

# Understanding Adjuvants

**Trends in chemical usage and crop production are making their marks on global adjuvant use.**

One of the most critical factors in maximizing profits from modern agronomic practices is getting full value from crop protection and crop production products. This involves proper selection for the intended purpose, following label directions, correctly calibrating spray equipment, and properly timing the spray application.

When these variables come together, spray application efficiency — or simply peak product performance — is usually the result. However, spray application efficiency involves more than mixing and spraying — even under perfect conditions. Often, adjuvants are needed to help end users capture full value from their spray applications and/or offset potential problems.

By definition, adjuvants are materials that are added to a tank mix for one or all of the following reasons:

- **To enhance the activity (performance) of a pesticide.**
- **To minimize or eliminate spray application problems by modifying the physical characteristics of a spray mixture.**
- **To meet legal application requirements.**

In recent years, adjuvant technology has made significant advances. These products perform a wide variety of functions that act individually — or in conjunction — to improve the performance of a spray application. Some of these functions include deposition, spreading, sticking, compatibility, buffering, dispersing, emulsifying, reducing foam, reducing evaporation, minimizing spray drift, and many others.

While adjuvant technology has advanced to the point where many of these functions have been incorporated into fewer, higher value products, there is no “magic bullet” or single adjuvant product that can perform all of these needed functions. Thus, a wide range of products, all with specific — and increasingly, multiple functions — are included under the spray adjuvant “umbrella.” In many cases, a combination of compatible adjuvants is needed to offset or correct potential spray application problems.

Currently, more than 200 EPA-registered pesticides list specific label recommendations for the use of one or more adjuvants. These recommendations include various types of adjuvants that will increase pesticide activity and/or help avoid crop injury.

Thus, to protect or enhance your pesticide investment with an adjuvant — and to comply with label directions — it is important to:

- 1) select the right type;**
- 2) select the best product within the correct type; and**
- 3) use the correct rate.**

That can be confusing with the overwhelming number of adjuvants available today. This is due in part, to the fact that spray adjuvants are not regulated by the Environmental Protection Agency (EPA), and there are few barriers to market entry.

Standards for high quality adjuvants are the combined efforts of member companies of the Adjuvants and Inerts Committee (AIC) of the Chemical Producers and Distributors Association (CPDA). The committee's purpose is to help set minimum standards for the adjuvant industry. The committee is doing this in conjunction with the American Society for Testing and Materials (ASTM) and other science and industry organizations. If approved, acceptance of the standards can be noted by a seal to be displayed on the packaging of adjuvant materials that are in compliance with the standards.

For spray application efficiency, the AIC adjuvant standards represent a new era. End users can now compare product quality and utility by standards that have been set forth scientifically and impartially.

This progressive move is a resounding confirmation of the recognized value of adjuvants by the crop protection industry — now and in the future.

As technology advances — whether it's new, innovative chemistry, biological pesticides, or genetically engineering specific traits into seed — adjuvants will continue to play a major role in agriculture. That's because as agricultural technology advances, inputs should be protected. When adjuvants are used as a part of the input “protection” or “enhancement” package, questions about the integrity of the adjuvant formulation should not be a concern.

## Trends In Adjuvant Markets

Regarding the U.S. market, there appears to have been a recent shift from oil-based adjuvants back to nonionic surfactant-based ones. These two types still comprise the largest share of the market, but fertilizers and fertilizer-based adjuvants and deposition/drift adjuvants have increased in share. Water conditioners and adjuvants for use in non-ag segments of the market have also increased. Paraffin oil-based crop oil concentrates and methylated seed oils blended with high-percentage surfactant systems have declined.

Adjuvants with spreading/sticking functions have remained stable or declined due to the small size of the U.S. fungicide market, revised labeling of agrochemical fungicide active ingredients (ais), or the increased liabilities associated with their use on high-value crops.

Another change that has impacted the adjuvant market is the continuing shift from patented ag-chem active ingredients to generic off-patent chemistries. The United States is now experiencing the rapid shifts Europe experienced in the 1990s. Major products which will have patent protection expiring within the next 5 years are closely watched, and their market introductions anticipated. The branded and generic versions of these EPA registered agrochemicals reveal many adjuvant recommendations.

The largest adjuvant markets will generally follow the uses of post-applied herbicides, but adjuvant markets are developing wherever there are foliage applications of insecticides, fungicides, and plant growth regulators.

# Crop Protection Dictionary

The dictionary of pesticides and pesticide-related products

- 1300 Orthene\* TR** — see Acephate.  
**1600 X-clude\*** — see Piperonyl Butoxide; Pyrethrins.  
**180 Cleaner\*** — see Fruit Cleaner/Wash.  
**240\*** — see 2,4-D.  
**26/36\*** — see Iprodione; Thiophanate-methyl.  
**3,4-DCPA** — see Propanil.  
**3336\*** — see Thiophanate-methyl.  
**3336 Plus\*** — see Thiophanate-methyl.  
**4-Speed\*** — see 2,4-D; Dicamba; Mecoprop-P; Pyraflufen-ethyl.  
**4-Speed\* XT** — see 2,4-D; Dicamba; Pyraflufen-ethyl; Triclopyr.  
**A & V 70 Plus\* algaecide (copper triethanolamine complex)** — Discontinued 1995 by A & V, Inc.  
**A & V 90 Plus\* herbicide (copper ethanolamine complex)** — Discontinued 1999 by A & V, Inc.  
**A-Maize-N\*** — see Corn Gluten Meal; Soybean Oil.  
**A-One\*** — see Imidacloprid.  
**A7\* fumigant (metam-sodium)** — Discontinued 1984 by Procidia.  
**Aatank\*** — see Carbosulfan.  
**Access Penetrator\* adjuvant (d-limonene)** — Discontinued 1998 by Corbett Chemical Co.  
**AAPCO**  
 see Association of American Pesticide Control Officials  
**AAPROTURON\*** — see Isoproturon.  
**AASTAR\* insecticide (flucythrinate + phorate)** — Discontinued 1992 by American Cyanamid Co.  
**Aaterra\* fungicide (etridiazole)** — Discontinued 2000 by Uniroyal Chemical/Crompton Corp.  
**Aatram\* herbicide (atrazine + propachlor)** — Discontinued by Ciba-Geigy.  
**AAtrex\*** — see Atrazine.  
**AAtrex\* Nine-0** — see Atrazine.  
**Aazomate\* acaricide (benzoximate)** — Discontinued 2007 by Nippon Soda Co., Ltd.  
**ABA** — see S-Abscisic Acid.  
**Abacin\*** — see Abamectin.  
**Abamcol\*** — see Abamectin.  
**Abamec\* insecticide (abamectin)** — Discontinued 2000 by Pazchem Ltd.

## Abamectin



### Action/Use

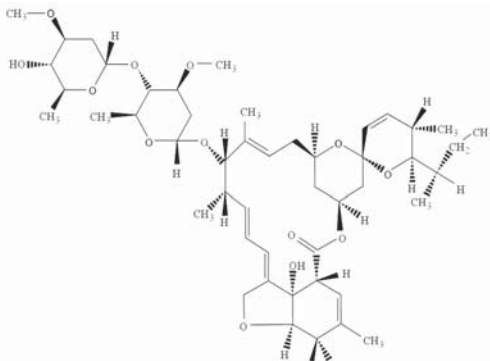
**ACTION:** Acaricide/Miticide, Insecticide, Seed Treatment/Protectant.  
**USE:** Controls Colorado potato beetles, fire ants, leafminers, mites, and pinworms on citrus, fruits, mint, nuts, vegetables. Sirocco\* controls thrips and mites and may be used in greenhouse, shadehouses, nurseries (including Christmas tree / conifer plantations), landscapes and interiorscapes.  
**FORMULATIONS:** Suspension concentrate.  
**PREMIX PARTNERS:** Bifenazate; Bifenthrin; Chlorpyrifos; *lambda*-Cyhalothrin; *beta*-Cypermethrin; Cyromazine; Imidacloprid; Propargite; Thiamethoxam.

### Identification

**COMMON NAME:** Abamectin (ANSI, BSI, USAN).  
**TRIVIAL NAME:** Avermectin B1.  
**CODE NUMBERS:** CAS 71751-41-2; SHA 0122804.

### Description

**COMPOSITION:** Avermectin B<sub>1</sub>: Mixture of avermectins containing >80% avermectin B<sub>1a</sub> and <20% avermectin B<sub>1b</sub>.  
**CLASS:** Fungus.  
**CATEGORY:** Microbial.



Abamectin

### Registration Notes

RUP: Abba\*, Abba\* Ultra, AgMectin\*, Agri-Flex\*, Agri-Mek\*, Athena\*, Avicta\*, Avicta\* Duo Corn, Avicta\* Duo Cotton, Epi-Mek\*, Reaper\*, Temprano\*, Timectin\*, Zoro\*.

### Mode of Action/Resistance Management

**CHEMICAL GROUP:** Avermectin, milbemycin.  
**MODE OF ACTION:** Chloride channel activator.  
**ACTION GROUP:** IRAC Group 6.

### Environmental Guidelines

**WATER SOLUBILITY:** 7-10 µg/l at 20° C.

### Safety Guidelines

**SIGNAL WORD:** WARNING  
**TOXICITY CLASS:** II  
**TOXICITY:** (Rat): Oral LD<sub>50</sub> 300 mg/kg. (Rabbit): Dermal LD<sub>50</sub> >1800 mg/kg. Moderate eye irritation, slight primary skin irritation.

### Emergency Guidelines

**FLASHPOINT:** 161°F.  
**FIRE EXTINGUISHING MEDIA:** Dry chemical, foam, CO<sub>2</sub>.

### Suppliers and Branded Products

**FROM:**  
 AAKO B.V.  
 Agrinoon Enterprise Limited  
 Agro-Care Chemical Industry Group Limited (Avermk\*)  
 AgroDragon Co., Ltd. (Agromectin\*, Touchdown\*)  
 Agsin Pte. Ltd. (Zabamec\*)  
 Anhui Huaxing Chemical Industry Co., Ltd.  
 AnHui JuKai Agrochemical Co., Ltd.  
 ArborSystems (Greyhound\*)  
 Bailing Agrochemical Co., Ltd.  
 Beta Chemicals Ltd.  
 Biesterfeld U.S. Inc.  
 Cambus Corp.  
 Cheminova A/S (Zoro\*)  
 Chemtura AgroSolutions (Temprano\*)  
 Chimac-Agriphar S.A.  
 Crystal Phosphates Ltd. (Abacin\*)  
 Denka International B.V. (Denka-Flylure\*)  
 Eastsun Chemical Co., Ltd.  
 Fertiagro Pte. Ltd. (Fertimectin\*)  
 FFC Limited  
 General Chemical Co., Ltd.  
 Gilmore Marketing & Development, Inc. (Gilmectin\*)  
 Golden Harvest Chemical Co., Ltd.  
 Hangzhou March Chemicals Co. Ltd.  
 Hebei Veyong Bio-Chemical Co., Ltd.  
 Hesenta Chemicals Co., Ltd.  
 Hualong Chemical Industry Co., Ltd.  
 Hubei Sanonda Co., Ltd. (Satin\*)  
 Huikwang Corp.  
 Inform Chemical Co., Ltd.  
 Jiangsu Fengyuan Biochemical Co., Ltd.  
 Ki-Hara Chemicals Ltd.  
 King Tech Corp.  
 Kingtai Chemicals Co., Ltd.  
 Krishi Rasayan Exports Pvt. Ltd.  
 Lainco, S.A. (Laotta\*)  
 Makhteshim Agan Group (Abba\*)  
 MANA - Makhteshim Agan North America, Inc. (Abba\*, Abba\* Ultra)  
 Nanjing Essence Fine-Chemical Co., Ltd.  
 Pacific Agriscience Pte. Ltd.  
 Pilar AgriScience (Canada) Corp. (Pilarmectin\*)  
 Point Americas Inc.  
 Qiaoji Group Co., Ltd. (Shanghai Qiaoji International Co., Ltd.)  
 Rotam CropSciences, Inc. (Romectin\*)  
 Shandong Kesai Eagrow Co., Ltd. (Eagrow\*)  
 Shanghai Forever Chemical Co.  
 Shanghai Psyche Chemicals Co., Ltd.  
 Shenzhen Qinfeng Pesticides Co., Ltd.  
 Sinochem Hebei Corp.

