EXPERIMENTAL TREATMENT OF SAWDUST WITH ANHYDROUS AMMONIA

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The need for soil organic matter in an area where acid peat is not available locally has led to the use of sawdust in large quantities as a soil amendment at the Mason State Tree Nursery in central Illinois. It has been used for over eleven years as a winter mulch on first year seedling and transplant beds to prevent frost heaving and later to improve the soil. A sawdustground corncob mulch is spread about 3/4 inch thick, top dressed annually with about 300 pounds of ammonium sulphate, and incorporated with the soil at the end of the rotation.

Heavy applications of sawdust for soil improvement between rotations, with and without attempts at preliminary composting, have been tried periodically. In 1954 information on the use of anhydrous ammonia to impregnate sawdust with nitrogen was obtained from the Soils Department of the University of Wisconsin, where a good deal of work on the subject has been done (1). Their recommendations have been followed to some extent in the work at the Mason Nursery. The physical and chemical characteristics of anhydrous ammonia seem to adapt it remarkably well for treatment of sawdust under favorable conditions.

At the Mason Nursery fresh hardwood sawdust has been treated both in the compost pit and in the field with anhydrous ammonia, phosphoric acid and other fertilizers. Up to 500 cubic yards of sawdust have been applied per acre. Many aspects of these practices need refinement, evaluation and further study, but it is strongly felt that sawdust can play an increasingly important part in nursery soil management. Some progress has been made in evolving techniques and a number of test plots have been established and are under observation. A discussion of our techniques and the tests follows.

The compost pit being used is thirty-five feet wide, fifty feet long, and five feet deep. It is sloped toward the back, with a drain to an outside sump. It was filled with mixed upland and bottomland hardwood sawdust.

Anhydrous ammonia is readily available in Illinois. The dealer from whom we purchased our supply was of inestimable help for he not only delivered the material but he also furnished the delivery hose, 6-outlet valve and six lengths of high pressure hose from field injection equipment; helped set up the equipment; released the anhydrous ammonia; and regulated the amount injected at each point.

In order to space the injections evenly a frame was laid on top of the sawdust. The frame was of 1 /2 x 1 x 2 lumber and was two feet wide, and twelve feet long, made with crosspieces that divided it into two foot squares. An injection was made in the center of each two foot square.

Six injection pipes were constructed from 1/4" galvanized pipe six feet long. A T with two six-inch nipples was placed on the top of each pipe as a handle. One nipple was capped. The high pressure hose was clamped to the other nipple. Each injection pipe was threaded on the inside at the lower end and fitted with a sharp point threaded to screw into the pipe. This point was removable to permit cleaning the pipe with a rod when it becomes clogged with sawdust. Starting two feet from the top of the pipe, 1/8[11] holes were drilled through it at six-inch intervals. Each pair of holes were drilled at right angles to the preceeding pair. These galvanized pipes are cleaned and oiled after each use and have not been seriously affected by ammonia or dilute acid.

The anhydrous ammonia was turned off at the supply tank until the six injection pipes were connected and inserted in the sawdust, which had been thoroughly watered previously, and the workers moved back a safe distance. The control valve was then opened and the anhydrous ammonia, which is under considerable pressure, was allowed to flow through the hoses and injection pipes, escaping into the damp sawdust pile through the 1/8 inch holes in the pipes. Each set of six injections required less than thirty seconds, followed by a thirty second pause after the control valve was closed to allow time for the chemical to diffuse into the sawdust.

Since anhydrous ammonia is very hazardous to handle, an experienced operator should control it. All hoses and fittings should be absolutely safe, and personnel kept at a safe distance when the ammonia is being released from the supply tank. The top holes in the applicator should be eighteen inches below the surface of the pile and the sawdust should be pressed around the pipes. The upper holes can be tapped shut if the pile is not deep enough. Very little gas was detected during or after treatment.

