

Subject: Diatomaceous Earth (Technical inf.)

Date: 4/17/1999

The following information was selectively quoted and typed in from "The IPM Practitioner" Monitoring the field of Pest Management Volume XVIII, number 5/6, May/June 1996 article title "Diatomaceous Earth and Stored Product Pests" By William Quarles and Peter S. Winn.

Diatomaceous earth is composed of microscopic fossils of diatoms. Diatoms are a type of green algae (phytoplankton) that produces a shell made of amorphous (non-crystalline) silica. The diatoms grow in freshwater lakes or quiet salt water bays or estuaries, either as individual cells or in long strands that float in the water. They absorb dissolved silica (silicon dioxide) from the water to produce their shells. Almost universally, the source of this silica is volcanic ash which falls into the water and partially dissolves. When the silica is depleted, the diatoms die and their shells fall to the bottom of the lake or bay, building up layers of microscopic fossil shells. Another algae bloom develops after the next volcanic eruption, and the process repeats.

Selective mining is required to avoid contaminating the DE with ash, clay, limestone, chert or salt. DE in the ground contains about 35% moisture. After mining, it is dried at low temperatures to about 5% moisture, milled and classified (sorted by size) (calvert 1930)

Only uncalcined (not heated to high temperatures) DE is suitable for use as an insecticide, as calcining reduces its effectiveness and increases crystalline silica content significantly. Calcined products are typically used for filtration (Quarles 1992a). Currently, no major DE producers routinely test their products for insecticidal efficiency.

Subramanyam (1995) found that 5 commercial brands of DE were better than 90% silicon dioxide by weight and the silica was better than 97% amorphous. The mean particle size was 7-15 microns, bulk densities ranged from 300-350 g/liter, and surface areas ranged from 2-3 g/sq. m.

DE dust kills insects by desiccation. It absorbs waxy fats and oils (lipids) from the epicuticle (skin) of the insects and other invertebrate pests. Once the waxy, oily coating is removed, the insect cannot retain water and dies due to dehydration. Silica gel and fumed silica are synthetic amorphous silicas (SiO<sub>2</sub>) that also kill insects in this way.

In large-scaled field test in the 1960s and 1970s the USDA proved that diatomaceous earth or silica gel treatment could protect stored products against a whole host of weevils, beetles, and borers. Treatment was most effective for hairy insects with large surface-to Volume ratios. Concentrations of Diatomaceous earth Permaguard(r) between 2000 to 5000 PPM gave protection as good or better than malathion (see Quarles 1992ab)

DE is less effective on moist grain (>14.5% moisture content) not because the DE becomes less effective as a desiccant, but because insects have a constant source of water to replace their losses. Higher relative humidities of air (>70%) also make DE less effective for the same reason (korunic 1996). Higher temperatures make DE more effective, as water loss is enhanced. The larger the concentration applied, the more effective, as the insect has a greater chance of encountering the

desiccant. The type of grain is important, because before DE can give protection it must adhere. Thus a higher applied concentration of DE is needed to protect corn than wheat.

DE products with a top particle size greater than 45 microns are not sufficiently effective to be worth using. Based on technical information provided by the four DE producers, for products with a top particle size of 45 microns, marine DE has a larger oil absorption capability. For example, the oil absorption value of the marine DE product Insecto(r) is 175%. DiaFil a freshwater DE, shows absorption of about 116%. Various grades of silica gel absorb between 200 and 300%.

Published research indicates that the primary mode of insecticidal action of DE is absorption of lipids from insects epicuticles. Since lipids are basically high molecular weight oil, the greater the oil absorption capability of a DE product, the greater the efficiency is likely to be.

The advantage of DE for stored product protection are that it is nontoxic, leaves no chemical residues, can be separated from grain by physical means and can be left in silos for on-going protection. DE has no adverse affects on grain milling or baking (below 300 PPM) or malting (below 900 PPM).

Things to understand when you purchase: The lower the content of Crystalline Silica the better the product. Is the source from fresh water or salt? Is the name and address on the bag?

Notes and thoughts come PS time:

- \* Put 1-2 cups/50 lb in your storage bags of cat, dog or animal feed as you buy them to allow for longer storage.
- \* Silica Gel can be used in conjunction with DE for maximum protection.
- \* Completely mix and coat each seed, bean or etc. with DE powder. Seeds take more to coat beans take less. Use at the rate of approximately 1 cup/50 lb.
- \* If your not sure of the efficiency of your DE you can always use more of it to compensate. For example 2 cups/50 lb.
- \* I have found, if your DE has a high moisture content, you can gently dry it in a flat dish, by use of a microwave oven on short intervals of power, taking it out to stir it so the moisture comes out. Just make sure the DE doesn't get too hot.

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Subject: Food storage (revised 17 April)  
Sent: 17 April 99

The first and the 4th paragraph needed some revision to take into account Rogers information on viability of seeds and more information I found about Diatomaceous earth. Hope I did this revision before it was put on the web.

The following describes one way (defiantly not the only way) to store beans and seeds for later food use. This method should work for seeds you plan to plant and grow up to a limited storage time of 2-3 year or less depending on temperature. See Rogers notes on this.

Purchase 5 gal plastic paint buckets with lids (about \$3/each), and heavy duty Compactor plastic bags (about 2 Mil) at your local discount building supplies store (Home Depot, HomeBase..). If you are worried about plastic absorption into the food then use Mylar rugged food grade liner bags 4 mil (see last paragraph). Purchase some Diatomaceous earth. As an example of a source see: <http://www.zetatal3.com/food/tfoox042.htm>

Line the bucket with a 2-4 mil plastic bag and pour in the seeds or beans until the bucket is about 1/2 full. See next.