## Key to Crop Protection Dictionary

Chemicals are cross-referenced by common and trade name.

- = Organic
- = Biopesticide/Biocontrol
- = Seed Treatment
- = New Technology
- = Plant Health

\* = Trade Name/®/TM

Information is presented here for preliminary planning only. Exclusive reliance must be placed on the information/ directions supplied by the manufacturer.

<sup>1</sup>Reduced Risk - Some or all uses have been approved by U.S. EPA

Qiaojiao Group Co., Ltd. (Shanghai Qiaojiao International Co., Ltd.)  
 Shenzhen Baocheng Chemical Industry Co., Ltd.  
 Shenzhen Qinfeng Pesticides Co., Ltd.  
 Syngenta (Armor\*, Citation\*, Neporex\*, Patron\*, Trigard\*, Trigard\* OMC)  
 Wangs Crop-Science Co., Ltd. (Cycle\*)  
 Wonderful Agriculture Co., Ltd.  
 Zagro Singapore Pte. Ltd.

## FORMULATORS' TRADE NAMES:

Cliper\* — United Phosphorus Ltd.  
 Cyrodex\* — Chema Industries  
 Cyrogard\* — Hektas Ticaret T.A.S.  
 Gardex\* — Medmac for Manufacturing Agricultural Chemicals & Veterinary Products Ltd.  
 Trimazine\* — SAFA TARIM A.S.  
 Trivap\* — VAPCO, Veterinary & Agricultural Products Mfg. Co. Ltd.  
 Wopro-cyromazine\* — B.V. Industrie- & Handelsonderneming Simonis

## PREMIX PRODUCTS:

+ **abamectin**  
 Locking\* — Wangs Crop-Science Co., Ltd.

**Cylothrin\*** — see Cypermethrin.

**Cyradim\*** insecticide (cypermethrin + dimethoate) — Discontinued 2002 by Pazchem Ltd.

**Cyrux\*** — see Cypermethrin.

**Cytac\*** insecticide (amitraz + cypermethrin) — Discontinued 1992 by Schering AG.

**Cytel\*** insecticide (fenitrothion) — Discontinued 1989 by American Cyanamid Co.

**Cythion\*** insecticide (malathion) — Discontinued 1995 by American Cyanamid Co.

**Cythrane\*** — see Cypermethrin.

**CytoBooster\*** plant growth regulator (cytokinins) — Discontinued 2003 by Plant Bio-Tech, Inc.

**CytoFe\*** plant growth regulator (cytokinins) — Discontinued 2002 by Plant BioTech, Inc.

**Cytokin\*** — see Cytokinins.

## Cytokinins



## Action/Use

ACTION: Plant Growth Regulator, Plant Health Product.

USE: Increases yields and growth of field crops, fruits, horticultural crops, ornamentals, trees, turf, and vegetables.

PREMIX PARTNERS: Gibberellic Acid; Indole-3-acetic Acid; Indole-3-butyric Acid; Seaweed Extract.

## Description

COMPOSITION: Group of plant growth regulators containing naturally occurring adenine-based products, e.g. zeatin riboside and related glucosides, kinetin, and benzyl adenine. Foliar TRIGGRR\*, Soil TRIGGRR\*, and Organic TRIGGRR\* contain mixed cytokinins. Cynetin\* and X-Cyte\* contains kinetin blends. CytoBooster\*, Maxiscrop\*, and STIMPLEX\* contain seaweed extract. Arise\*, Burst\*, and CytoPlex\* also contain amino acids.

## Environmental Guidelines

WATER SOLUBILITY: Slightly Soluble.

## Suppliers and Branded Products

FROM:

Acadian Agritech (STIMPLEX\*)  
 Huikwang Corp. (PowerUp\*)  
 JH Biotech, Inc. (Bio-Activate\*)  
 Loveland Products, Inc. (Validate\*)  
 Plant BioTech, Inc. (Arise\*, Burst\*, Cytokin\*, CytoPlex\*)  
 Stoller USA (X-Cyte\*)  
 U.S. Ag Associates, Inc. (Cynetin\*)  
 Westbridge (SUPPRESS\*, TRIGGRR\*)

## PREMIX PRODUCTS:

+ **gibberellic acid**  
 Impact\* — Point Americas Inc.  
 + **gibberellic acid + indole-3-acetic acid**  
 Gibberella Fujikuroi\* — Agroquimicos Versa, S.A. de C.V.  
 + **gibberellic acid + indole-3-butyric acid**  
 Stimulate\*, Vigor S\* — Stoller USA  
 + **gibberellic acid + seaweed extract**  
 Vitamar-Excel\* — Point Americas Inc.  
 + **indole-3-butyric acid**  
 Radiate\* — Loveland Products, Inc.

**CytoPlex\*** — see Cytokinins.

**Cytrin\*** — see Cypermethrin.

**Cytrol Amitrole-T\*** herbicide (amitrole) — Discontinued 1987 by American Cyanamid Co.

**Cytrolane\*** insecticide (mepfosolan) — Discontinued by BASF Corporation, Ag Products.

**Cyungpro\*** — see Fenpropathrin.

**D 50\*** herbicide (2,4-D) — Discontinued by Shell Chemicals UK Ltd.

**D-Mark\*** — see Deltamethrin.

**D•z•n\*** insecticide (diazinon) — Discontinued 2002 by Syngenta.

## 2,4-D

## Action/Use

ACTION: Herbicide.

USE: For asparagus, cereals, corn, grasses, hay, rice, sorghum, soybeans (preplant), sugar-cane, fallow land, pasture, rangeland, turf, and noncropland for control of annual mustard, Canada thistle, dandelion, lambsquarters, ragweed, etc. Many broadleaf crops (cotton, grapevines) are extremely sensitive. Aqua-Kleen\* for control of aquatic weeds in lakes and ponds. Citrus Fix\* in lemon packinghouses; prevents preharvest drop of mature fruit.

FORMULATIONS: Emulsion (esters), aqueous solution (salts), emulsifiable concentrate, wettable powder. The amine salts are: dimethylamine (DMA), diethanolamine (DEA), isopro-

pylamine (IPA), trisopropanolamine (TIPA), etc. As with amines which form salts with the 2,4-D acid, esters are made with a wide variety of alcohols.

PREMIX PARTNERS: Ametryn; Anilofos; Atrazine; Bentazone; Bromoxynil; Butachlor; Carfentrazone-ethyl; Cinidon-ethyl; Clopyralid; Cyanazine; Dicamba; Dichlorprop; dichlorprop-P; Diuron; fenoxaprop-P-ethyl; Fluroxypyr; Gibberellic Acid; Glyphosate; Ioxynil; MCPA; Mecoprop; mecoprop-P; Metsulfuron-methyl; MSMA; 1-Naphthaleneacetic Acid; Picloram; Piperophos; Prometon; Propanil; Pyraflufen-ethyl; Quinclorac; Sulfentrazone; Thiencarbazone-methyl; Triclopyr.

## Identification

COMMON NAME: 2,4-D (BSI, ISO, WSSA); 2,4-PA (JMAF).

EXP. CODE NUMBERS: CN 3808300 (Ciech S.A. Agro-Sulphur Group).

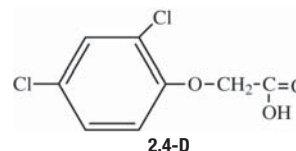
OTHER CODE NUMBERS: CAS 2008-39-1 (dimethyl ammonium); CAS 94-75-7; CAS 94-11-1 (isopropyl ester); EINECS 202-361-1; SHA 030001.

## Chemistry

COMPOSITION: 2,4-dichlorophenoxyacetic acid.

CLASS: Chlorinated phenoxy.

PROPERTIES: White powder. Melting point 140.5°C. Vapor pressure < 10<sup>-7</sup> mbar. Acid not used customarily by itself; usually as an amine, salt, or ester. Only slightly soluble in petroleum distillate. Soluble in alcohols. Esters are soluble in oils. Aqua-Kleen\*: Gray to tan granules with mild phenolic odor.



## Mode of Action/Resistance Management

CHEMICAL GROUP: Phenoxy-carboxylic-acid.

MODE OF ACTION: Action like indole acetic acid (synthetic auxins).

ACTION GROUP: HRAC Group O; WSSA Group 4.

## Environmental Guidelines

HAZARDS: Fish: dimethylamine salt and acid LC<sub>50</sub> >250 ppm; ester LC<sub>50</sub> >5 ppm (bluegill, rainbow trout). Bird: LC<sub>50</sub> 5620 ppm (mallard duck, bobwhite quail).

WATER SOLUBILITY: Slightly soluble. Amine salts are soluble in water; isopropyl ester is insoluble. Esters are essentially insoluble, but available formulations are usually emulsifiable.

## Safety Guidelines

SIGNAL WORD: Varies by formulation

TOXICITY CLASS:

TOXICITY: (Rat): Oral LD<sub>50</sub> 699 mg/kg. Isopropyl: 700 mg/kg. Sodium Salt: 500-805 mg/kg. Dimethylamine salt: 949 mg/kg. Isooctyl ester: 896 mg/kg.

PROTECTIVE CLOTHING: Chemical-resistant apron when cleaning equipment, mixing, or loading. Chemical-resistant gloves. Long-sleeved shirt and long pants. Protective eyewear. Shoes plus socks.

HANDLING/STORAGE CAUTIONS: Do not contaminate water, food, or feed by product storage or disposal. Do not store near food, feed, fertilizers, seeds, insecticides, or fungicides. Do not use spray equipment contaminated with this product for any other purposes unless thoroughly cleaned with a suitable cleaner. The greatest danger to susceptible crops is spray drift and volatilization. Highly volatile esters may result in vapor damage to such crops, while low volatile esters such as butoxyethyl and isooctyl esters are less likely to cause damage, and salt formations are essentially non-volatile. Do not apply where irrigation water may be contaminated. Citrus Fix\* may crystallize if stored at cold temperatures; if this occurs, call Amvac Chemical Corp. before using. Store in closed, original container in secure, dry, temperate area. Avoid contact with water.

SPILL CONTROL/CLEANUP: Large spillages should be dammed-off and pumped into containers; soak up remainder with absorbent material; dispose of in accordance with local regulations.

PRODUCT/WASTE DISPOSAL: Disposed of by special means (suitable incineration, etc.) in accordance with local regulations.

## Emergency Guidelines

FLASHPOINT: Approx. 65°C (ester).

FIRE EXTINGUISHING MEDIA: Citrus Fix\*: CO<sub>2</sub>, dry chemical, foam.

FIRST AID: Get medical aid. **Eyes:** flush with plenty of water. **Skin:** flush with plenty of water; remove contaminated clothing and clean before reuse. **Ingestion:** do NOT induce vomiting unless advised by a physician.

