHM-NC-07-95.

Van Frankenhuizen, K., N. Payne, L. Cadogan, B. Mickle and A. Robinson (1996) Effect of droplet size spectrum and application rate on field efficacy of *Bacillus thuringiensis*. Report submitted to the Spray Efficacy Research Group.

N.R. Dubois, K. Mierzejewski, R. C. Reardon, W.

McLane, and J.J. Witcosky (1994) J. Environ. Sci. Health, B29(4), 679-695 *Bacillus thuringiensis* Field Applications: Effect of Nozzle Type, Drop Size, and Application Timing on Efficacy Against Gypsy Moth.

Dubois, Normand R., Richard C. Reardon and Karl Mierzejewski (1993) Field Efficacy and Deposit Analysis of *Bacillus thuringiensis*, Foray 48B, against Gypsy Moth. Journal Econ. Entomol. 86 (1) 27-33.

Maczuga, Steven A. and Karl J. Mierzejewski (1995) Journal Econ. Entomol. 88 (5) 1376-1379 Droplet Size and Density Effects of *Bacillus thuringiensis kurstaki* on Gypsy Moth.

Other information sources include internal research reports performed by and for Valent BioSciences and manufacturer literature.

APPENDIX 5: FORAY TOXICOLOGY PROFILE

Foray is a selective, microbial insecticide that effectively protects forests throughout the world from defoliating lepidoptera larvae, including Gypsy Moths, spruce budworms, and other leaf-eating caterpillars.

The active ingredient in Foray, *Bacillus thuringiensis* spp. *kurstaki*, or Btk, is a naturally occurring bacterium commonly found on foliage and in soil. Unlike chemicals, Foray works by quickly paralyzing the digestive system of the pest after the active ingredient, Btk, is eaten, causing the insects to stop feeding immediately and die within a few days. Foray formulations are used to economically and effectively control a wide variety of damaging forest pests.

Toxicity Studies

Oral Toxicity Studies

No oral toxicity has been demonstrated in rats given Foray at 5000 milligrams per kilogram of animal body weight. In a separate study, a dose of 108 Btk Colony Forming Units (CFU: a measure of viable spore concentration) did not cause any toxic or pathogenic effects.

Inhalation Toxicity Studies

No toxic effects were observed in rats exposed to approximately 7 milligrams of Foray per liter of air for 4 hours.

The low pathogenic potential of Btk was demonstrated when rats were exposed to a concentration of approximately 108 CFU of Btk per liter of air for 4 hours. No overt symptoms of toxicity have been reported by individuals during the use of this or other Btk containing products.

Dermal Toxicity Studies

No toxic effects were observed when Foray at 2.5 gram per kilogram of body weight was applied as a single dose exposure to the skin of rats.

Dermal Irritation Studies

Very mild, temporary dermal irritation was seen when Foray was applied to the skin of rabbits for 4 hours. All signs of irritation cleared in all animals within 2 days after application.

Eye Irritation Studies

Foray was moderately irritating in a rabbit eye irritation test. No apparent redness or other ocular finding remained 7 days after the application of 109 CFU of Btk to the eye.

I.V. Injection Studies

A single I.V. dose of 108 CFU of Btk was not toxic to rats. Btk was not able to multiply in the tissue as examined periodically during the 167 days of the study.

Freshwater Fish Toxicity Studies

No toxicity or pathogenicity was shown in rainbow trout exposed to Btk for 31 days at a dose of 1010 CFU per liter of water and in the diet at 1010 CFU per gram of feed.

Freshwater Aquatic Invertebrate Toxicity Studies

Btk had no observed effect on *Daphnia magna* exposed to over 108 CFU of Btk per liter of water for 21 days.

Bird Toxicity Studies

No toxicity or pathogenicity was seen in bobwhite quail after they were orally dosed with Btk at 1011 CFU per kilogram body weight each day for 5 consecutive days.

No toxicity or pathogenicity was seen in mallard ducks orally dosed with Btk at 1011 CFU per kilogram body weight each day for 5 consecutive days.

Honey Bee Toxicity Studies

The LC50 for Btk on honey bees was determined to be 108 CFU per gram of feed and the no-observed-effect-concentration was determined to be 106 CFU per gram of feed.

Non-Target Insect Toxicity Studies

The LC50 of Btk on green lacewing larvae was greater than 108 CFU per gram of feed and the no-observed-effect-concentration was 108 CFU per gram of feed.

The LC50 of Btk on ladybird beetles was greater than 108 CFU per gram of feed and the no-observed-effect-concentration level for pathogenicity was 106 CFU per gram of feed.

The LC50 of Btk on a species of parasitic wasps was greater than 108 CFU per gram of feed and the no-observed-effect-concentration was 108 CFU per gram of feed.

Residues

As Foray has been shown to be non-toxic to non-target organisms, residues and spray drift are not considered hazardous.

APPENDIX 6: VALENT BIOSCIENCES FOREST HEALTH CONTACT INFORMATION

Valent BioSciences LLC
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Libertyville, IL 60048
U.S.A.

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1-800-323-9597
foresthealth@valentbiosciences.com