

# Grain Protectant Application Systems

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Protectant insecticides are gaining in popularity as tools of choice for protecting certain grains, nuts and products from insect infestations. Protectants are also appreciated as economical and pro-active alternatives to commodity fumigations, especially when multiple fumigations may be anticipated over time and all the costs of turning grain, fumigation safety equipment and regulatory compliance are considered. Modern protectant treatments often provide greater than 12 month residual performance.

Application capability is often the factor that limits more adoption of protectant programs. This paper will review some of the equipment available “off the shelf” for protectant applications, and considerations and sources for custom-designed application systems. Some systems can be quite sophisticated and expensive, but a basic system capable of serving a large commodity facility can often be assembled for a very modest expense.

## **Coverage and Diluents**

Good coverage is essential for the best protection. Coverage will be a function of treatment solution volume, nozzle type and the point of application. Grain protectants have typically been applied as aqueous spray solutions at volumes of 5 gallons per 1000 bushels. There is no reliable information on how low treatment solution volumes can go without performance suffering. At the extreme low end, however, there is a labeled option to apply Diacon IGR in dust control oil according to manufacturer recommendations which may be at less than 1 gallon per 1000 bushels. At least one Kansas grain company reports excellent efficacy with Diacon IGR applied in dust control oil. The best nozzle design for achieving coverage is generally a hollow cone. The best points of application will generally be where commodities are also tumbling or mixing in a screw auger, at a point of transition or falling, or in a batch mixer, but lots of successful treatments are made to grain passing on a belt conveyor. Application of a protectant as a spray will be the most precise and simple method for most situations. Diacon IGR also has the versatility to be mixed with diverse other liquid ingredients that may be part of a manufacturing process including polishing oils, binder glues, or mold inhibitors. Ready to use dry protectant products are available as alternatives to liquid applications. Rates of application for dry protectants are generally around 8-10 pounds per 1000 bushels.

Good coverage also implies treatment of the complete grain or product mass. Partial treatments such as top dressing bins, or treating protective layers of the mass only in the bottoms and tops of bins may be necessary or desirable in some circumstances. Certain insects concentrate their activity at or near the surface of stored commodities, and top dressing may be the only feasible way to add a measure of protection to a bin that is already full. Understand that these partial treatments are not as robust as complete commodity mass treatments, and protection could be variable.

### **Off the shelf – Liquid Application**

Gustafson was the leader for many years in the field of grain and seed treatments. Now a division of Bayer Crop Science, Gustafson Equipment still offers a line of seed treating equipment and at least one grain protectant applicator. Seed treatment equipment takes the considerations of coverage and gentle seed handling to an extreme not necessary for most commodity protectant applications. See website:  
[http://www.bayercropscience.com/BAYER/CropScience/BCSUS.nsf/id/Gust\\_Home](http://www.bayercropscience.com/BAYER/CropScience/BCSUS.nsf/id/Gust_Home)



Gustafson Little Gus Applicator

The Little Gus is a small portable unit designed especially for treating grain being loaded into farm bins, and it has been used successfully in some low-volume industrial settings. The unit features a 14 gallon tank, choice of 12 volt or 110 electric power, and adjustable output for treating 250-4500 bushels per hour.

### **Off the shelf – Dry Product Application**

A common method of application for ready to use dry protectants is to sprinkle an appropriate dose over the surface of a truckload before unloading. The dumping action and transfer operation into a bin will distribute the protectant throughout the grain adequately.

The Cyclone Grain Master was developed by The Cyclone Manufacturing Co., Urbana, IN, especially for application of Diacon D but would probably also handle diatomaceous earth. The unit features a product bin, electric powered adjustable auger feed, and a means to prevent bridging of dry product in the bin so that an even output is maintained. The unit is sized like a garden tractor accessory. Contact Sam Speicher (260) 918-3380, [manager@cyclone.us.com](mailto:manager@cyclone.us.com).



### Custom-design considerations & sources

The most straightforward kind of application system for a grain facility might consist of a treatment solution reservoir tank positioned for convenient filling, electric motor and pump, and plumbing to the point of application. Almost every element of this system can be modified to fit individual circumstances or preferences:

- Seasonal or permanent.
- Mobile around the facility, or permanently installed.
- Power source: electric, gasoline engine, pneumatic powered pump or pressurized tank.
- Treatment solution reservoir tank or in-line mixing.
- On/Off switching: at sprayer, remote at application point, or automated with grain flow.
- Application in water or some other diluent (depending on protectant product label flexibility).
- Treatment of commodity streams or mixer batches.