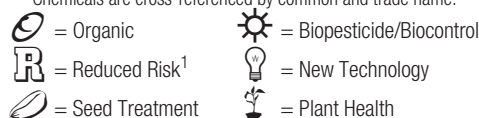
## Suppliers and Branded Products

BASIC PRODUCERS:

AAKO B.V. (AKOPUR\*)  
 Acme Organics Pvt. Ltd. (Acmecheck\*, Acmehalt\*)  
 Agrinoon Enterprise Limited  
 Agro-Care Chemical Industry Group Limited (Dieon\*)  
 Agsin Pte. Ltd. (D-Amin\*)  
 Akruiti Trexim Pvt. Ltd.  
 Albaugh, Inc. (D-638, Five Star\*, Orchard Star\*, Solve\*)

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\* = Trade Name/®/TM

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<sup>1</sup>Reduced Risk - Some or all uses have been approved by U.S. EPA

AMVAC Chemical Corp. (Citrus Fix\*, Hivol\*-44)  
 Ancom Crop Care S.B. (Megatox\*)  
 Atanor S.A. (Herbifen\*)  
 Biesterfeld U.S. Inc.  
 BSM Chemical Import & Export Co., Ltd.  
 Cambus Corp.  
 Crystal Chemical Inter-America (Crisalamina\*, Crisamina\*)  
 Crystal Phosphates Ltd.  
 Eastsun Chemical Co., Ltd.  
 Fertiagro Pte. Ltd. (Killer\*)  
 FFC Limited  
 Fortune Ag. Co., Ltd.  
 General Chemical Co., Ltd.  
 Gilmore Marketing & Development, Inc.  
 Hektas Ticaret T.A.S. (Ester\*H\*, Hektafermin\*)  
 Helm AG  
 Hubei Sanonda Co., Ltd. (Weedkiller\*)  
 IFC International Co., Ltd.  
 Inform Chemical Co., Ltd.  
 Jingma Chemicals Ltd.  
 Ki-Hara Chemicals Ltd.  
 King Tech Corp.  
 Kingtai Chemicals Co., Ltd.  
 Krishi Rasayan Exports Pvt. Ltd.  
 M/S Modern Insecticides Ltd.  
 Makhteshim Agan Group (Aminol\*)  
 Nanjing Bestgreen Chemical Co., Ltd.  
 Nanjing CF Agrochemical Co., Ltd.  
 Nanjing Essence Fine-Chemical Co., Ltd.  
 Nufarm Americas Inc. (Esteron\*, Formula 40\*, Orchard Clean\*, Solution\*, Turret\*, Weedar\* 64, WeeDestroy\* AM-40, Weedone\*)  
 Pacific Agriscience Pte. Ltd.  
 PBI/Gordon Corp. (HI-DEP\*)  
 Pilar AgriScience (Canada) Corp. (Pilar-2,4-D\*)  
 Point Americas Inc.  
 Projectfield Co., Ltd.  
 Qiaojia Group Co., Ltd. (Shanghai Qiaojia International Co., Ltd.)  
 SAFA TARIM A.S. (Amin Ext\*, Di-Amin\*, Ester Ext\*, SAFA Ester\*)  
 SePRO Corp. (Sculpin\* G)  
 Shandong Weifang Rainbow Chemical Co., Ltd.  
 Shanghai MEG Import & Export Corp.  
 Shenzhen Baocheng Chemical Industry Co., Ltd.  
 Shenzhen Yancheng Chemicals Co., Ltd.  
 Sinochem Hebei Corp.  
 Zagro Singapore Pte. Ltd. (D-Amin\*, Gold Coin Amine\*, ZA-Amine\*)  
 Zhejiang Dayoo Chemical Industries Co., Ltd.  
 Zhejiang E-Tong Chemical Co., Ltd.  
 Zhejiang Tide CropScience Co., Ltd.

**FORMULATORS' TRADE NAMES:**  
 240\* — United Phosphorus Ltd.  
 Aminol\* — Milenia Agrociencias S.A.  
 Amoxone\*, Chloroxone\*, Crop Rider\*, Dinoxol\*, Dormone\*, Emulsamine\*, Fernimine\*, Fernoxone\*, Gesapax-H\*, Rilof-H\* — Syngenta  
 Anilo-D\*, Better-D\*, Weedclean\* — Ladda Co., Ltd.  
 Arena\*, Campeon\*, Fenix\*, Fenix Gold\*, Stockton\* 2,4-D, Talion\*, Turuna\*, Valsamba\*, Valsamin\*, Valsamin\* — Stockton Agrimor AG  
 Barrage\* HF, Brush-Rhap\*, Double Up\* B+D, EndRun\*, HardBall\*, Opti-Amine\*, Trump-Card\*, Unison\* — Helena Chemical Co.  
 Base Camp Amine 4, Weco Max\* — Wilbur-Ellis Co.  
 Brush\*, E-99, Phenoxy 088\*, Strike\* 3, Strike\* Three Ultra 2, SWB 2,4-D — Winfield Solutions, LLC  
 Charge\*, Dacom\* — PT. Mastec  
 Chaser\*, Chaser\* Ultra2, Clean amine\*, Crossbow\* L, Rifle\*-D, Saber\*, Salvo\*, Savage\*, Shotgun\*, Starane\* +Salvo\* — Loveland Products, Inc.  
 Chimac\* Cop Special, Chimac\* Mixte, Dam\*, Selectone D\*, Selectone G\*, Selectly MD\*, Stantox\*, Trimonial\* — Chimac-Agriphar S.A.  
 Crisalamina\*, Crisamina\*, Exterminator\*, Fenox\*, Matamonte\*, Stoke\*, Terminator\* — Dupocsa, Protectores Quimicos para el Campo S.A.  
 Defy\* — MANA - Makhteshim Agan North America, Inc.  
 Dical\* — Willowood Ltd.  
 Duplosan\* DP/D, Duplosan\* Kombi, Duplosan\* KV-Combi, Dyvel\* DS, Lotus\* D, Topshot\*, U 46\* Combi-Fluid, U 46\* D-Fluid, U 46\* KV-Combi-Fluid, Weedmaster\* — BASF Corporation  
 Durtok\* 540, Durtok\* Amina, Galope\*, Invesamina\*, Malezafin\*, Malezafin\* 57 — Invesa S.A.  
 Electron\*, Safaya\* — Devidayal Agro Chemicals  
 Esterdefore\*, Kamel-fert\*, Speed-Mix\* — VAPCO, Veterinary & Agricultural Products Mfg. Co. Ltd.  
 Grotex Complex\*, Grox\*, Trago\* — TRAGUSA (Tratamientos Guadalquivir S.L.)  
 Herb Ester\*, Herb-Amin\* — Polsas Chemicals and Machinery Co.  
 Kaal-38\*, Kaal-80\* — Plant Remedies Pvt. Ltd.  
 Kilweed\* — Kilpest India Ltd.  
 Malerbane Cereali\* — Diachem S.p.A.  
 Medamine\* — Medcam for Manufacturing Agricultural Chemicals & Veterinary Products Ltd.  
 Menjel\* — PROTECO  
 Profiamina\*, Troton\* — Proficol  
 Smash\* — Nagarjuna Agrichem Ltd.  
 VI 2,4-D\* — Vietnam Pesticide Joint Stock Co. (VIPESCO)  
 Weedmar\*, Weedmar\* Super — Dhanuka Agritech Ltd.  
 Wopro-2,4-D\* — B.V. Industrie- & Handelonderneming Simonis  
 Zantan\* — Ivorychem Pte. Ltd.

**PREMIX PRODUCTS:**

+ **ametryn**  
 Gesapax-H\* — Syngenta  
 Versatil\* — Agroquimicos Versa, S.A. de C.V.  
 + **anilofos**  
 Anilo-D\* — Ladda Co., Ltd.

+ **atrazine**  
 Shotgun\* — Loveland Products, Inc.  
 + **bentazone + cyanazine**  
 Topshot\* — BASF Corporation  
 + **bromoxynil**  
 Double Up\* B+D — Helena Chemical Co.  
 Maestro\* D — Nufarm Americas Inc.  
 Thumper\* — Bayer CropScience  
 Weco Max\* — Wilbur-Ellis Co.  
 + **bromoxynil + fluoxyppy**  
 Cleansweep\* D — Nufarm Americas Inc.  
 + **bromoxynil + propanil**  
 Trio\* — Bayer CropScience  
 + **bromoxynil + thiencarbazone-methyl**  
 Thumper\* Total — Bayer CropScience  
 + **butachlor**  
 Blog\* — Agsin Pte. Ltd.  
 Weedclean\* — Ladda Co., Ltd.  
 + **carfentrazone-ethyl**  
 Rage\* D-TECH — FMC Corp.  
 + **carfentrazone-ethyl + dicamba + mecoprop-P**  
 SpeedZone\* — PBI/Gordon Corp.  
 + **cinidon-ethyl**  
 Lotus\* D — BASF Corporation  
 + **clopyralid**  
 Commando\* — Albaugh, Inc.  
 Curtail\* — Dow AgroSciences LLC  
 Cutback\* — Nufarm Americas Inc.  
 + **clopyralid + dicamba**  
 Millennium Ultra\* 2 — Nufarm Americas Inc.  
 + **dicamba**  
 Banvel\* + 2 — Arysta LifeScience North America Corp.  
 Brush\* — Winfield Solutions, LLC  
 Brush-Rhap\* — Helena Chemical Co.  
 Diachem\* — Parijat  
 KambaMaster\*, Veteran\* 720 — Nufarm Americas Inc.  
 Magnolia Super\* — Hektas Ticaret T.A.S.  
 Range Star\* — Albaugh, Inc.  
 Rifle\*-D — Loveland Products, Inc.  
 Selectone G\* — Chimac-Agriphar S.A.  
 Valsamba\*, Valsamin\* — Stockton Agrimor AG  
 Weedmaster\* — BASF Corporation  
 + **dicamba + dichlorprop**  
 Brushmaster\*, Super Brush\* Killer, Super Trimec\* — PBI/Gordon Corp.  
 Durtok\* 540, Durtok\* Amina — Invesa S.A.  
 + **dicamba + fluoxyppy**  
 Escalade\* 2 — Nufarm Americas Inc.  
 + **dicamba + MCPA**  
 Trimonial\* — Chimac-Agriphar S.A.  
 + **dicamba + mecoprop**  
 Dyvel\* DS — BASF Corporation  
 EndRun\* — Helena Chemical Co.  
 Trimec\* 992, Trimec\* Bentgrass, Trimec\* Classic, Trimec\* Southern — PBI/Gordon Corp.  
 + **dicamba + mecoprop + MSMA**  
 Trimec\* Plus — PBI/Gordon Corp.  
 + **dicamba + mecoprop-P**  
 Strike\* 3 — Winfield Solutions, LLC  
 Triple\*, TruPower\* 2 — Nufarm Americas Inc.  
 + **dicamba + mecoprop-P + pyraflufen-ethyl**  
 4-Speed\* — Nufarm Americas Inc.  
 + **dicamba + mecoprop-P + sulfentrazone**  
 Surge\* — PBI/Gordon Corp.  
 + **dicamba + metsulfuron-methyl**  
 Cimarron\* Max — DuPont Crop Protection  
 + **dicamba + picloram**  
 PD2\* — Albaugh, Inc.  
 + **dicamba + pyraflufen-ethyl + triclopyr**  
 4-Speed\* XT — Nufarm Americas Inc.  
 + **dicamba + quinclorac**  
 Quincept\* — Nufarm Americas Inc.  
 + **dicamba + quinclorac + sulfentrazone**  
 Q4\* Plus — PBI/Gordon Corp.  
 + **dicamba + sulfentrazone + triclopyr**  
 T-Zone\* — PBI/Gordon Corp.  
 + **dichlorprop**  
 Malezafin\* 57 — Invesa S.A.  
 + **dichlorprop-P**  
 Duplosan\* DP/D, Duplosan\* Kombi — BASF Corporation  
 Patron\* 170 — Nufarm Americas Inc.  
 + **dichlorprop-P + fluoxyppy**  
 Strike\* Three Ultra 2 — Winfield Solutions, LLC  
 + **dichlorprop-P + mecoprop-P**  
 Spoiler\*, Triamine\*, Triamine\* Jet-Spray — Nufarm Americas Inc.  
 + **diuron + MSMA**  
 Dasatox\* — Ancom Crop Care S.B.  
 + **fenoxaprop-P-ethyl + MCPA**  
 Tiller\* — Bayer CropScience  
 + **fluoxyppy**  
 Starane\* +Salvo\* — Dow AgroSciences LLC  
 Starane\* +Salvo\* — Loveland Products, Inc.  
 TrumpCard\* — Helena Chemical Co.  
 + **fluoxyppy + MCPA**  
 Chaser\* Ultra2 — Loveland Products, Inc.  
 + **gibberellic acid + 1-naphthaleneacetic acid**  
 Kamel-fert\*, Speed-Mix\* — VAPCO, Veterinary & Agricultural Products Mfg. Co. Ltd.

