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SOYBEAN INOCULANT QUALITY

J. L. Sims, E. C. Lacefield, and L. Murdock

Research studies have shown that from 40 to 80 percent of the nitrogen required for a soybean crop comes from nitrogen fixed in the nodules, depending on the degree of nodulation and the level of soil nitrogen. Hence, it is important that soybean plants be well-nodulated for most efficient soybean production.

Inoculation is probably not necessary in fields having produced inoculated soybeans during the last 3 to 5 years since these soils usually contain sufficient numbers of rhizobia to adequately nodulate the soybean crop. However, many fields in Kentucky, particularly in central Kentucky, are being cropped to soybeans for the first time. It is important that soybean seed used on these fields be inoculated, and that the inoculant be of good quality.

Research and extension personnel of the Agronomy Department at the University of Kentucky conducted a survey of soybean inoculants being sold in Kentucky during 1977 and 1978. The purpose of the survey was to evaluate the number of viable nitrogen-fixing bacteria, Rhizobium japonicum, in inoculants obtained from commercial retail outlets. The inoculants were purchased from retail outlets during April, May, and June of each year and brought to the laboratory under controlled conditions. Two methods were used to measure viable organisms: 1) a standard plate count procedure and, 2) a procedure based on the nodulation of soybean seedlings called the Most Probable Number (MPN). Usually the values by the MPN test are smaller than by the plate count procedure but values by both methods generally are significantly correlated. Table 1 contains the data obtained by both methods during 1977 and 1978. Most brands of inoculants obtained in the survey had greater than 10 million viable rhizobia per gram of inoculant by one or both methods of measurement. Most soil microbiologists agree that a minimum of 1 million but preferably 10 to 100 million rhizobia per gram of inoculant by the plate method are needed to affect nodulation by the applied rhizobia. Only the Triple Noctin brand had less than adequate numbers, probably because both molybdenum and a fungicide were pre-mixed dry with live bacteria in the inoculant. Values for molybdenum also were inadequate in 1977 but acceptable in 1978. In contrast, a product (Triple Noctin L.) having molybdenum and a fungicide pre-mixed as a liquid contained large numbers of viable rhizobia.

Our data confirm results obtained in Georgia and South Carolina by research and extension personnel. Therefore, it is not advisable to use inoculants that were pre-mixed dry with molybdenum or fungicides. Similarly it isn't advisable to store seed having been inoculated and treated separately with molybdenum and/or fungicides for more than a few hours. This is particularly important on land not previously planted to soybeans in the last 3 to 5 years or on land with a history of poor nodulation. General recommendations of the University of Kentucky Agronomy Department for inoculation of soybean seed and molybdenum application are given below.

INOCULATION:

Soybeans should be inoculated when planted in fields where soybeans have not been grown in the past 3 to 5 years, or where previously grown soybeans had few nodules. If inoculation is necessary, the inoculant should be applied to the seed or in the row at planting. Delays in planting inoculated seed often result in poor nodulation. Numbers of live rhizobia in inoculum decrease rapidly under dry conditions, exposure to sunlight and/or high temperatures, or when packaged dry with sodium molybdate and/or fungicides.

MOLYBDENUM:

If soils are limed to maintain pH values at 6.2 or above, aluminum and manganese toxicities and molybdenum deficiency usually do not occur in soybeans. However, in soils having pH values below 6.2 at seeding time, molybdenum application to soybeans is recommended. Apply 1 to 2 ounces of sodium molybdate (0.4 to 0.8 ounces of elemental molybdenum) per acre as a seed treatment. This is a satisfactory method of applying a small amount of molybdenum where no seed inoculant is needed. Where soybean seed is to be inoculated, inclusion of sodium molybdate with the inoculum may seriously lower the numbers of live rhizobia if not planted immediately. If both inoculum and molybdenum are needed and the seed cannot be planted immediately (less than 3 hours) after inoculation, apply inoculum to the seed and broadcast the molybdenum on the soil. For each acre, dissolve 1 lb sodium molybdate (6.4 oz. molybdenum) in 20 to 40 gallons of water and spray uniformly ahead of final seedbed preparation. Not more than 2 lb sodium molybdate (13 oz. molybdenum) per acre should be used during any 5-year period.

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Table 1. Viable rhizobia in commercial soybean inoculants sold in Kentucky in 1977 and 1978, average of two years.

| Brand | No. of organisms per gram ^{1/} inoculant, plate method | No. of organisms per gram inoculant, MPN method | Rating ^{2/} |
|------------------------------|--|--|----------------------|
| Nitragin | 2,870,000,000 | 1,792,000,000 | Good |
| Hansen | 2,268,500,000 | 1,546,190,000 | Good |
| Unico | 2,405,000,000 | 444,700,000 | Good |
| Urbana | 606,000,000 | 87,800,000 | Good |
| Noculator ^{3/} | 690,000,000 | 26,000,000 | Good |
| Legume Aid | 3,568,000,000 | 579,000 | Good to Fair |
| Molynoctin | 22,251,000 | 976,000 | Good to Fair |
| Triple Noctin ^{3/} | less than 1000 | less than 1000 | Poor |
| Triple Noctin L. (liquid) | 38,500,000 | 2,246,000 | Good to Fair |

1/ Values are averages of 12 plates, two subsamples of each inoculant plated three times each year.

2/ Rating scale: Good = 10,000,000 + per gram inoculant; Fair = 1,000,000 to 10,000,000 per gram; and
Poor = less than 1,000,000 per gram

3/ Data are for 1 year only.