*A simple but adequate protectant application system at a country elevator: Mobile application equipment at ground level used temporarily during grain harvest season; electric motor and pump; hose running to top of bin to an optimum application point; on/off control was the plug outlet for the motor/pump.*

*Prerequisite information for equipment selection or design:*

- *Grain flow rate or mixer batch size:* Grain flow rates will dictate the output requirements of a treatment system, or the amount of protectant solution that needs to be added to a mixer batch. Characteristics of the grain flow will also dictate the number, positioning and size of spray nozzles. Protectants are generally labeled for a certain amount of concentrate, usually in fluid ounces or milliliters per 1000 bushels, or sometimes per ton of grain. The concentrate is then diluted to create a solution of sufficient volume to achieve good coverage (5 gallons per 1000 bushels often suggested). Some facilities deal in weight of commodity rather than bushels. A conversion can be made between bushels and weight as necessary. Many grain facilities will have variable grain flow rates, or may be dealing with a variety of different grains, seeds, or blends. Often these variables can be condensed down to one (or very few) typical flow rates. Some protectants also allow for a range of dosage rates. The simpler the system the better if a standardized mixing / loading / calibration scheme or minimal adjustments can be achieved.

Flow rate notes and variables:

- *What would the width of the grain flow be on a belt, within an auger or transition at the likely point of application? Or, how wide would the spray pattern likely need to be if the application was not into a batch mixer?* This is a consideration for the selection and mounting of a single nozzle or multiple nozzles.
- *Quantity of commodity to be treated in a day:* This will dictate reservoir tank size, especially for aqueous treatment solutions. Protectants in water solutions usually need to be used within a day or two, so plan tank size so that treatment solutions do not carry over and fresh treatment solutions can be prepared daily.

Protectants with the option to be mixed in mineral or vegetable oil (Diacon IGR) can remain stable and in solution for a long time after initial thorough mixing. These kinds of treatment scenarios often utilize mini-bulk tanks of about 250 gallons as treatment solution reservoirs that may last about a month, depending on the amount of commodity being treated. It is probably not advisable to add protectant to a very large outdoor bulk tank because prolonged outdoor exposure to sunlight could degrade the protectant, and uniform mixing in a very large bulk tank would be difficult..

Daily treatment projections:

- *Length of time a spraying system may need to operate daily:* This may dictate whether motors and pumps need to be rated for continuous duty. Or, this may be a good specification simply for the sake of durability.

Application time projections:

- *Tank and pump location.* Plan the position of the tank and pump. The tank should be positioned in a convenient place for mixing and loading. Consideration should be given to the sanitary conditions of the tank location with a clean water supply, and perhaps capability to periodically clean and sanitize the system.
- *Component selection and plumbing design.* Begin at your anticipated point of application. Determine whether you want one or multiple nozzles for coverage of the width of grain flow. Grain flow rate(s) will dictate the amount of treatment solution you need to apply at his point. Consult Spraying Systems (or similar) references to find nozzles that will deliver the correct output at about 20 psi. Beware of coverage efforts that can be counterproductive: Wide angle nozzles mounted too high and operating at pressures too high can atomize spray causing considerable loss. Multiple narrow angle nozzles, mounted low and operating at lower pressure will be better. Utilize nozzle sizes (flow rates) and numbers of nozzles for optimizing application and avoid high pressure to achieve application volume requirements. Many nozzle styles are available (flat fan, cone, hollow cone, extended range (XR)). Nozzle bodies – the fixtures that hold the actual nozzles, also feature different designs that may be desirable: no-drip, with or without screens, etc. Spraying System references or equipment suppliers can advise for particular circumstances.  
Measure the plumbing route and distance from nozzles back to the anticipated tank and pump location, as well as the elevation difference. Elevation and distance to points of application will influence plumbing and pump specifications. Larger diameter plumbing may be needed to overcome friction and maintain the flow rate and pressure needed at the nozzles.

*Consult Spraying Systems Co. technical resources online ([www.spray.com](http://www.spray.com)) for advice on pressure drop due to friction that can be expected for different diameters of pipe or hose over distances. This will be a factor if a sprayer system is positioned at ground level and points of application are some distance away or 100+ feet higher on a gallery floor.*

Pressure at nozzles ideally should be limited to about 20 psi, and nozzles selected for large droplet sizes.