**Glyphomax\* Plus** — see Glyphosate.

**Glyphomax\* XRT** — see Glyphosate.

## Glyphosate

R

### Action/Use

**ACTION:** Defoliant/Desiccant, Herbicide.

**USE:** For control of annual and perennial weeds, woody brush, and trees on over 150 crops. Use postdirected in tree and plantation crops, postemergence over Roundup\* Ready soybeans, and postharvest in fallow periods and noncropland. Helosate\* 75: Pending use on all Roundup\* Ready crops.

**FORMULATIONS:** Aqueous solution, water-soluble liquid, water soluble concentrate.

**PREMIX PARTNERS:** Amitrole; Atrazine; Butafenacil; 2,4-D; Dicamba; Diquat Dibromide; Diuron; Fluometuron; Fomesafen; Imazapic; Imazapyr; Imazaquin; Imazethapyr; Indole-3-butyric Acid; Kinetin; MCPA; Mesotrione; S-metolachlor; Metsulfuron-methyl; Oxlyfluorfen; Prodiamine; Prometryn; Simazine; Sulfentrazone; Terbutylazine.

### Identification

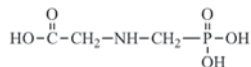
**COMMON NAME:** Glyphosate (ANSI, ISO, JMAF, WSSA).

**CODE NUMBERS:** CAS 1071-83-6 (glyphosate); CAS 69254-40-6 (diammonium salt); CAS 70901-12-1 (potassium salt); CAS 38641-94-0 (isopropylamine salt); CAS 81591-81-3 (trimesium salt); SHA 417300 (glyphosate).

### Chemistry

**COMPOSITION:** N-(phosphonomethyl)glycine.

**PROPERTIES:** Glifonox\*, Roundup\*: Clear, viscous amber-colored solution; pH 4.4-4.9. Practically odorless to slight amine-like odor. **Lider\*:** Colorless crystals.



glyphosate

### Registration Notes

US: Registration pending 2012 for Helosate\* 75.

OUTSIDE US: Dominator\* in Europe; Estelar\* in Central America; Gliz\* in Brazil; Rondo\* and Panzer\* in Argentina. Vantage\* Plus in Canada. Arbex\*, Bamox\*, Glifonox\*, Supex\*.

### Mode of Action/Resistance Management

**CHEMICAL GROUP:** Glycine.

**MODE OF ACTION:** Inhibits three amino acids and protein synthesis (inhibition of EPSP synthase).

**ACTION GROUP:** HRAC Group G; WSSA Group 9.

### Environmental Guidelines

**WATER SOLUBILITY:** 12,000 ppm.

### Safety Guidelines

**SIGNAL WORD:** WARNING

**TOXICITY CLASS:** II

**TOXICITY:** (Rat): Oral LD<sub>50</sub> 5400 mg/kg. (Rabbit): Dermal LD<sub>50</sub> >5000 mg/kg. Severely irritating to eyes, nonirritating to skin.

**PROTECTIVE CLOTHING:** Long-sleeved shirt and long pants. Protective eyewear. Shoes plus socks. Waterproof gloves.

### Emergency Guidelines

**FLASHPOINT:** >200°F (TCC).

**FIRE EXTINGUISHING MEDIA:** Water spray, foam, dry chemical, CO<sub>2</sub>, or any other Class B agent.

**FIRST AID:** Get medical aid. **Eyes:** flush with plenty of water for 15 minutes. **Ingestion:** immediately dilute by swallowing milk or water.

**EMERGENCY TELEPHONE:** 314-694-4000 (Monsanto Co.).

### Suppliers and Branded Products

**BASIC PRODUCERS:**

AAKO B.V.  
Acme Organics Pvt. Ltd. (Weedex\*)  
Agrinoon Enterprise Limited  
Agro-Care Chemical Industry Group Limited (Glyfomon\*, Glyphocare\*)  
Agro-Chemie Ltd. (Fozat 480\*)  
AgroDragon Co., Ltd. (Agrofosate\*)  
Agsin Pte. Ltd. (Pin Up\*, Pounce\*, Wipe Out\*)  
Aimco Pesticides Ltd. (Glyphotox\*)  
Albaugh, Inc. (Aqua Star\*, Forest Star\*, Gly Star\*)  
Anhui Fengle Agrochemical Co., Ltd.  
AnHui JuKai Agrochemical Co., Ltd.  
Bailing Agrochemical Co., Ltd.  
Biesterfeld U.S. Inc.  
Cambus Corp.  
Cheminova A/S (Glyfos\*)  
Chimac-Agriphar S.A.  
Crystal Chemical Inter-America (Arbex\*, Banox\*, Glifonox\*, Supex\*)  
Crystal Phosphates Ltd.  
Dow AgroSciences LLC (Dominator\*, Duramax\*, Durango\*, Durango\* DMA\*, Estelar\*, Gliz\*, Glyphomax\*, Glyphomax\* Plus, Glyphomax\* XRT, Glypro\*, Glypro\* Plus, Panzer\*, Vantage\* Plus)  
Drexel Chemical Co. (Duplikator\*, Imitator Plus\*, Imitator Xtra\*)  
Dupocsa, Protectores Quimicos para el Campo S.A. (Arbex\*, Banox\*, Glifonox\*, Supex\*)  
Eastsun Chemical Co., Ltd. (Extril\*)  
Excel Crop Care Limited (Excel DF Gold\*, Excel Mera 71\*, Glycel Super\*, Glycel\*, Speed\*)  
EZ-Ject, Inc. (EZ-Ject\* Diamondback)  
Fertiagro Pte. Ltd. (Fertiphosphate\*)  
FFC Limited  
Fuhua Tongda Agro-Chemical  
Ful Chemical Industrial Co., Ltd.  
General Chemical Co., Ltd.  
Gilmore Marketing & Development, Inc.  
Golden Harvest Chemical Co., Ltd.  
Hangzhou Fresh Cure Chemical Co., Ltd.  
Hangzhou March Chemicals Co. Ltd.  
Hektas Ticaret T.A.S. (Knock-Out\*)  
Helena Chemical Co. (Rattler\*)  
Helm AG

Heranba Industries Ltd.

Hextar Chemicals Sdn Bhd (Supremo\*)

Hualong Chemical Industry Co., Ltd.

Hubei Sanonda Co., Ltd. (Sanos\*)

Huikwang Corp.

IFC International Co., Ltd.

Inform Chemical Co., Ltd.

Jiangsu Anpon Electrochemical Co., Ltd.

Jiangsu Fengshan Group Co., Ltd.

Jingma Chemicals Ltd. (Longyou\*)

Ki-Hara Chemicals Ltd.

Kilpest India Ltd.

King Tech Corp.

Kingtai Chemicals Co., Ltd.

Krishi Rasayan Exports Pvt. Ltd.

Lainco, S.A. (Karda\*)

M/S Modern Insecticides Ltd. (Glidder\*)

Makhteshim Agan Group (Eraser\*, Glyphogan\*, Taifun\* Forte)

Monsanto Co. (Aquamaster\*, Honcho\* Plus, Ranger PRO\*, Roundup PowerMAX\*, Roundup

PROMAX\*, Roundup WeatherMAX\*, RT 3\*)

Nagarjuna Agrichem Ltd.

Nanjing Bestgreen Chemical Co., Ltd.

Nanjing Essence Fine-Chemical Co., Ltd.

Nanjing Red Sun Co., Ltd.

Nanjing Zhuochuang Chemical Co., Ltd.

National Company for Agrochemicals Production (Agrochem) (Herphosate\*)

Nufarm Americas Inc. (AquaNeat\*, Credit\*, Credit\* Duo, Credit\* Duo Extra, Credit\* Extra,

Credit\* Xtreme, Extra Credit 5\*, Foresters\*, Razor\*, Razor\* Pro)

Pacific Agriscience Pte. Ltd.

Pilar AgriScience (Canada) Corp. (Pilarsato\*)

Point Americas Inc.

Premier.Shukuroglou Cyprus Ltd. (Control\*)

Projectfield Co., Ltd.

Qiaoji Group Co., Ltd. (Shanghai Qiaoji International Co., Ltd.)

Rotam CropSciences, Inc. (Rophosate\*)

Sabero Organics Gujarat Ltd. (Glyweed\*)

Shandong Jingbo Agrochemicals Co., Ltd.

Shandong Kesai Eagrow Co., Ltd. (Eagrow\*)

Shandong Weifang Rainbow Chemical Co., Ltd.

Shanghai Forever Chemical Co.

Shanghai MEG Import & Export Corp.

Shenzhen Baocheng Chemical Industry Co., Ltd.

Shenzhen Qinfeng Pesticides Co., Ltd.

Shenzhen Yancheng Chemicals Co., Ltd.

Sinochem Hebei Corp.

Sinochem Ningbo Chemicals Co., Ltd.

Sinon Corporation

Sulphur Mills Limited (Vinash\*)

Sundat (S) Pte. Ltd. (Glyfall\*, Sunup\*, Swift\*)

Syngenta (Coloso\*, Cycle\*, Refuge\*, Touchdown HiTech\*, Touchdown Total\*, Touchdown\*,

Touchdown\* CF, Touchdown\* CT, Touchdown\* Pro, Traxion\*)

Topchems International Ltd.

Trustchem Co., Ltd.

Willowood USA (Willowood\* Glyphosate)

Youth Chemical Co., Ltd.

Zagro Singapore Pte. Ltd. (Pin Up\*, Pounce\*)

Zhejiang Dayoo Chemical Industries Co., Ltd.

Zhejiang E-Tong Chemical Co., Ltd.

Zhejiang Tide CropScience Co., Ltd.

Zhejiang Xinan Chemical Industrial Group Co., Ltd.

### FORMULATORS' TRADE NAMES:

Ammo\*, Asset\*, Hat-trick\* — Ancom Crop Care S.B.

AquaPro\* — SePRO Corp.

Arbex\*, Atred\*, Banox\*, Glyphonox\*, Glifonox\* M, Glifuron\*, Rondo\*, Supex\* — Dupocsa,

Protectores Quimicos para el Campo S.A.

Audit\*, Index\*, Master\*, Partner\*, Reuters\*, Smart\*, Special\* — PT. Mastec

Bingo\*, Glifosato\*, Glyphostock\*, Potensato\*, Prince Gold\*, Rondonor\*, Sigma Max\*,

Stockton\* Glyphosate, Valsaglif\*, Valsaup\* — Stockton Agrimor AG

Break Up\* — Plant Remedies Pvt. Ltd.

Cinco\*, Kleenup Pro\*, Mad Dog\*, Mad Dog Plus\*, Makaze\*, Makaze Yield Pro\*, Mirage\*,

Mirage\* Plus — Loveland Products, Inc.

Close up\* — Indofil Industries Limited

Cornerstone\*, Cornerstone\* Plus — Winfield Solutions, LLC

Dera\*, Noweed\* — Dhanuka Agritech Ltd.

Desert\* — Zapi Industrie Chimiche S.p.A.

Faena\*, Glyphogan\* — Proficol

Gladiator\* — Devidayal Agro Chemicals

Gland-Up\*, Glytex\*, Ground-Up\* — VAPCO, Veterinary & Agricultural Products Mfg. Co. Ltd.

Glifene\* — Diachem S.p.A.

Glifosato\*, Glypho Up\*, Terminator\*, Weedclear\*, Willosate\* — Willowood Ltd.

Glyfos\*, Glyfos\* Aquatic, Glyfos\* PRO, Glyfos\* X-Tra, Tackle\* — Cheminova, Inc.

GlyPho Sel Pro\* — Agrisel USA Inc.

Glyphogan\*, Glyphogan\* Plus — MANA - Makhteshim Agan North America, Inc.

GlyphoMate\* 41 — PBI/Gordon Corp.

Glytaf\* — Rallis India Ltd.

Grenade\* — ISAGRO (Asia) Agrochemicals Pvt. Ltd.

