The Use of Fumigants in Nursery Management

By Jack Fisher.

"I want to go right into the slides, Dick, if you please...

"Some years ago when we started work on soil fumigants, our research department primarily studied the movement of fumigants in the soil. And we've learned a great deal about this particular phenomenon. I'd like to discuss that today. Each one moves by a different phenomenon through the soil . Now what about the amount of moisture in this soil

mass? If you have a dry soil, you'll have a very small amount of. soil water and your air space will be proportionately larger. Therefore, you have quite a few of your molecules of fumigant in the soil air in proportion to the soil water. If you have a moist soil, you see, relatively speaking, there's more soil moisture. Therefore, you have more chemical in your soil water. In this case your chemicals will move much more quickly through a soil mass than it will in here. The water tends to slow it down; and as you will see later, this is a desirable point. If you have a wet soil, as in the early spring coming out of the winter, you'll have your soil pore spaces or air spaces discontinued--they'll be full of water. Therefore, the chemical will move a little bit into the soil water, but it won't move very much further because there's no air there for it to move through the soil. Now, what about this soil porosity or air spaces in the soil? If you have a loose soil, you have a fairly good size of pore space or air space so that the chemicals can diffuse through the soil mass. I don't know if I've made this point clear, but as they move through, equilibrium is constantly in effect. The chemical will go out of the soil water to replace that which has moved on, and you'll have some more molecules of chemical in this soil air. In a compact soil, which hasn't been worked up, your soil air spaces are very small. Your chemical can't move very fast or very far through that soil. It stays more in the soil water and for that reason, as I said before, it can't move very fast. In a very compact situation, you can see that you have a bit of the chemical going into the soil water, and then it goes into some soil air and it reaches an impasse. It can't go any further. So you have a lot of discontinuous soil air spaces which prevent it from moving hardly at all through that soil mass.

"What about temperatures? At 40 degrees your chemicals will have this proportionate amount of chemical in the soil air in relation to the soil water. At 60, you'll have more, merely because of the molecular movement of the molecules of fumigants. At higher temperatures, you can see you'd have proportionately more chemicals going into the soil air, and this is why you can get a better job of fumigation at these higher temperatures. This is why we recommend you do not use a fumigant when the soil temperatures are in that range.

What about soil type? Here's the sand with a fairly good size soil air space or porosity. Here's a clay where you have many more tubes of air space. Now, somebody could say, "All right, you add all these together and they will equal this." That's true. But quite often in a clay case, more often than not, you have in connection with the clay organic matter in this heavy soil clay type soil which tends to have an effect on this movement of the chemicals. In a dry soil, the organic matter has very little effect on it. There's a fair amount of molecules in the soil air. In a moist condition there's still a fair amount, but in a saturated condition, the same is true as in just coming out of the winter rainy period.

The organic matter tends to tie up and break, down the soil fumigants so that they don't move. So, in a high organic type soil, it's the same as being a very saturated soil.

"Now, the phenomenon that killed these nematodes is a concentration of the chemical times time. This is diagrammatic. But here you can see in one hour it takes this many molecules of fumigants to kill that nematode. Two hours, less. Three, four, five, six-

Time versus concentration. Now, let's take these two different types of fumigants. In the case of Telone or Shell DD for nematodes, it would take this many molecules of fumigants to kill a nematode. Methylbromide is not quite as good as a nematocide. In the case of fungi, you can see how Telone is not as good as Methybromide for controlling that particular organism. It takes more of Telone to control and kill weed seeds than it does Methybromide. So you want to pick the fumigant for the job you want to do.

"This is a kind of picture 'to show you again what the two chemicals. will do relative to temperatures. We were talking about soil temperatures at six inches deep. These are picutres of nematodes Telone will kill in case you don't recognize them. These nematodes are unhappy at all ranges, or at least all ranges shown here. Some chemicals have a wide spectrum of activity on nematodes at all temperatures. With Methybromide it does a very good job at 85 and 70; 55 is fair; 45, and then the nematodes are happy. It doesn't kill them.. You can remember one of the earliest slides where we showed temperature effect on Methybromide. It doesn't move through the soil too fast.

"Now, let's talk a little bit about the practice of or method of injection. If you were to pick a glob of soil and inject a spot of fumigant in the middle, the fumigant will spread out in all directions in a sphere. If you were to put a single line of fumigant through the soil you would again have it going out in this direction, but you'd have a long cylinder. (The tape missed a point here.)