Ten pounds of anhydrous ammonia was injected per cubic yard. Since this treatment raises the pH very high, 85 percent phosphoric acid at the rate of two pounds per cubic yard was injected after two weeks. A Hozon was used to dilute the concentrated acid. The dilute acid was pumped into the pile through the same applicator hose and pipes used for the ammonia by means of a power sprayer. It is not known how uniformly the acid was distributed by this method. Sprinkling the dilute acid on top of the pile and allowing it

to drain through would have been less expensive and possibly better, although leaching might occur. One year later the sawdust tested pH6 to 8. 7 at increasing depth. No inoculation was attempted since it was felt that wood destroying fungi would probably be present in the sawdust. They may have been killed by the chemical treatments. Potassium was not added because it is not needed in the nursery fertility program. However, it may be necessary to the development of the fungi in the sawdust. The pile was later covered with about an inch of nursery soil and watered to hold the sawdust in place and possibly inoculate it. The drainage water was also pumped out of the sump and spread over the pile periodically.

With the above treatment little obvious decomposition is noted at the end of a year. It remains to be determined whether sawdust in deep piles can be sufficiently modified in a reasonable time by chemical treatment without actual composting. However, the treated sawdust will decompose in a reasonably short time after being incorporated in the soil.

In the fall of 1955 over three hundred cubic yards of sawdust were treated with ammonia in the pit and with phosphoric acid and sulphate of potash magnesia in the field. It has produced excellent rye and sudan crops for two years without additional fertilizer. However, this sawdust soil mixture in containers during the summer of 1956 required supplemental nitrogen for Taxus liners. Some difficulty with germination and growth of sudan grass has been experienced on very light soil where seeding was done in midsummer within two or three weeks after the application of treated sawdust and acid. Plots which received 300 yards of treated sawdust per acre a year ago were seeded to northern conifers this spring. The seedbeds have developed normally for two and a half months.

The anhydrous ammonia costs 7 1/2 cents a pound or 75 cents per yard of sawdust and the phosphoric acid 12 cents a pound or 24 cents per yard. The dealer charged 70 cents per yard for his equipment and services. Nursery labor was about $1.00 a yard for applying the ammonia and somewhat more for the phosphoric acid injection, which was slower. If the sawdust is not left in the pit to decompose it can be treated more economically in the field.

Direct field application of fresh sawdust followed by chemical treatment is the most economical from the standpoint of labor and decomposition time. Under certain conditions heavy field applications may prove undesirable or keep land out of tree production for too long a period of time.

Test plots using up to 500 cubic yards of fresh sawdust per acre have been established for a year. A skid mounted spreader box was constructed and

is pulled behind the dump trucks. They dump the sawdust into it as they pull it along. A very uniform 'layer is applied by this method. Some of these plots have been treated with anhydrous ammonia using agricultural knife injectors on a tractor, and phosphoric acid with a power sprayer,
at various rates. It was necessary to make a considerable number of applications with the available injection equipment to get the desired rate of ammonia treatment. Other plots were treated with ammonium nitrate at corresponding rates.

Some of these plots are in seedbeds of northern conifers less than a year after sawdust application. Seedling development has been normal for two and a half months with the exception of a bed next to an irrigation line where nitrogen deficiency developed almost at once. This was easily corrected by a top dressing of ammonium nitrate. Presumably the anhydrous ammonia injection was not heavy enough at the edge of the plot. It may be difficult to get uniform coverage with field injection where numerous applications are required to apply the ammonia. There is some indication of this after three months in seedbeds where 500 yards of fresh sawdust was applied a year ago. Rye and sudan grass made luxuriant growth on all except the plot receiving the heaviest ammonium nitrate treatment. The plot with the heaviest anhydrous ammonia treatment is in first year conifer seedbeds.

Inconclusive tests and examinations indicate reduced pH and good decomposition in one to two seasons after field application, depending on factors such as soil moisture and temperature. Additional tests and observations will be made as time and facilities permit. Present tests suggest lighter fertilizer applications and split applications instead of single heavy applications.

It is felt that in order to keep labor cost at a minimum, direct field application and treatment will be the method used whenever possible. In this way treatment costs are reduced and the cost of filling and emptying the pit is eliminated. The pit method can be used to stockpile sawdust and shorten application time when this is desirable. The more uniform ammonia treatment in the pit may prove to be an important factor in achieving uniform stands where seedbeds closely follow sawdust application. Under Mason Nursery conditions all practical methods must be used to increase organic matter in the soil, and a variety of methods will no doubt continue in use. Much more work must be done before final conclusions can be drawn regarding the heavy applications of sawdust as a soil amendment even under local
conditions.

(1). Davey, Charles B., Soil Science Proceedings, Vol. 17, No. 1, Jan. 1953.