Helosate\* 70, Helosate\* 75, Helosate\* Aquatic and VM, Helosate\* Plus Advanced — Helm

Agro US, Inc.

Inter-Glyphosat\* — Inter-Trade A/S

Knockdown\*, Knockdown Max\* — SAFA TARIM A.S.

New Glycin\* — SM-BT Co., Ltd.

Panzer\* — Invesa S.A.

Phomac\* — Medmac for Manufacturing Agricultural Chemicals & Veterinary Products Ltd.

PI Glypho\* — PI Industries Ltd.

Rondo\*, Rondo Logico\*, Rondo Super\*, Sweep\* — United Phosphorus Ltd.

Rudo\* — Agroquimicos Versa, S.A. de C.V.

**Maloran\*** herbicide (chlorbromuron) — Discontinued 1996 by Ciba, Ltd.

**Maltox\*** — see Malathion.

## MAMA

### Action/Use

ACTION: Herbicide.

### Identification

COMMON NAME: MAMA (WSSA).

CODE NUMBERS: CAS 2321-53-1; SHA 013808.

### Chemistry

COMPOSITION: Monoammonium methanearsonate.

### Safety Guidelines

SIGNAL WORD: CAUTION

TOXICITY CLASS: III

TOXICITY: LD<sub>50</sub> 750 mg/kg.

## Mamestra configurata NPV



### Action/Use

ACTION: Virus.

USE: For control of Bertha armyworm on canola.

### Identification

COMMON NAME: *Mamestra configurata* NPV.

### Description

CLASS: Baculovirus.

CATEGORY: Microbial.

### Suppliers and Branded Products

FROM:

BioTEPP (Virosoft\* BA<sup>3</sup>)

**Manuri\*** herbicide (bensulfuron-methyl + daimuron + mefenacet) — Discontinued 2006 by SDS Biotech K.K.

**Man 50\*** fungicide (mancozeb) — Discontinued 2000 by Chemiplant S.A.

**Man Duitou\*** — see Propargite.

**Manaco\*** — see Mancozeb.

**Manage\*** — see Hexaconazole.

**Manage\*** — see Imibenconazole.

**Manage\*** herbicide (halosulfuron-methyl) — Discontinued 2008 by Nissan Chemical Industries, Ltd.

**Manage\* M** fungicide (imibenconazole + mancozeb) — Discontinued 2005 by Hokko Chemical Industry Co., Ltd.

**Manager\*** fungicide (maneb + zinc sulfate) — Discontinued 1989 by Agtrol Chemical Products.

**ManaPro\*** — see Prodiamine.

**Manara\*** — see Thiamethoxam.

**Manco\*** — see Mancozeb.

**Manco D\*** — see Mancozeb.

**Mancoflow\*** — see Mancozeb.

**Mancolaxyl\*** — see Mancozeb; Metalaxyl.

**Mancomed\*** — see Mancozeb.

**Manconyl\*** — see Mancozeb.

**Mancosil\*** — see Mancozeb; Metalaxyl.

**Mancosil\* Plus** — see Copper Oxochloride; Metalaxyl.

**Mancosol\*** — see Mancozeb.

**Mancotan\* fungicide (mancozeb)** — Discontinued 2000 by Agrochemical Industries Co., Ltd.

**Mancothane\*** — see Mancozeb.

**Mancozan\*** — see Mancozeb.

**Mancozan\* fungicide (maneb + zineb)** — Discontinued by Rhone-Poulenc.

**Mancozate\*** — see Mancozeb.

## Mancozeb



### Action/Use

ACTION: Fungicide, Seed Treatment/Protectant.

USE: For field crops, fruits, grapevines, vegetables, nuts, and commercial sod farms. Seed treatment for cereal grains, corn, cotton, flax, peanuts, potatoes, safflower, sorghum, and tomatoes. Fore\* for flowers, ornamental trees, shrubs, turf sod, and golf courses. MonCoat\* MZ is a seed piece treatment for potatoes.

FORMULATIONS: Dust, flowable suspension, liquid flowable, water dispersible granules, wettable powder.

PREMIX PARTNERS: Ametoctradin; Benalaxyl; benalaxyl-M; Carbendazim; Copper Carbonate, Basic; Copper, Fixed; Copper Hydroxide; Copper Oxochloride; Copper Sulfate; Copper Sulfate, Basic; Copper Sulfate, Tribasic; Cymoxanil; Dimethomorph; Famoxadone; Fenamidone; Fenpropimorph; Fludioxonil; Flutolanil; Folpet; Imidacloprid; Metalaxyl; Metalaxyl-M; Oxadixyl; Propamocarb Hydrochloride; Thiophanate-methyl; Tricyclazole; Zoxamide.

### Identification

COMMON NAME: Mancozeb (BSI, ISO-E); Manzeb (JMAF); Mancozèbe (ISO-F).

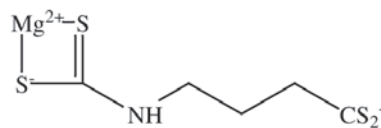
CODE NUMBERS: CAS 8018-01-7; SHA 014504.

### Chemistry

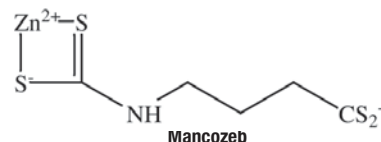
COMPOSITION: Coordination product of zinc ion, manganese ethylene bisdithiocarbamate related to both maneb and zineb.

CLASS: Ethylene bisdithiocarbamate.

PROPERTIES: Yellowish powder, practically odorless; Fore\*: blue to green powdered solid, musty odor. Decomposes in acid and alkaline conditions. Decomposed by heat and when exposed to moisture and air. No corrosive properties. Negligible volatility at room temperature. Practically insoluble in most organic solvents.



and



### Registration Notes

OUTSIDE US: Mancozin\*, Manzin\*, Manzeb\*, Tatto\*. Flonex\* MZ in Mexico, Costa Rica, Peru, Dominican Republic. Luxazeb\* in South America. Aderio\*, Electis\*, Roxam Combi\* in France. Valbon\* in Switzerland.

### Environmental Guidelines

HAZARDS: Fish: LD<sub>50</sub> (96 h) 0.46 mg/l (rainbow trout). Bird: Oral LD<sub>50</sub> >6400 mg/kg (mallard duck).

WATER SOLUBILITY: Dispersible.

### Safety Guidelines

SIGNAL WORD: CAUTION

TOXICITY CLASS: III

TOXICITY: Dithane\*, Fore\*: (Rat): Oral LD<sub>50</sub> >5000 mg/kg; Inhalation LC<sub>50</sub> >5.14 mg/l (4 h).

(Rabbit): Dermal LD<sub>50</sub> >5000.

PROTECTIVE CLOTHING: Chemical-resistant apron when cleaning equipment, mixing, or loading. Chemical-resistant gloves. Protective eyewear.

HANDLING/STORAGE CAUTIONS: Do not store near food, feed, or drinking water. Store in dry, well-ventilated area. Keep container tightly closed when not in use. Keep from freezing.

PRODUCT/WASTE DISPOSAL: Dispose of empty container in a sanitary landfill or by incineration as allowed by state and local authorities.

### Emergency Guidelines

FLASHPOINT: 138°C (TOC).

FIRST AID: Get medical aid. **Eyes:** flush immediately with plenty of water. **Skin:** wash thoroughly with soap and water. Remove contaminated clothing and shoes. **Ingestion:** drink 2 glasses of water. **Inhalation:** remove to fresh air.

### Suppliers and Branded Products

BASIC PRODUCERS:

Agria SA  
Agrinon Enterprise Limited  
Agro-Care Chemical Industry Group Limited (Lamanco\*, Mancozate\*)  
Agsin Pte. Ltd. (Fungizeb\*, Mancozide\*)  
Aimco Pesticides Ltd. (Aimcozeb\*)  
Bailing Agrochemical Co., Ltd.  
Briesterfeld U.S. Inc.  
China Jiangsu International Group  
Crystal Chemical Inter-America (Mancozin\*, Manzin\*)  
Crystal Phosphates Ltd.  
Dow AgroSciences LLC (Dithane\*, Fore\*)  
DuPont Crop Protection (Manzate\*, Manzate\* Pro-Stick\*)  
FFC Limited  
Fulon Chemical Industrial Co., Ltd.  
General Chemical Co., Ltd.  
Gilmore Marketing & Development, Inc.  
Grupo Bioquimico Mexicano S.A. de C.V. (Flonex\* MZ)  
Hangzhou March Chemicals Co. Ltd.  
Helm AG  
Hindustan Insecticides Ltd. (Hilthane\* M-45)  
Hualong Chemical Industry Co., Ltd.  
Hubei Sanonda Co., Ltd. (Deal\*, Saver\*)  
Huikwang Corp.  
IFC International Co., Ltd.  
Indofil Industries Limited (Eurofil\* NT, Indofil\* M-45, Manfil\*)  
Inform Chemical Co., Ltd.  
Ingenieria Industrial, S.A. de C.V. (Mancoflow\*, Mancosol\*)  
Jiangsu Baoling Chemical Co., Ltd. (Superzeb\*)  
Ki-Hara Chemicals Ltd.  
King Tech Corp.  
Krishi Rasayan Exports Pvt. Ltd.  
Lainco, S.A. (FL-80 Fuerte\*)  
Limin Chemical Co., Ltd.  
M/S Modern Insecticides Ltd. (Masthane M-45\*)  
Max (Rudong) Chemicals Co., Ltd.  
Nanjing Essence Fine-Chemical Co., Ltd.  
National Company for Agrochemicals Production (Agrochem) (Dicozeb\*)  
Pilar AgriScience (Canada) Corp. (Pilarzeb\*)  
Point Americas Inc.  
Projectfield Co., Ltd.  
Qiaoj Group Co., Ltd. (Shanghai Qiaoj International Co., Ltd.)  
Sabero Organics Gujarat Ltd. (Emthane M-45\*)  
SePRO Corp. (Pentathlon\*)

Shanghai MEG Import & Export Corp.  
Shanghai Psyche Chemicals Co., Ltd.  
Shenzhen Baocheng Chemical Industry Co., Ltd.  
Shenzhen Qinfeng Pesticides Co., Ltd.  
Shenzhen Yancheng Chemicals Co., Ltd.  
Sinochem Hebei Corp.  
Sulphur Mills Limited (Hydroman\*, Manco\*)  
Sundat (S) Pte. Ltd. (Suncozeb\*)  
Topchems International Ltd.  
Trustchem Co., Ltd.  
United Phosphorus Inc. (Manzate\*, Manzate\* Pro-Stick\*, Penncozeb\*)  
United Phosphorus Ltd. (Dequiman\*, Grizeb\*, Manco D\*, Manconyl\*, Mancozan\*, Manex Plus\*, Manex\*, Mangrif\*, Manzate\*, Manzate\* Pro-Stick\*, Penncozeb\*, Pennfluid\*, Pennzebe\*, Policar\* MZ, Tridex\*, Trimangol\*, Trimanoc\*, Triziman\*, Unizeb\*, Uthane M 45\*, Vondocarb\*, Vondoflo\*, Vondozeb\*)  
Wonderful Agriculture Co., Ltd.  
Zagro Singapore Pte. Ltd. (Mancozeb\*)  
Zhejiang E-Tong Chemical Co., Ltd.  
Zhejiang Tide CropScience Co., Ltd.

