POSSIBLE USES OF KRILIUM IN SILVICULTURE

By J. H. G. SMITH¹

A recent development data report of a chemical company tells of spectacular improvement of soil structure by a new synthetic resin, Krilium. This new product is expected to find wide use in the growing of field and greenhouse crops, in home gardening and landscaping, in land reclamation, in erosion control on highways and rights-of-way, and in sports field maintenance. Possible uses in forest nurseries, in direct seeding, and in erosion control problems warrant careful consideration by foresters.

The trade name, Krilium, refers to a hydrolyzed polyacrylonitrile and other polyelectrolytes which can replace certain naturally occurring gums as soil conditioners. In nature, gums of the polysaccharide or polyuronide types cement together primary soil particles to form water-stable aggregates of optimum size in good top soil. These polysaccharides are formed in small quantities, 1-2 per cent by weight, by decomposition of plant residues, manures, composts, and organic matter. Because natural soil binding gums are rapidly decomposed by soil bacteria, it is usually necessary to add large quantities of organic matter to maintain soil structure in the condition of a loose, porous mass. Krilium has a great advantage in its retention of aggregating power against decomposition at least 10 times as long as the natural crude organic matter.

MECHANISM OF AGGREGATE FORMATION

Krilium polymer is a water soluble resin which exists in aqueous solution as a polyanion with a hundred or more negative charges on the individual "ions". The hygroscopic action of Krilium helps it become solubilized in soil water. Presumably the polyanions are adsorbed to colloidal clay particles, binding these through the carbon linkage "bridge" between reactive groups on the polymer. The soil conditioning effect is based on the ability of Krilium to bind the ultimate particles of clay together by means of polymer bridges. It has been shown experimentally that the highest level of adsorption is about equal to the anion exchange capacity of the clay.

Once the reactive groups are adsorbed on the clay particles they cannot be leached out with water even though Krilium is a water-soluble polymer. The maximum aggregating effect at lowest concentration of Krilium is obtained in the presence of small amounts of sodium, calcium, magnesium, and other cations which are present in most natural soils.

EFFECTS OF KRILIUM ON SOIL STRUCTURE

As little as .02 per cent by weight of Krilium, adequately dispersed in the upper soil layer, results in quick aggregation of soil particles. Within 24 hours the soil mass becomes porous and friable as numerous round aggregates ranging in size from a pinhead to a pea are formed. Generally 15 to 20 per cent of water by weight in the soil give the best crumb formation. Most satisfactory

¹ Conducting study on effects of Krilium on survival and root development of some western species at Yale School of Forestry, New Haven, Conn.

results are secured when Krilium is applied to a dry surface which is subsequently wetted down to work the resin into the moister subsurface soil.

Spectacular effects of the addition of Krilium to clay type soils include raised water-holding capacity of the treated layer, workability at higher moisture content, and prevention of slaking and crusting.

Results of tests with Miami silt loam may indicate possibilities of stabilizing and conditioning soil surface layers with Krilium to result in greater germination and survival in direct seeding. When Miami silt loam was treated with 0.1 per cent Krilium, by weight, under laboratory conditions the amount of water-stable aggregates larger than .25 mm. was raised to nearly three times that of untreated soil (Monsanto, 1951). In the same soil, tests showed a 30 per cent increase in field capacity with very slight increase in wilting point to provide a net increase of available water of 40 per cent. Evaporation of moisture from soil surfaces has been reduced from 30 to 40 per cent in treated soils. Improved aeration results in greater availability of oxygen to plant roots, increased activity of soil microflora and possible reduction of fungal diseases. Reduction of surface run-off, greater availability of water and enhanced root penetration should improve seedling survival during drought.

USES IN SILVICULTURE

About .0005 pounds of Krilium would be required to treat a pound of mineral soil for a seed spot. With Krilium costing 2 dollars a pound, treatment with soil conditioner would cost .1 cent at each spot. Then the cost of this product should not be excessive for direct seeding. However its hygroscopicity will be a handicap in transportation and application, even though some of the difficulties of field application may be solved by the use of extenders. Except on the large exposures of mineral soil caused by burns, and land with high clay content, it is likely that the problems of soil stabilization and conditioning are not primary problems in direct seeding, but it is encouraging to know that the forester will soon have this helpful new product added to his kit.

There is more promise for the use of Krilium in forest nurseries where good tilth may be lost progressively by cultivation, or where treatment with plant residues is expensive. A well-aggregated soil has many advantages. It permits easy intake and assures good retention, of rainfall, provides a plentiful air supply for root respiration, offers less resistance to penetration by plant roots, and promotes easier tilling over a wider time range. It stimulates activity of soil organisms and permits easier placement of seeds and emergence of seedlings. While soils can be put into a loose, porous condition by properly timed cultivation, rainfall will disperse and slake the clay fraction unless aggregates are stabilized by natural gums or Krilium. Savings may be made by the use of Krilium because one pound of this compound will have essentially the same effect on soil structure as 200 pounds of peat moss or 500 pounds of commercial compost. Krilium costing two dollars would be the equivalent of \$8.00 worth of peat moss, or \$12.50 worth of commercial compost. Of course Krilium supplies no mineral nutrients and is effective only in improving soil structure.

Krilium's greatest use is in erosion control where it may be applied in powder or liquid form with fertilizers and seed. Combined with some mechanical obstructions to prevent too rapid runoff, Krilium should be most useful in preventing erosion on logging roads and skid trails.

Although Krilium is not yet available commercially, its properties are being tested at experiment stations and Universities throughout the United States. The reviewer and W. Stein are investigating the effects of Krilium on survival and root development of some western conifers at the Yale School of Forestry, New Haven, Conn.

SUMMARY

A hydrolyzed polyacrylonitrile and other polyelectrolytes which will be marketed by Monsanto Chemical Company under the trade name, Krilium, may find wide use for conditioning and stabilising soil in erosion control, in forest nursery work, and in direct seeding. Krilium is a water soluble resin which binds clay particles through polymer bridges into water-stable aggregates. Development of crumb structure may result in increased germination, followed by improved root growth caused by more favourable aeration and moisture relations. Because Krilium decreases surface runoff and increases soil stability, soil erosion can be effectively controlled in clay, loam, and silt soils. When commercially available, Krilium is expected to sell at something less than \$2.00 a pound.

REFERENCES

1. Monsanto Chemical Company, 1951. Development data report Monsanto Krilium. 24pp.
2. SCHULENBERG, L. 1952. Krilium soil conditioner. *Monsanto Magazine* 31(1) : 4-14.