Soil Fumigation at J. Herbert Stone Nursery[1]

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Scholtes, John R. 1989. Soil Fumigation at J. Herbert Stone Nursery. In: Landis, T.D., technical coordinator. Proceedings, Intermountain Forest Nursery Association; 1989 August 14-18; Bismarck, ND. General Technical Report RM-184. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 35-37. Available at: http:www.fcnanet.org/proceedings/1989/scholtes1.pdf

Abstract.--A brief discussion of the history, and current fumigation operations and experiences at the J. Herbert Stone Nursery. Also a post script to this presentation.

INTRODUCTION

The J. Herbert Stone Nursery (JHSN) was established Through a joint effort between the USDA Forest Service and Bureau of Land Management. The site was obtained in two purchases in 1976 and 1982. It is administered by the Rogue River National Forest. The nursery is located in Southwestern Oregon near the towns of Central Point and Medford, Oregon. The total area of the Nursery site is 306 acres with approximately 213 acres of seedling production area. Douglas-fir makes up approximately 608 of the production although a total of 18 - 22 species are produced each year.

The climate is described as "mediterranean" having hot-dry summers, a long growing season and wet-mild winters. The established lifting window for the "dormant plant" lifting season is between December 1st and March 1st.

Most of the nursery's clients are made up of several National Forests and Bureau of Land Management Districts within the southwestern quarter of Oregon and the northern portion of California. Some specialty products such as 1-0 Western larch are being produced for clients as far away as Northern Idaho and Western Montana.

Age classes being grown include both 1-0 and 2-0 ship seedlings with a minor but increasing number of 1-1 transplant seedlings being ordered. These different species and age classes are further divided into a complicated array of "cultural groups" in order to custom grow seedlings which meet the different morphological characteristics requested by the clients while still producing plants that are phenologically sound for lifting, handling and transplanting. The "target seedling" concept has been used for several years to establish the range in options which are available to clients have when ordering seedlings.

PAST EXPERIENCES WITH FUMIGATION

Soil fumigation has been a standard part of the nursery production program since the first seed was sown in the spring of 1978. The original fumigant used was a mixture of 67% methyl bromide and 33% chloropicrin (MB-C). This material was applied and covered with plastic tarp in the standard manner. It was always applied by a fumigation contractor. Fumigation was generally done in the fall before sowing. There have been small areas fumigated in the spring when there were seedlings still occupying areas designated for sowing the following spring. In these cases, the seedlings were removed during the winter lifting season and the fumigation was completed as soon as the soil was in acceptable condition that spring.

Fumigation has always been done for the control of soil born pathogenic fungi which are known to cause pre and post germination dampening-off as well as root rot during later plant development. The pre and post fumigation soil tests have consistently shown that MB-C is a highly effective fumigant for the pathological fungi which were considered threatening at this site.

However, there has been an increasing concern over the continued use of MB-C. This concern has developed from several factors. There has been rumors that MB-C may be more stringently regulated or even banned from use. There have also been rumors about tighter controls on the disposal of the tarp and other materials which have been in contact with the chemical. One nursery had an incident involving this material as well as other factors which led to an administrative decision to ban the use of the product at that site. Recent experiences with poor contractor safety and performance at JHSN has also been a major factor in searching for an alternative product.

1Paper presented at Intermountain Forest Nursery Association Annual Meeting. [Bismack, North Dakota, August 14-17, 1989].

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The development of a new formulation of the fumigant dazomet known as Basamid [R] spurred the Nursery Management and the Forest Pest Management people in the Forest Service Regional Office in Portland, Oregon to look into the use of this new product as a nursery fumigant. Several tests have been conducted at JHSN over the past several years.

The first test involved several small plots in a single seedling bed. Different levels of dazomet were incorporated into plots. Pre and post fumigation soil analysis was done to evaluate the effectiveness of the material. Seedlings were also grown in these plots and evaluated. The data was very encouraging so the following year, an area of approximately one acre was not fumigated with methyl MB-C. The standard fumigation layout in this field required that fumigation be done perpendicular to the way the seedbeds run. Therefore, the area left untreated ran across an entire field of seedbeds. This area was later treated with dazomet. Pre and post fumigation soil samples were taken for both fumigants for laboratory analysis by FPM personnel. The area was sown to several species of seedlings involving many different seedlots. The soil samples proved that, while the dazomet was not quite as thorough as the MB-C, it still performed within the ranges considered to be effective. Informal evaluation of the seedlings growing in the two treatment areas did not detect any differences.

The following year, about half of the ground to be fumigated was treated with dazomet. Again, no differences in effectiveness nor seedling characteristics were noted.