## FORMULATORS' TRADE NAMES:

Agrizeb\*, Rainbow\*, Romel\*, Victory\* — Parijat  
Ajomil\*, Kilpest M-45\*, Pearl\* — Kilpest India Ltd.  
Cotran\*, Cotran Mix\*, Cotran Plus\*, Gucor\*, Guzan\*, Icaro\* — TRAGUSA (Tratamientos Guadalquivir S.L.)  
Crysthane\*, Cy-Man\*, Koclet\*, Mancozin\*, Manzin\* — Dupocsa, Protectores Quimicos para el Campo S.A.  
Cupenix\*, Vimancoz\*, Vimonyl\* — Vietnam Pesticide Joint Stock Co. (VIPESCO)  
Curtine-V\*, Mancothane\*, Mantox\*, Mantox-Forte\*, Vacomil Gold\*, Vacomil MZ\* — VAPCO, Veterinary & Agricultural Products Mfg. Co. Ltd.  
Curzeb\*, Emthane\*, Fumazin\* M-45, Trooper\* — Hektas Ticaret T.A.S.  
Dacozeb\* — PT. Mastec  
Devidayal M-45\*, Duet\*, Maczim\* — Devidayal Agro Chemicals  
Dhanuka M-45\*, Qurate Gold\*, Sixer\* — Dhanuka Agritech Ltd.  
Dikozeb M-45\*, Midifan M\*, Midipost M\*, Trikuprozeb Forte-S\* — Polsas Chemicals and Machinery Co.  
Fantic\* M, Galben\* M, Nemispor\* — ISAGRO S.p.A.  
Grain Guard\* — Chemtura AgroSolutions  
Kotek\*, Max MZ\* — Zelam Ltd.  
Manaco\*, Micostock\*, Morizeb\*, Stockton\* Mancozeb, Valsalaxyl\*, Valsalaxyl C Plus\*, Valsazeb\* — Stockton Agrimor AG  
Mancomed\*, Medomil\* — Medmac for Manufacturing Agricultural Chemicals & Veterinary Products Ltd.  
Master\*, Tata M-45\* — Rallis India Ltd.  
Nagzeb\* — Multiplex Fertilizers Pvt. Ltd.  
Noster\* MZ, Tokat\* MZ, Tornado\* — Agroquimicos Versa, S.A. de C.V.  
Pamix\*, Top-Gun\* — Ladda Co., Ltd.  
Plant M-45\*, Relaxyl\*, Safaya\* — Plant Remedies Pvt. Ltd.  
Potato Seed Treater — Loveland Products, Inc.  
Protect\* — Cleary Chemical LLC  
Rapid\*, Rido\*, Rover\*, Willoxan\*, Willozeb\* — Willowood Ltd.  
Ridonet\* MZ, SAFA Ridonet Gold\* MZ, Sakozeb-Blue\*, Sakozeb M-45\*, Santophen-M\*, Serpost\* M, Topzeb\* — SAFA TARIM A.S.  
Saath\*, Sicozeb\* — The Scientific Fertiliser Co. Pvt. Ltd.  
Systakil\* — Ivorychem Pte. Ltd.  
Wopromanzin\* — B.V. Industrie- & Handelsonderneming Simonis  
Zeb\* — Nagarjuna Agrichem Ltd.

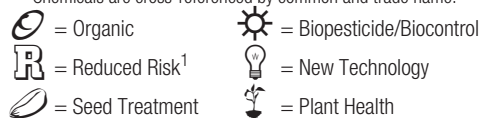
## PREMIX PRODUCTS:

**+ ametoctradin**  
Decabane\* — BASF Corporation  
**+ benalaxyl**  
Galben\* M — ISAGRO S.p.A.  
**+ benalaxyl-M**  
Fantic\* M — ISAGRO S.p.A.  
**+ carbendazim**  
Carma\* — Sulphur Mills Limited  
Companion\*, Sprint\* — Indofil Industries Limited  
EmCarb\* — Sabero Organics Gujarat Ltd.  
Icaro\* — TRAGUSA (Tratamientos Guadalquivir S.L.)  
Maczim\* — Devidayal Agro Chemicals  
Pamix\* — Ladda Co., Ltd.  
Pearl\* — Kilpest India Ltd.  
SAAF\* — United Phosphorus Ltd.  
Saath\* — The Scientific Fertiliser Co. Pvt. Ltd.  
Safaya\* — Plant Remedies Pvt. Ltd.  
Sixer\* — Dhanuka Agritech Ltd.  
Track\* — M/S Modern Insecticides Ltd.  
**+ carbendazim + fenpropimorph**  
Corvet\* CM — Syngenta  
**+ copper carbonate, basic + copper oxychloride + copper sulfate**  
Premitox Forte\* — Premier.Shukuroglou Cyprus Ltd.  
**+ copper, fixed**  
Trimiltax\* — Syngenta  
**+ copper hydroxide**  
Junction\* — SePRO Corp.  
ManKocide\* — DuPont Crop Protection  
**+ copper hydroxide + cymoxanil**  
Control III\*, K3\* — Ingenieria Industrial, S.A. de C.V.  
**+ copper oxychloride**  
Cotran\* — TRAGUSA (Tratamientos Guadalquivir S.L.)  
Cupenix\* — Vietnam Pesticide Joint Stock Co. (VIPESCO)  
Laincobre M\* — Lainco, S.A.  
Mantox\* — VAPCO, Veterinary & Agricultural Products Mfg. Co. Ltd.  
Oxib-mix\* — Ingenieria Industrial, S.A. de C.V.  
**+ copper oxychloride + copper sulfate**  
Mantox-Forte\* — VAPCO, Veterinary & Agricultural Products Mfg. Co. Ltd.

**+ copper sulfate**  
Gucor\* — TRAGUSA (Tratamientos Guadalquivir S.L.)  
**+ copper sulfate + cymoxanil**  
Cotran Plus\* — TRAGUSA (Tratamientos Guadalquivir S.L.)  
**+ copper sulfate, basic**  
Trikuprozeb Forte-S\* — Polsas Chemicals and Machinery Co.  
**+ copper sulfate, tribasic**  
Novofix\* — United Phosphorus Ltd.  
Qumran\* — Diachem S.p.A.  
**+ cymoxanil**  
Cimoter\*, Cyman\* — Sulphur Mills Limited  
Curtine-V\* — VAPCO, Veterinary & Agricultural Products Mfg. Co. Ltd.  
Curzate\* M — DuPont Crop Protection  
Curzeb\* — Hektas Ticaret T.A.S.  
Cy-Man\* — Dupocsa, Protectores Quimicos para el Campo S.A.  
Duet\* M, Fungiman Combi\*, Nautile\* — United Phosphorus Ltd.  
Encym\* — Sabero Organics Gujarat Ltd.  
Laincobia\* — Lainco, S.A.  
Moximate\* — Indofil Industries Limited  
Noster\* MZ — Agroquimicos Versa, S.A. de C.V.  
Precurar\* — Invesa S.A.  
Qurate Gold\* — Dhanuka Agritech Ltd.  
Rido\*, Rover\*, Willoxan\* — Willowood Ltd.  
Rifle\* 44 — Diachem S.p.A.  
Serpost\* M, Topzeb\* — SAFA TARIM A.S.  
Valsalaxyl C Plus\* — Stockton Agrimor AG  
**+ cymoxanil + folpet**  
Cotran Mix\* — TRAGUSA (Tratamientos Guadalquivir S.L.)  
Tri-Fi\* — Lainco, S.A.  
**+ cymoxanil + oxadixyl**  
Midipost M\* — Polsas Chemicals and Machinery Co.  
Pulsan\*, Ripost\* M — Syngenta  
**+ cymoxanil + thiophanate-methyl**  
Evolve\* — Bayer CropScience  
**+ dimethomorph**  
Acrobat\* MZ, Invader\* — BASF Corporation  
Gilmancomorph\* — Gilmore Marketing & Development, Inc.  
Quantum\* — Makhteshim Agan Group  
Rainbow\* — Parijat  
**+ famoxadone**  
Equation\* Contact — DuPont Crop Protection  
**+ fenamidone**  
Sagaie\*, Sereno\* — Bayer CropScience  
**+ fludioxonil**  
Maxim\* MZ — Syngenta  
**+ flutolanil**  
MonCoat\* MZ — Gowan Company  
MonCoat\* MZ — Nichino America, Inc.  
**+ imidacloprid**  
Gaucho\* MZ — Bayer CropScience  
**+ imidacloprid + thiophanate-methyl**  
Genesis\* XT, Tops\*-MZ-Gaucho\* — Bayer CropScience  
**+ metalaxyl**  
Acydon\*, Fubol\* — Syngenta  
Ajomil\* — Kilpest India Ltd.  
Cure-M\* — National Company for Agrochemicals Production (Agrochem)  
Duet\* — Devidayal Agro Chemicals  
Emaxyl\* — Sabero Organics Gujarat Ltd.  
Hi-Metalaxyl+Mancozeb — Hockley International Ltd.  
Koclet\* — Dupocsa, Protectores Quimicos para el Campo S.A.  
Krilaxyl\* 72 — Krishi Rasayan Exports Pvt. Ltd.  
Mancolaxyl\*, Talman Combi\*, Unilax\*, Zeemil\* — United Phosphorus Ltd.  
Mancosil\* — Chema Industries  
Master\* — Rallis India Ltd.  
Matco\* — Indofil Industries Limited  
Max MZ\* — Zelam Ltd.  
Medomil\* — Medmac for Manufacturing Agricultural Chemicals & Veterinary Products Ltd.  
Metalman\*, Rido Super\* — Sulphur Mills Limited  
Micostock\*, Valsalaxyl\* — Stockton Agrimor AG  
Milor\* — Rotam CropSciences, Inc.  
Mozart M 58\* — Suzhou Eagro Ltd.  
Pilaril-MZ\* — Pilar AgriScience (Canada) Corp.  
Premaxyl MZ\* — Premier.Shukuroglou Cyprus Ltd.  
Rapid\* — Willowood Ltd.  
Record\* — M/S Modern Insecticides Ltd.  
Relaxyl\* — Plant Remedies Pvt. Ltd.  
Ridodaisen\* — SM-BT Co., Ltd.  
Ridonet\* MZ, SAFA Ridonet Gold\* MZ — SAFA TARIM A.S.  
Romel\*, Victory\* — Parijat  
Superman\* — Aimco Pesticides Ltd.

## Key to Crop Protection Dictionary

Chemicals are cross-referenced by common and trade name.



\* = Trade Name/®/TM

Information is presented here for preliminary planning only. Exclusive reliance must be placed on the information/ directions supplied by the manufacturer.

<sup>1</sup>Reduced Risk - Some or all uses have been approved by U.S. EPA

**Environmental Guidelines**

HAZARDS: Fish: LC<sub>50</sub> (96 h) >96 mg/l (bluegill sunfish), >95 mg/l (rainbow trout); EC<sub>50</sub> (48 h) >96 mg/l (Daphnia). Bird: Dietary (8 day) LC<sub>50</sub> >5620 mg/kg (bobwhite quail, mallard duck).  
WATER SOLUBILITY: 18 ppm at pH 5, 1627 ppm at pH 7, 482 ppm at pH 9.

**Safety Guidelines**

SIGNAL WORD: CAUTION  
TOXICITY CLASS: III  
TOXICITY: (Rat): Oral LD<sub>50</sub> >5000 mg/kg; Dermal LD<sub>50</sub> >5000 mg/kg.  
PROTECTIVE CLOTHING: Long-sleeved shirt and long pants. Protective eyewear. Shoes plus socks.

HANDLING/STORAGE CAUTIONS: Store in dry place below 120°F.  
SPILL CONTROL/CLEANUP: Sweep, scoop or vacuum and remove. Flush residual spill area with water.

PRODUCT/WASTE DISPOSAL: This product should not be dumped, spilled, rinsed or washed into sewers or public waterways.

**Emergency Guidelines**

FIRE EXTINGUISHING MEDIA: Water, dry chemical, CO<sub>2</sub>, alcohol foam.  
FIRST AID: **Eyes:** immediately flush with plenty of water. Get medical aid if irritation persists.  
**Skin:** immediate first aid is not likely to be required, however, wash with soap and water. Wash heavily contaminated clothing before reuse. **Inhalation:** remove to fresh air.  
EMERGENCY TELEPHONE: 800-424-9300 (CHEMTREC).