"What are the factors that have to do with this spread of fumigants? At the soil surface you have a very small amount of resistance. Chemical is injected in here; it moves up and up; and it gets up to the surface without any air. If it were to go down, and those molecules do go down, they keep coming upon more and more resistance; so the general movement of fumigants, or their desire, is to move up and out. We want to keep them in so they will do the job.

"So, in essence, this will show you what we have. These are spheres of control. You get fairer control below than you do above, because the cemical gets up too fast. What can we do to prevent that or at least improve this upper surface zone of control, because that's where the nematodes are--at least there are more up there than there are at deeper depths. Also, that's where more of our roots are. :That's where our plants are grown. Now,

if you were to have a compact or moist wet condition in the subsoil with a loose dry soil above, this is all the zone of control you get in the subsoil. There's almost none at the surface and that's not good. Your depth would not be good either. But, if you had a compact moist surface area six, eight or ten inches and then in the subsoil you have a loose, with dry-to-moist situation, you have this type of control. It would go clear to near the surface and kill up there and would go down 18 or 24 inches, depending upon your subsoil. If you have a loose dry surface, and a moist or dry compact subsoil, what would you do to that soil to get a good fumigation job? The very first thing, and certainly a must, would be to compact that surface. You want to slow down its movement out of the soil. The second thing you would do would be to wet and compact that surface. These are the things you should do, if you can.

"Now, if you were to have a moist, loose surface with a wet compact subsoil, you'd get a fair job by compacting the surface. If you have a wet, loose or compact surface with a wet compact subsoil, you're just better off waiting until you can get your soil condition as described.

"Now, in regard to organic type soil, you should have the residues decomposed because, as I said earlier, these residues break down and tie up, mechanically tie up, the fumigants or take them out of action. You should loosen the soil; you should have it moist, sprinkle it if you have to. It should be warm. until it gets up to the 50 to 60 degree range.

"Some people wonder about injection depths. If you were to put it in at 3 to 4 inches, you would get very good control at the surface but it wouldn't go very deep. If you were to put it in at 8 to 10 inches, or along in that range, you'd still get good control at the surface with going down maybe 20 inches. If you were to drop it down to maybe 12 or 14 inches, you'd bring it out of the surface control range, but you'd go down deeper. It depends upon what you want. Or, if you wanted a really good job, and this is what they're doing in California, in many cases they're injecting at two different depths at 6 and 12 inches. That gives you surface control and gives you depth, as I recall, down to 30 or 36 inches.

"Remember we had a small hand up there and a large hand down here (he indicated hands on surface and below). Well, placing a sheet of polyethylene over the surface is the same as increasing the size of your hand up there. And with the case of Methylbromide, this is a must. Methylbromide should never be used in soils without some kind of help, by way of the tarp, because it is so volatile it will move through the soil so fast as to get out before it has a chance to kill the organisms we're after. For Methylbromide, I think, by this time you will be able to tell me the desirable conditions and conversely the undesirable conditions there.

"I brought along another set of slides, another little story showing types of tarp-laying equipment, and after we see these two here, we can go into that. There are two ways of putting on Methylbromide and

Methybromide-type chemicals for nursery practice. One is to inject it and lay a strip of polyethylene along behind; another one is to inject it and use a larger piece of polyethylene in which you do a 20-foot wide strip instead of a 4 to 5-foot wide strip. Working with the Chittenden Nursery, I believe there was an article in Tree Planters Notes last year on this tarp layer that they and Dow developed. We're quite happy with the way the machine works, and Jim will show you the machine tomorrow morning. Then at Coeur d'Alene tomorrow afternoon we'll see some of the plots that we put out over there."

Jack described the tarp-laying machine in detail without the pictures. There's not much use in attempting to describe them. Undoubtedly, he Will be glad to send pictures or more adequate description to those interested.

Homer Ward

"Thank you, Jack. That was an enlightening presentation on that subject. Quite often in our nurseries we do things and get a re-action and we don't know how or why. Now I think this sheds a great deal of light on that subject. The only thing I might comment upon, that is with tongue in cheek, is this entirely closed system. Once in a while you have to change those blooming nozzles, and it's not enclosed. That's just one of the little sidelights that makes fumi-gation interesting...It keeps you awake.

"The use of herbicides, while not new, has had only a very recent application to forest nurseries. Here with us is Roger Scott of Giegy Chemical who will present his story on herbicides."