Add about 1/2 a cup or less of Diatomaceous earth and stir it in completely. The recommended amount is 1 cup for every 50 lb. of seed or bean. Pour in more seeds or beans until the center mounds up just even with the top of the pail. This will go down to about 1" below the top once it is stirred.



Pour in a 1/2 cup of Diatomaceous earth (See above) and gently stir it (See next).



DE needs to mix with all of the seeds or beans uniformly. One easy way to do this is to put some seeds and the appropriate amount of DE in a closed bucket and shake it until mixed, then pour this into the storage bucket and repeat until storage bucket is full. Mix at the rate of about 1 cup (1/6 lb) of DE for every 50 lbs of grain or seed.

This step is an optional, do it if you think it is needed. Add 3 table spoons or more of Silica Gel (a drying agent some times sold to dry flowers, I got it at Michael's) to the center of a small square of fine weave cloth. I used 8"-10" square pieces of old bed sheeting. Lift the corners and bring them together, twist and tie with a stainless steel or copper wire (I believe Iron will rust over time and may rust through). Cut off the excess wire and bend the pig tale back so that it doesn't puncture the cloth. See next:



Place the bag upside down in the center with the excess cloth fanned out, to give an extra layer of cloth between the silica gel and the seeds or beans. See next.



Close the 2-4 mil plastic bag so as to not trap any air. This can be done by holding down on the bag close to the seeds or beans on the top then twisting it. Tape with some black plastic electricians tape with several turns. Copper or stainless steel wire can now be used over this tape to tighten it so it is even more air tight, and the tape will not relax over time. Use a pliers to get it tight. Cut off the excess wire and the remaining pig tail, bend it around the tape. Add a another layer of black electrical tape over the top of the wire. This keeps the wire from punching a hole in the plastic bag. See next.



Lay the round taped area of the bag down on the seeds or beans and push it flat. The seeds or beans will move around and make room for it. Check that there is enough room for the lid to properly close. If needed push the seeds or beans around to make it level. While holding the excess plastic on the top of the bag away from the edge of the bucket put the top on. Use a heavy weighted rubber mallet to pound the lid on. See next.



Caution: Don't stand on the lid to close it. It's too easy for the bucket to tip over with one possibly getting hurt from the fall. I almost fell off, several times on my first few buckets using this method.

Label the container as to its contents using a permanent marking pen. Put a clear plastic tape (box closure tape) over the top of it so it doesn't rub off. Even permanent marking pens will rub off on this type of plastic.

When your ready to open it, use a special tool to get it open (can be purchased at building supplies store). This tool has several shapes and sizes depending on where you get it. It basically has a metal lip, that pries up the edge of the lid without damaging it. No broken finger nails, etc. See next.



The number of pounds of raw beans or seeds that I was able to get in a 5 gallon bucket is listed below for Organic seeds from: <http://www.zetataalk3.com/food/tfood15e.htm> Note: These plastic buckets weigh about 3 lb. lid included.

| Name       | Pounds of beans or seeds<br>(not including bucket) |
|------------|--|
| Barley     | 28.5   |
| Garbanzos  | 35   |
| Brown Rice | 31.5   |
| Adzuki     | 33.5   |



IIVVII  
Light

Enzymes begins to die off at about 118-180 degrees Fahrenheit as best I can recall. It would be a good idea when building this to stick a thermometer in this unit near the inlet and where the air comes out to adjust the air flow volume by the size of hole in the bottom, until the temperature comes out to be below say about 118 degrees or whatever our experts on this subject say. It may be some foods are OK to dry at hotter temperature.

Another thought: I will bet one could slow cook a meal with a 1000 watt light designed to capture and hold the heat above the light in a more tight box with no air flow. I don't know if the cooks would like working up in the air like this or not. Many of us may not have a choice.

Another thought: I will bet one could distill water and alcohol above one of these lights.

Note: The above would be incandescent tungsten filament type bulbs. I doubt florescent or LEDs put out enough heat for cooking, and distillation but they may work for low heat food drying.

MikeL  
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Subject: High quality Seed and bean food source  
sent: 30 Dec 98

I got a recommendation of where to get high quality organic sproutable seeds and beans. This was given to me by a local company that grows and sells sprouts to health food stores and at local farmers markets. Request a Wholesale Catalog and order by the 50 or 25 lb. You essentially become a food-co-ops. Prices are reasonable. I believe this to be a good source for food storage and possibly seeds for growing more. I have been growing Kamut, Garbanzo, soy and some others from this source and will let you know latter if the second generation sprouts OK. To give you an idea of the prices. For 50 lb. of Organically grown Soy Beans (\$27.75), Peas whole (\$24.90), Barley sprouting (\$22.50), Wheat Berries sprouting (\$19.90), Long Grain brown rice (\$35.75). They ship UPS.

Sundance Country Farm  
P.O. Box 2429  
Valley Center, CA 92082  
Toll Free 1-888-269-9888  
Fax 760-751-1141  
<http://www.sunorganic.com/>

How to use: To prepare this after PS, one would use sprouting technology. This softens up the seeds and beans over a few days. Whether they sprouted or not after years of storage you would not care, they would still be edible. One could add a bit of colloidal silver to the batches of soak water to cut down on parasite growth possibility. This allows for minimal use of scarce cooking energy after PS.