**Suppliers and Branded Products**

BASIC PRODUCERS:  
Acme Organics Pvt. Ltd. (Acmeaxe\*)  
Bharat Rasayan Ltd.  
Crystal Phosphates Ltd.  
Gharda Chemicals Ltd. (Safal)  
Kilpest India Ltd.  
Kingtai Chemicals Co., Ltd.  
M/S Modern Insecticides Ltd. (Scoop\* Plus)  
Meghmani Organics Ltd.  
Monsanto Co. (Certainty\*, Maverick\*, Outrider\*)  
Pacific Agriscience Pte. Ltd.  
Shanghai Forever Chemical Co.  
Sulphur Mills Limited (Arrow\*)  
Sumitomo Chemical Co., Ltd. (Leader\*)

**FORMULATORS' TRADE NAMES:**

Fateh\* — Rallis India Ltd.  
Safari\* — Devidayal Agro Chemicals  
SF-10\*, Total\* — United Phosphorus Ltd.  
Sulfon\* — VAPCO, Veterinary & Agricultural Products Mfg. Co. Ltd.  
Sultop\* — Dhanuka Agritech Ltd.

**PREMIX PRODUCTS:**

+ **metsulfuron-methyl**  
Total\* — United Phosphorus Ltd.

**Sulfotep****Action/Use**

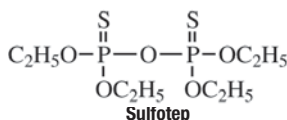
ACTION: Fumigant.  
USE: For use in greenhouses to control aphids, spider mites, thrips, whiteflies.

**Identification**

COMMON NAME: Sulfotep (BSI, ISO).  
CODE NUMBERS: CAS 3689-24-5; EINECS 222-995-2; ENT 16273; SHA 079501.

**Chemistry**

COMPOSITION: Tetraethyl thiodiphosphate.  
PROPERTIES: Pale yellow liquid. Vapor pressure 1.4 x 10<sup>-4</sup> mbar at 20°C. Miscible in *n*-hexane, dichloromethane, 2-propanol, toluene.

**Registration Notes**

US: Not marketed.  
OUTSIDE US: Not marketed in Canada.

**Mode of Action/Resistance Management**

CHEMICAL GROUP: Organophosphate.  
MODE OF ACTION: Acetylcholine esterase inhibitor.  
ACTION GROUP: IRAC Group 1.

**Environmental Guidelines**

WATER SOLUBILITY: 10 mg/l at 20° C.

**Safety Guidelines**

SIGNAL WORD: DANGER  
TOXICITY CLASS: I  
TOXICITY: (Rat): Oral LD<sub>50</sub> approx. 10 mg/kg; Dermal LD<sub>50</sub> 65 mg/kg.

**Suppliers and Branded Products**

BASIC PRODUCERS:  
Bayer CropScience (Bladafum\*)  
King Tech Corp.

**Sulfoxaflor****Action/Use**

ACTION: Insecticide.  
USE: Pending use on cotton and rice.

**Identification**

COMMON NAME: Sulfoxaflor (pa ISO).  
CODE NUMBERS: CAS 946578-00-3.

**Chemistry**

COMPOSITION: [methyl(oxo)[1-[6-(trifluoromethyl)-3-pyridyl]ethyl]-λ<sup>6</sup>-sulfanylidene]cyanamide (IUPAC); *N*-[methyloxido[1-[6-(trifluoromethyl)-3-pyridinyl]ethyl]-λ<sup>4</sup>-sulfanylidene]cyanamide (CAS).  
MOLECULAR FORMULA: C<sub>10</sub>H<sub>10</sub>F<sub>3</sub>N<sub>3</sub>O<sub>3</sub>S.

**Registration Notes**

GLOBAL: Expected launch 2012.

**Suppliers and Branded Products**

BASIC PRODUCERS:  
Dow AgroSciences LLC (Closer\*, Transform\*)

**Sulfox-Cide\*** synergist (sulfoxide) — Discontinued by Penick Corp.

**Sulfoxide****Action/Use**

ACTION: Synergist.

**Identification**

COMMON NAME: Sulfoxide (ESA).  
CODE NUMBERS: CAS 120-62-7.

**Chemistry**

COMPOSITION: 1,2-methylenedioxy-4-[2-(octylsufinyl)propyl]benzene also known as the *n*-octyl sulfoxide of isosafrole.

**Safety Guidelines**

SIGNAL WORD: CAUTION  
TOXICITY CLASS: III  
TOXICITY: (Rat): Oral LD<sub>50</sub> 2000-2500 mg/kg.

**Sulfoxyl\*** synergist (sulfoxide) — Discontinued by Penick Corp.

**Sulfur****Action/Use**

ACTION: Fungicide, Insecticide.

USE: Diseases: apple scab, brown rot, leaf spot, rust, and powdery mildew on apples, grapes, ornamentals, peaches, pecans, peanuts, roses. Insects: fleahoppers, mites on alfalfa, almonds, apricots, artichokes, bananas, barley, beans, beets, cabbage, carrots, cauliflower, citrus, corn, cotton, dates, eggplant, mangos, melons, mustard greens, oats, onions, peppers, plums, potatoes, prunes, strawberries, sugarbeets, tomatoes, wheat.

FORMULATIONS: Various forms of elemental sulfur, dry flowable, water dispersible granules, soluble concentrates, wettable powder. Finely ground sulfur for dusting is made free-flowing by the addition of 1-5% clay, talc, gypsum, tricalcium phosphate, or similar material. May be made especially fine by micronizing. Sulfur grinding involves a high degree of explosive hazard. Colloidal sulfurs, smaller particles than those produced by ordinary grinding processes, may be produced in several ways, generally by acidifying lime-sulfur solution or similar reaction. Flowable sulfur is microfine sulfur formulation in aqueous suspension form. Particle diameter size average not >5 microns via coulter counter measurement. Strong adhesive properties act as a sticker and deposit builder for other spray materials. Micronized wettable sulfur is specially made into a carefully balanced extremely fine particle size. Wettable sulfur is prepared by adding wetting and dispersing agents to finely ground sulfur, since sulfur itself cannot be suspended in water. Cavalry\* contains fine particles of fused bentonite-sulfur, which in the presence of water, shear apart into even smaller particles to increase coverage and adhesion.

PREMIX PARTNERS: *Bacillus thuringiensis* spp. *kurstaki*; Carbendazim; Chlorothalonil; Copper Oxchloride; Copper Oxchloride Sulfate; Copper Sulfate, Basic; Copper Sulfate, Tribasic; Cyproconazole; Naphthalene; Pheromone; Pyridaben; Tetraconazole; Triadimenol; Zineb.

**Identification**

COMMON NAME: Brimstone.  
TRIVIAL NAME: Flowers of Sulfur.  
EXP. CODE NUMBERS: CN 38082080 (Ciech S.A. Agro-Sulphur Group); SAN 7116 (Novartis).  
OTHER CODE NUMBERS: CAS 7704-34-9; EINECS 231-722-6; SHA 077501.

**Chemistry**

COMPOSITION: Flowers of sulfur (originally the normal form of sulfur for dusting) is the term for sulfur particles resulting from sublimation. Sulfur flour (former term for ground sulfur).  
PROPERTIES: Yellow solid. Melting point 112.8°-119.8°C. Soluble in organic solvents. Compatible with most other insecticides and fungicides.

**Registration Notes**

OMRI: Microthiol\* Dispers\*, THAT\*, Top Cop\* with Sulfur.  
OUTSIDE US: Crisazufre\*, Sulfox\*.

**Environmental Guidelines**

HAZARDS: Fish, Bee: Nontoxic.  
WATER SOLUBILITY: Insoluble.

**Key to Crop Protection Dictionary**

Chemicals are cross-referenced by common and trade name.

- = Organic
- = Reduced Risk<sup>1</sup>
- = Seed Treatment
- = Biopesticide/Biocontrol
- = New Technology
- = Plant Health

\* = Trade Name/®/TM

Information is presented here for preliminary planning only. Exclusive reliance must be placed on the information/ directions supplied by the manufacturer.

<sup>1</sup>Reduced Risk - Some or all uses have been approved by U.S. EPA

Sulfur continued

**Safety Guidelines**

SIGNAL WORD: CAUTION

TOXICITY CLASS: III

TOXICITY: Relatively nontoxic. May slightly irritate skin. Kumulus\* (Rat): Oral LD<sub>50</sub> >5000 mg/kg. Dermal LD<sub>50</sub> >5000 mg/kg.

HANDLING/STORAGE CAUTIONS: Store away from sparks, fire, flame. Isolate from oxidizing materials.

SPILL CONTROL/CLEANUP: Large spillages should be dammed-off and pumped into containers; soak up remainder with absorbent material and dispose of in accordance with local regulations.

PRODUCT/WASTE DISPOSAL: Must be disposed of in accordance with local regulations.

**Emergency Guidelines**FIRST AID: **Eyes:** flush with plenty of water. **Skin:** wash with plenty of soap and water. **Ingestion:** do NOT induce vomiting unless advised by a physician. Treat symptomatically.

EMERGENCY TELEPHONE: 800-424-9300 (CHEMTREC).

**Suppliers and Branded Products**

BASIC PRODUCERS:

Agrostuln GmbH (Sulfolac\*)  
 Aimco Pesticides Ltd. (Aimcoflo\*, Sulphotox\*)  
 BASF Corporation (Kumulus\*)  
 Biesterfeld U.S. Inc.  
 CIECH S.A. (Siarkol\*)  
 Crystal Chemical Inter-America (Crisazufre\*, Sulflox\*)  
 Crystal Phosphates Ltd.  
 Drexel Chemical Co. (Micronized Gold\*, Suffa\*)  
 Excel Crop Care Limited (Sulfex Gold\*, Sulfex\*)  
 Georgia Gulf Corp. (Yellow Jacket\*)  
 Grupo Bioquimico Mexicano S.A. de C.V. (Sultron\*)  
 Helm AG (Netzschwefel\*)  
 Hualong Chemical Industry Co., Ltd.  
 Ki-Hara Chemicals Ltd.  
 Krishi Rasayan Exports Pvt. Ltd.  
 Lainco, S.A. (Fungistop\*, Kualai\*, Lainzufre\*)  
 M/S Modern Insecticides Ltd.  
 Martin Resources Inc. (CSC\* Dusting, CSC\* Micro 90, CSC\* Thioben, CSC\* Thiosperse, CSC\* Wetttable)  
 Meghmani Organics Ltd.  
 Nanjing Essence Fine-Chemical Co., Ltd.  
 Nufarm Americas Inc. (Micro Sulf\*)  
 Projectfield Co., Ltd.  
 Punjab Chemicals and Crop Protection Ltd.  
 Qiaoji Group Co., Ltd. (Shanghai Qiaoji International Co., Ltd.)  
 Sabero Organics Gujarat Ltd.  
 Stoller USA (THAT\*)  
 Sulphur Mills Limited (5-Roses\*, Cosavet\*, Flosul\*, Hi-Yield\*, Sulgran\*, Wettasul\*)  
 Syngenta (Thiolux\*, Thiolux\* Jet, Thiovit\*)  
 United Phosphorus Inc. (Microthiol\* Disperss\*)  
 Wilbur-Ellis Co. (Proganic\* Micronized Sulfur, Special Electric\*)

FORMULATORS' TRADE NAMES:

Azufre Colidal\*, Insuf\*, Insulfgold\*, Microthiol\* — United Phosphorus Ltd.  
 BT Sulfur 15-50 Dust, C-0-C-S\* 15 Sulfur 25 Dust, Kolodust\*, Kolospray\* — Loveland Products, Inc.  
 Cabriidust\*, Micronite\* — National Company for Agrochemicals Production (Agrochem)  
 Cosan\*, Elosal\*, Fruvit\* Combi — Bayer CropScience  
 Crisazufre\*, Kipper\*, Sulflox\* — Dupocsa, Protectores Quimicos para el Campo S.A.  
 DFSulfur\*, Dryflosulf\*, OS\* 60, Sulflow\*, Sumite\*, WDGsulf\*, WDGsulfur\* — Ingenieria Industrial, S.A. de C.V.  
 Dhanusul\* — Dhanuka Agritech Ltd.  
 Fertisulph\*, Nagsulf\* — Multiplex Fertilizers Pvt. Ltd.  
 Kumulus\* — Arysta LifeScience North America Corp.  
 Power Sulphur\*H\* — SAFA TARIM A.S.  
 Prahara\* — Kilpest India Ltd.  
 Share\*, Sulfil\* — Indofil Industries Limited  
 Solor\* — Polsas Chemicals and Machinery Co.  
 Sufuro\* — Premier.Shukuroglou Cyprus Ltd.  
 Sulf\* — TRAGUSA (Tratamientos Guadalquivir S.L.)  
 Sul-F\* — Ladda Co., Ltd.  
 Sulfa Plus\*, Sulfer\* — Plant Remedies Pvt. Ltd.  
 Sulfat\* — Rallis India Ltd.  
 Tiolene\* — Diachem S.p.A.  
 U.S. Ag Sul, U.S. Ag Sul Cop — U.S. Ag Associates, Inc.  
 Woprosulph\* — B.V. Industrie- & Handelonderneming Simonis

