The Science Behind Borates

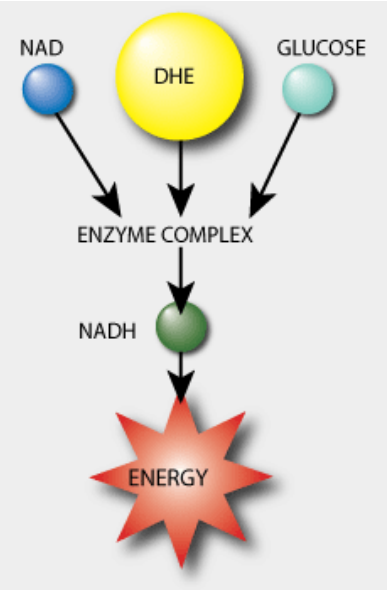
Two common kinds of products used against pests are knockdown poisons and borate-based baiting systems. A poison's effect is immediate, but very short-lived. It kills the individual that comes in contact with it, but other individuals who don't encounter the poison live, and a colony will return to be a nuisance again. With a borate bait, the final effect takes a bit longer because the pests ultimately starve to death after consuming the product; but any colony is effectively controlled so pests cannot return until a brand new colony moves into the area.

So how do borates work if they don't act like poisons? For insects and other animals to create energy from food, they must extract energy from their food using enzymes. Enzymes are proteins that accelerate chemical reactions within cells. To turn food into energy, a specific dehydrogenase enzyme needs to bind to both the food molecule and another compound called a co-enzyme (NAD+). The enzyme then breaks the food molecule into small pieces and transfers reducing power to the co-enzyme (NAD+ becomes NADH) that then carries it away to make energy, a process known as the Krebs Cycle.

Borates, however, interfere with this process of turning food into energy in insects and other pests. They intercept the NAD+ co-enzyme before it can be bound by the dehydrogenase enzyme. The resulting co-enzyme/borate complex can no longer be accepted by the dehydrogenase enzyme to create NADH, and energy cannot be created by breaking down food.

Normal Metabolism

(A simplified view)

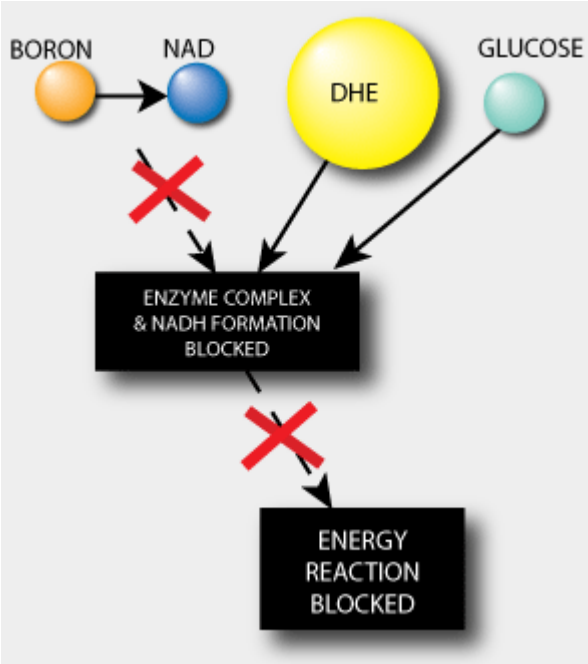


The NAD co-enzyme combines with DHE (dehydrogenase enzyme) & glucose which is broken down. NADH is a by-product that ultimately produces energy when fed into the electron transport chain.

As the pest continues to eat the borate bait, it accumulates more co-enzyme/borate complexes, and when the borate load is sufficient, all the co-enzymes are tied up with borates. At this point, the pest can't gain energy from the food it consumes, and because insect or fungal pests are not able to easily excrete borate (unlike mammals), their cells starve and they die. Because of this process, social insects such as ants that share food through regurgitation will contaminate and kill the entire nest or colony.

Interrupted Metabolism with Boron

(A simplified view)



The Boron molecule attaches to the NAD co-enzyme, blocking NAD from attaching to DHE (dehydrogenase enzyme) and preventing formation of the enzyme complex and NADH. As a result, the glucose reaction is also blocked, and no energy is released.

As an added plus, pests cannot develop a resistance to borates because of their unique action.

How are borates "green"?

Borates are an essential micronutrient important in animal and human nutrition. They are natural components of the environment that are essential for the healthy growth of plants. They neither accumulate nor bio-accumulate, and are present naturally in sea water, fresh water, rocks, soil and all plants.

Borate-based products are made from low toxicity materials that are broken down in the environment. Their borate active ingredient is released as a natural borate salt, and is part of a normal healthy environment.

One of the great things about borates is their low acute mammalian toxicity. In people and pets, the digestive system extracts what borate is needed for a healthy metabolism, but excretes any excess in urine via the kidneys. Furthermore, it is difficult to get people or pets to consume as much borate as target pests do. Insects do not have kidneys, and their equivalent of kidneys—Malpighian tubules—cannot easily excrete borates.

Borates have a long and successful history of usage spanning more than 50 years in Europe, New Zealand and Australia.