In the fall of 1988, the entire area to be fumigated was treated with dazomet. All went well for several days after the treatment. Then it was discovered that both 1-0 and 2-0 Western white pine in a field east of the treated area was starting to exhibit signs of chemical injury to the needles. The affected needles turned straw yellow to reddish brown within a period of one to three days from the first indications of trouble. This was quite a surprise to the management of JHSN. Up to this point, there had been no indication of trouble with seedlings in areas adjacent to areas treated with this product. There had been discussion with another nursery about observed trouble when it was applied near Western white pine. However, it was thought that being across a major field road which was a distance of over fifty feet would be sufficient to afford protection from any chemical or gaseous drift. In this case, the JHSN damage extended well over 200 feet into the seedbeds with occasional damage over 300 feet into the beds. The damage seemed to be quite selective. Even though there was a gradient of damage from heavy near the fumigation site to minor at a distance of 250-300 feet away from the treatment boundary, there was also a distinct pattern of individual seedlings. Near the treatment site, certain individuals would have 90-100% needle kill while neighboring seedlings would show only minor tip burn. Further away, there were seedlings with one half the length of nearly all their needles burned while adjacent seedlings showed no symptoms.

This event also surprised the chemical dealer and manufacturer. They had been involved with the JHSN testing and use from the very first tests. The application of the chemical had even been video taped at the JHSN location as a demo on how to apply it on a large scale operation.

Having experienced this event, the management of JHSN is looking at how to prevent a similar occurrence in the future. It is felt that this is an effective alternative to the use of MB-C and its continued use is justified. Proper precautions, however, must be taken when it is used in areas near plants which are apparently susceptible to it or its by-products.

The reasons for this incident and the causal agents have been discussed at length. We are virtually certain that the problem was not caused by drift of the product during application. The application was done under carefully monitored conditions and the damage did not appear for some days after application. It was noted that there had been a weather incident after the application during which there had been particularly still mornings. This is not unusual in the Rogue River Valley in which the nursery is located. This type of condition, known as an air inversion, traps air in the entire valley but is also noticeable within local areas of the valley when ground fog lays just a few feet off the ground and there is no noticeable movement of the local air. It is conjectured that such a condition led to the buildup of escaping by product gasses from the dazomet into some level of concentration at or near the ground surface. This concentration could have then moved slowly down drainage across the area of Western white pine. The affected area was located at a lower elevation than the treated area and the pattern of damage supports this idea.

Future use of this product must be more carefully planned. Among the measures being considered at this time include: Treating smaller areas within a given time frame (approximately 20 acres had been treated in one application day in the case of the damage to the Western white pine). Perhaps treatment with another fumigant should be used when the area is near the susceptible species. Better sealing techniques may be required such as using plastic. The weather patterns may be more carefully monitored to avoid still air and inversion conditions. Other more radical treatments have also been considered. Using a fan system such as used for slash burning or orchard frost protection may provide the air movement needed to prevent damage to susceptible species. A barrier such as a plastic covered fence may detour the air around the area to be protected. There may be other methods of protection as well.

A POST SCRIPT TO THE PAPER

Dazamet was used again in the fall of 1989. Prior to treatment, a few methods of protecting Western white pine seedlings which would again be near the

treated area were evaluated. A barrier of plastic over shade frames was placed down slope between the Western white pine and the treatment area. Smoke from torches was released on the treatment side of the barrier on a "still" morning. The smoke simply built up and crawled over the 4-5 foot high fence. A large gas powered fan used to fire piles of forest logging slash was placed in different positions around the barrier. This offered little or no protection as the smoke went over, around, and past the fan.

Finally, it was decided that the only protection that could be counted on was distance or being totally down wind from susceptible species. A small contract was let to use MB-C adjacent to two areas of Western white pine. One area adjacent to Western white pine transplants was completely treated with MB-C. The other area was treated for a distance of 250 feet from the Western white pine. The results were that the area totally treated with MB-C has no noticeable affects from the fumigation. However, the Western white pine that was within 250 feet of the dazamet was again seriously affected. This time, no affects were observed for several days after treatment. Then, after another heavy-still morning, the needles on the Western white pine started turning. Again, a definite pattern is noticeable across the area of seedlings. A portion of the area which is at the same elevation or higher that the treated area had no damage. The damage also grades out as the distance from the treated field increases. There is again, a noticeable difference between damage to individual seedlings adjacent to each other.

THE FUTURE

The old adage "if he does it to me once, shame on him - if he does it to me a second time, shame on me" is beginning to nag at the management at JHSN. We know that dazamet is a useful tool and a good alternative to using MB-C. We feel that we need to keep both of these chemicals available for selective use as needed. The fact that Western white pine can be damaged when dazamet is used in the vicinity attests very strongly to the need for alternatives. We had sown the two age classes of Western white pine involved in this damage in the center of the nursery not anticipating any problems. Last spring (1989) we located the Western white pine in an area of the nursery which is up drainage and generally upwind from any other field at the nursery. We will continue to locate this species into areas which are not susceptible to the downwind or down drainage conditions which led to the damage of the past two seasons. In addition, we will be looking very hard at using MB-C in any area that is within 500 to 700 feet of Western white pine seedlings. We know now that preventive steps must be extra ordinary. The 250 foot buffer was simply not sufficient.

We have also been working on other treatments to give us additional tools in the fight against pathogenic fungi. We have participated with several other nurseries in a contract with a local University to study fusarium. This work has shed some light on management options which may one day help control this pathogen. Other treatments and management techniques will be evaluated in the future as organic methods become better understood and alternatives to chemical control are developed.