PREMIX PRODUCTS:

+ *Bacillus thuringiensis* spp. *kurstaki*  
 BT 320 Sulfur 25 Dust — Wilbur-Ellis Co.  
 BT Sulfur 15-50 Dust — Loveland Products, Inc.  
 + **carbendazim**  
 Kolfugo S\* — Agro-Chemie Ltd.  
 Vicarben-S\* — Vietnam Pesticide Joint Stock Co. (VIPESCO)  
 + **chlorothalonil**  
 Bravo\* S — Helena Chemical Co.  
 + **copper oxychloride**  
 OS\* 60 — Ingenieria Industrial, S.A. de C.V.  
 + **copper oxychloride + copper sulfate, basic**  
 Wil-Dry\* — Wilbur-Ellis Co.  
 + **copper oxychloride sulfate**  
 C-0-C-S\* 15 Sulfur 25 Dust — Loveland Products, Inc.  
 + **copper sulfate, tribasic**  
 Top Cop\* with Sulfur — Stoller USA  
 U.S. Ag Sul Cop — U.S. Ag Associates, Inc.  
 + **cyproconazole**  
 Atemi\* S — Syngenta  
 + **naphthalene**  
 VSR\* — VAPCO, Veterinary & Agricultural Products Mfg. Co. Ltd.

+ **pheromone**

Stirrup\* M — Troy Biosciences, Inc.

+ **pyridaben**

Desperado\* — Wilbur-Ellis Co.

+ **tetraconazole**

Domark\* Combi — ISAGRO S.p.A.

+ **triadimenol**

Fruvit\* Combi — Bayer CropScience

+ **zineb**

Vizines\* — Vietnam Pesticide Joint Stock Co. (VIPESCO)

**Sulfur Dioxide****Action/Use**

ACTION: Fumigant.

**Identification**

CODE NUMBERS: CAS 7446-09-5; SHA 077601.

**Sulfuric Acid****Action/Use**

ACTION: Herbicide.

**Identification**

CODE NUMBERS: CAS 7664-93-9; SHA 078001.

**Sulfuryl Fluoride****Action/Use**

ACTION: Fumigant.

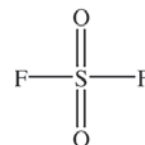
**Identification**

COMMON NAME: Sulfuryl Fluoride.

CODE NUMBERS: CAS 2699-79-8; SHA 078003.

**Chemistry**

PROPERTIES: Colorless, odorless compressed gas. Boiling point -67°F. Vapor pressure 9150 mm/Hg at 50°F (10°C).



Sulfuryl Fluoride

**Registration Notes**

RUP: Vikane\*.

**Mode of Action/Resistance Management**

MODE OF ACTION: Unknown or non-specific mode of action.

ACTION GROUP: IRAC Group 8.

**Environmental Guidelines**

WATER SOLUBILITY: 750 ppm at 77°F (25°C) and 1 atmosphere.

**Safety Guidelines**

SIGNAL WORD: DANGER

TOXICITY CLASS: I

TOXICITY: May be fatal if inhaled. TLV 5 ppm; STEL 10 ppm.

**Emergency Guidelines**FIRST AID: Get immediate medical aid. **Inhalation:** remove to fresh air. Keep warm. If breathing stops, give artificial respiration. Note to physician: First symptoms expected are those of respiratory irritation and central nervous system depression, excitation may follow; treat symptomatically.

EMERGENCY TELEPHONE: 800-992-5994.

**Suppliers and Branded Products**

BASIC PRODUCERS:

Dow AgroSciences LLC (Vikane\*)  
 Pacific Agriscience Pte. Ltd.

Sulgran\* — see Sulfur.

Sulmathion\* — see Malathion.

Sulphotox\* — see Sulfur.

Sulpox\* — see Epoxiconazole.

Sulprazole\* fungicide (cyproconazole) — Discontinued 2005 by Sulphur Mills Limited.

**Sulprofos****Action/Use**

ACTION: Insecticide.

**Identification**

COMMON NAME: Sulprofos (BSI, ESA, ISO).

EXP. CODE NUMBERS: Bay NTN 9306 (Bayer).

OTHER CODE NUMBERS: CAS 35400-43-2; EINECS 252-545-0; SHA 111501.

**Chemistry**

COMPOSITION: O-ethyl O-[4-(methylthio)phenyl] S-propyl phosphorodithioate (CAS). CLASS: Organophosphate.

# Spotlight On New Technology

The lifeblood of the industry is new technology. This snapshot of active ingredients introduced over the last five years, including nine new ones listed below for this edition, shows new product development continues at a healthy pace. Included are trade names, regulatory status, and brief comments, arranged by pesticidal action. For company contact information, see Suppliers Directory on page 752.

## Nine New Active Ingredients for 2012

### Biopesticide

*Chromobacterium subtsugae*  
Saponins of *Quillaja saponaria*

### Fungicide

Coumoxystrobin

### Herbicide

Imazosulfuron  
Iofensulfuron  
Triafamone

### Insecticide

Flometoquin  
Flupifrole  
Flupyradifurone

See chart for complete info

ACTION	ACTIVE INGREDIENT	TRADE NAMES	REGULATORY	COMMENTS
<b>Biopesticide</b>				
Biopesticide/ Insecticide	<i>Chromobacterium subtsugae</i>	Grandevo*	Registered 2011 by Marrone Bio Innovations.	For control of psyllids, thrips, mealybugs, leafminers, stinkbugs, Lygus, leaf beetles, white grubs, and armyworms in vegetables and turf.
Biopesticide/ Insecticide	Citronellol + Farnesol + Geraniol + Nerolidol	(premix: Biomite*)	Registered 2009 by Arysta LifeScience North America	For control of mites on cucurbits, hops, grapes, pome and stone fruits, nuts, and ornamentals.
Biopesticide/ Nematicide	Saponins of <i>Quillaja saponaria</i>	Nema-Q*	Registered 2008 by Monterey AgResources.	For control of plant parasitic nematodes in vineyards, orchards, field crops, turf and ornamentals.
Biopesticide/ Fungicide	<i>Trichoderma asperellum</i> + <i>Trichoderma gamsii</i>	(premix: Tenet*)	Registered 2010 by ISAGRO	For use on vegetables and ornamentals.
<b>Fungicide</b>				
Fungicide	Ametoctradin (Initium*)	(premixes: Decabane*, Enervin*, Orvego*, Resplend*, Zampro*)	Introduced in 2009 by BASF. Registered 2010 Netherlands (Orvego*); Romania (Enervin*, Zampro*); U.K. (Decabane*, Resplend*). Expected launch 2012 U.S. (Orvego*, Zampro*).	Enervin* for grapes; Zampro* for cucumbers, onions, potatoes, tomatoes; Decabane* and Resplend* for potatoes. Orvego* for ornamentals.
Fungicide	Bixafen (Xpro*)	(premixes: Aviator* 235 Xpro*, Siltra* Xpro*)	Introduced 2006 by Bayer CropScience. Aviator* 235 Xpro* launched 2010; Siltra* Xpro* launched 2011.	Aviator* 235 Xpro* for use on spring and winter wheat, triticale, winter rye. Siltra* Xpro* for use on spring and winter barley, spring and winter oats.
Fungicide	Coumoxystrobin		Introduced 2007 by Shenyang Research Institute of Chemical Industry (SYRICI).	Pending use to control anthracnose, rot, downy mildew, blight, powdery mildew, and rice blast on rice.
Fungicide	Fenpyrazamine		Introduced 2010 by Sumitomo Chemical. Valent USA seeks US approval, EPA to respond 2013.	Pending use on almonds, grapevines, lettuce, strawberries and ornamentals.
Fungicide	Fluopyram	(premixes: Luna* Experience, Luna* Sensation, Luna* Tranquility)	Introduced 2007 by Bayer CropScience. Expected launch 2nd half of 2011-2012 for all Luna* products.	Pending use on small fruits, pome and stone fruits, nuts.
Fungicide	Flutianil	Pinpoint*	Introduced 2008 by Otsuka Chemical. Pending registration by Valent USA.	Pending use on strawberries and vegetables.
Fungicide Seed Treatment	Fluxapyroxad (Xemium*)	Systiva* (seed treatment), (premixes: Adexar*, Merivon*, Priaxor*)	Introduced 2010 by BASF. Adexar* in U.K. Launch expected 2012 Europe, South America, and U.S. for Systiva*, Merivon* Priaxor*.	Pending use on cereal, corn, soybeans, vegetables, oilseed crops (Priaxor*). Pome and stone fruits (Merivon*). Cotton, peanuts, soybeans, some row crops (Systiva*). Barley, oats, rye, and wheat (Adexar*).

# imazaquin

Brand Names:	<b>Image</b>	<b>Scepter</b>
Formulation:	<b>70DG</b>	<b>70DG</b>
Company:	<b>BASF Corp.</b>	

**Action:** Herbicide

**Chemical Family:** Imidazolinone

## Introduced By

American Cyanamid (now BASF AG). Registered in U.S. in 1986. Scepter 70DG (2006) and Image 70DG (2008) contain 70% imazaquin. Scepter for use in soybeans; Image for use on turf and ornamentals.

## What It Is

One of the first ALS-inhibiting herbicides to be marketed for nutsedge control in turf in the mid-1980s, imazaquin is a selective systemic absorbed by the roots and foliage.

## What It Controls

Scepter controls broadleaf weeds in soybeans. Image controls summer weeds including nutsedge, ryegrass, and sandbur and winter weeds including chickweed, henbit, wild garlic and wild onion in warm-season turfgrass and landscape ornamentals.

## Resistance Management

Imazaquin (HRAC Group B; WSSA Group 2) inhibits acetolactate synthase ALS (acetohydroxyacid synthase AHAS).

## Restrictions

Do not apply through any type of irrigation system. Do not apply Scepter more than once a year. Do not apply Image aerially.

## Application Tips

Apply through ground equipment as soil application, preplant, preemergence, or postemergence. Shallow cultivation may aid in the control of certain weeds when adequate moisture is not received after application.

## Mixing Instructions

Maintain agitation while spraying to ensure a uniform spray mixture. Add a nonionic surfactant if tank mixing with other pesticides.

## Applicator Safety and Re-Entry

Applicators and other handlers must wear long-sleeved shirt and long pants, shoes plus socks and chemical-resistant gloves. Re-entry interval for Scepter and Image is 12 hours.

## Environment Considerations

The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination. Do not apply directly to water, in areas where surface water is present, or to intertidal areas below the mean high water mark.

## REGISTRATION

- USA
- Canada
- Mexico
- Chile
- Argentina
- Brazil
- EU
- India
- China
- Japan
- South Korea
- Philippines
- Thailand
- Indonesia
- Australia

Yes\*  Pending

\*Blue indicates that one or more branded products containing this active ingredient has been registered or is pending registration in this country/region. Multiple brand names may exist. Registered brands and uses (crops and pests) can vary by country.



Information is presented for preliminary planning purposes only. Exclusive reliance must be placed on the information/directions supplied by the manufacturer. **ALWAYS READ AND HEED THE LABEL.**

<sup>1</sup> Reduced Risk - Some or all uses have been approved by U.S. EPA as Reduced Risk application.

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