*Pump selection:* A pump needs to be selected that will deliver the correct quantity of treatment solution to the nozzles at the correct pressure, while overcoming the interior friction of the plumbing lines and other pressure-drop

contributors (elevation, misc. fittings and fixtures, etc.) in the system. *Also, the pump needs to have the capacity to provide adequate recirculation flow to keep the treatment solution in the supply tank properly agitated and mixed.* A good rule of thumb for recirculation is for 3X the tank capacity per hour.

Notes on sprayer location and plumbing:

### ***In-line mixing options***

A tank of spray solution may not be an appealing prospect for some facilities. Another option might be to accurately inject the proper amount of concentrate into the flow of water or other diluent. Supplemental tanks or pumps may or may not be necessary to produce the necessary output characteristics to properly treat a grain stream. Needless to say, a check valve should be positioned to prevent any back-flow contamination of a water supply. A variety of technologies are available for in-line metering including veturi designs, peristaltic pumps, or non-electric water-driven proportional pumps. Identify parameters of treatment volume requirements and protectant concentration necessary for your facility. For design assistance and parts utilizing injection mixing consult DEMA Engineering, [www.DEMAeng.com](http://www.DEMAeng.com), or [www.pestspray.ca](http://www.pestspray.ca).

For information on non-electric water-driven chemical injectors see [www.dosmatic.com](http://www.dosmatic.com) or [www.dosatronusa.com](http://www.dosatronusa.com). For a selection of peristaltic pumps see [www.grainger.com](http://www.grainger.com). Search: peristaltic pumps.

### ***Putting it all together***

Considerable expertise and resources for sprayer design and assembly can be found locally in virtually all areas. Along with the ingenuity of many maintenance personnel it should be feasible to plumb a system and devise appropriate application points and on/off controls. Inquire at local agricultural equipment dealerships, or locate sprayer suppliers for the horticultural or structural pest control industries. Sprayers with hundreds of feet of hose will often have tank sizes and pump characteristics similar to a sprayer plumbed to the top of a grain elevator. Also, be sure to get these features:

- Recirculation to tank to achieve and maintain good protectant mixing. Agitation in the tank is critical for most protectants. Plan on recirculating #X the tank capacity per hour. Cone-bottom tanks empty nicely, and achieve good recirculation mixing in their cone bottoms.

- Adequate filtration/screening to prevent clogging nozzles with grain elevator debris.
- Ball valve at the tank outlet for leak control should one develop. And, another near nozzles to facilitate maintenance.
- Nozzles with no-drip valves.
- Pump self-priming whether by positioning or with a check valve.
- Anti-siphon protection by some means at the tank filling site.

More help:

- Ag West Distributing, [www.agwestdist.com](http://www.agwestdist.com). Locations throughout the Northwest. An example of an agriculturally-oriented company that can fabricate specialized agricultural spraying equipment. An Ag West outlet in Montana assembled an economical treatment system for an elevator/flour mill that has served well for a number of years.
- Raymar Supply Co., 2404 D.E. Short Rd., Sasser, GA 39885  
[www.raymarsupply.com](http://www.raymarsupply.com) (800) 499-6930, (229) 698-6930  
David Sapp, [David@raymarsupply.com](mailto:David@raymarsupply.com)
- Simpson Farm Enterprises, 20333 North Ness County Line Rd., Ransom, KS 67572. [www.simpsonfarm.com](http://www.simpsonfarm.com). Greg Simpson (800) 235-5359. Outlets also located in Hays, Great Bend and Beloit, KS. Farm equipment and sprayer specialists. Two pump kits are available pre-assembled that will match most grain protectant needs
- Edward J. Heck & Sons, Omaha, NE, [www.ejheck.com](http://www.ejheck.com), is a prominent designer and installer of mineral oil dust suppressant spraying systems for grain elevators. Heck's experience designing and installing durable spraying systems in elevators and convenient control systems warrants their listing here. However, we do not know if they have experience specifically with grain protectants in any respects, or incorporating injection metering of additional ingredients into oil systems. A simple system for incorporating Diacon IGR treatments in dust control oil consists of a small tank for mixing a daily supply of oil + Diacon IGR plumbed back into the oil application system.
- Spraying Systems, [www.spray.com](http://www.spray.com), is the ultimate authority on any kind of spraying equipment and application engineering. Regional affiliates are available for custom design and installation of any kind of spraying system. Contact these

people for more complex systems, more exotic power supplies, or more sophisticated control systems.

- (Contact information for additional regional shops capable of designing and building treatment systems is pending.)