TECHNICAL NOTE

USDA NATURAL RESOURCES CONSERVATION SERVICE PACIFIC ISLANDS AREA

Plant Materials Technical Note 10

UNDERSTANDING INOCULANTS

INTRODUCTION

Nitrogen is one of the most important nutrients that plants require for healthy growth. Almost all plants depend on some outside source of nitrogen, but plants of the legume family are able to fix their own nitrogen. In other words, they are able to convert atmospheric nitrogen, which is unusable to all plants, into a form of nitrogen that plants can use. Legumes accomplished this through a symbiotic relationship with *Rhizobium*, bacteria that are naturally found in the soil. When *Rhizobium* bacteria are taken in by legumes, nodules are formed on their roots. These are, in essence, the nitrogen-fixing factories. In this mutually beneficial relationship, legumes provide a means to acquire atmospheric nitrogen and an ideal environment for *Rhizobium* growth, while *Rhizobium* bacteria convert unusable nitrogen into a form that can be utilized by the host legume plant.

A common practice of producers is to apply commercial nitrogen fertilizers to increase their crop production. Over time this can become very expensive and can also degrade the quality of the soil. When a legume plant is utilized as a cover crop, the nitrogen produced can be made available to other plants. The free air we breathe contains about 80 percent atmospheric nitrogen. Legumes are able to convert this atmospheric nitrogen into 50-200 pounds of "plant-useable" nitrogen per acre. On the other hand, the amount of nitrogen produced depends on the legume species and the amount of *Rhizobium* bacteria in the soil. In addition, when legumes are incorporated into the soil, organic matter and other micronutrients are also added to the soil. The cover crop practice reduces fertilizers costs and improves soil quality at the same time.

INOCULANTS

Inoculants are commercially prepared *Rhizobium* bacteria. There are many different species of *Rhizobium* bacteria and of those species, there are many different strains. Much of these are found naturally in the soil in very small amounts. To assure an adequate amount of *Rhizobium* bacteria is present in the soil to benefit the crop; the producer is recommended to apply an inoculant to the legume seed before planting. When acquiring inoculants, it is very important to know that the symbiotic relationship between legumes and *Rhizobium* bacteria is specific. Although most *Rhizobium* bacteria will work with most legumes, if optimum nitrogen production is desired, the selected legume should be inoculated with specific *Rhizobium* bacteria. There are many different companies that offer inoculants, but they will all have virtually the same species for certain types of legumes. The producer should follow the manufacturer's recommendations regarding the strain of *Rhizobium* bacteria and the amount to be added with

the legume seed. The inoculant package will list the appropriate legume species. Due to the different formulations and carriers used in developing the inoculant, each manufacturer will have a different requirement for the amount needed.

The following table is a list of *Rhizobium* species and corresponding legume species that are listed in the Pacific Island Area Vegetative Guide.

Rhizobium Species	**Legume Species**	**Legume Common Name**
Bradyrhizobium japonicum (Soybean)	*Glycine max*	soybean
Rhizobium leguminosarum (Pea/Vetch)	*Vicia benghalensis*	purple vetch
	Vicia sativa	common vetch
	Vicia villosa	wooly-pod vetch
Sinorhizobium meliloti (Alfalfa/Clover)	*Medicago sativa*	alfalfa
	Melilotus officinalis	sweet clover
Rhizobium sp. (Cowpea)	*Arachis glabrata*	rhizoma peanut
	Arachis pintoi	pinto peanut
	Cajanus cajan	pigeon pea
	Crotalaria juncea	sunn hemp
	Desmodium heterophyllum	variable-leaf ticktrefoil
	Desmodium incanum	Spanish clover
	Desmodium intortum	green-leaf ticktrefoil
	Desmodium triflorum	three-flowered beggarweed
	Vigna radiate	mung bean
	Vigna marina	beach vigna
	Vigna unguiculata	cowpea
Rhizobium sp. (Lotus)	*Lotus pedunculatus*	big trefoil
Rhizobium trifolii	*Trifolium repens*	white clover

INOCULANT APPLICATION METHODS

Inoculants are available in dry, granular, or liquid formulations and may be applied to the seed by either one of the following methods:

1. Slurry Method – The inoculant is mixed with a liquid sticker*. The resulting slurry is mixed with the seed. Immediately after coating, spread the seed out and allow it to dry in a cool, shady area before planting. This method is generally considered to be the most effective.

2. Dry Sprinkle Method –The dry inoculant is sprinkled over the seed and thoroughly mixed in a container or seed hopper. This may be a quick way to inoculate seed, but

considered not as effective as the slurry method because the inoculant does not adhere well to the seed.

* Effective liquid stickers include 10-20% solutions of gums or sugars mixed with water, depending on the type of seed. There are also commercial sticker products available.

POINTS TO REMEMBER

- Based on the relatively inexpensive cost of inoculants and the high cost of nitrogen fertilizers, the addition of inoculants to a legume species is a wise investment in crop management.
- There is no simple test to determine whether a suitable Rhizobia bacterium already exists in the soil prior to planting. A relatively small investment of time and money in seed inoculation will ensure that the correct bacteria species will be present in the soil at the time of planting.
- To maximize biological nitrogen fixation, inoculate legumes with the appropriate *Rhizobia* bacteria. Do not use an inoculant if the legume species is not listed on the package or company literature.
- Because inoculants are cultures of living organisms, contact suppliers well in advance of the planned seeding dates to ensure viable inoculants will be available.
- Store inoculants according to the manufacturer's recommendations (refrigeration may be required but do not freeze).
- Do not allow the inoculant to be exposed to direct sunlight or heat when transporting.
- Inoculate seed in a shady location out of direct sunlight.
- Plant inoculated seed within 24 hours of application.
- Never mix the inoculant with any kind of fertilizer or pesticide unless specifically labeled for that use. Avoid contact with agricultural lime.
- Soil moisture is very important for *Rhizobia* bacteria survival. Do not plant inoculated seed into dry soil.
- Soil temperature and soil pH can also affect *Rhizobia* bacteria survival and effectiveness.

REFERENCES

Miller, R., Kaiser, J., Ogle, D.G., October 2010, *Technical Note No. 26 – Legume Inoculation*, USDA NRCS Boise, Idaho – Salt Lake City Utah.

Nitrogen Fixation for Tropical Agricultural Legumes (NifTAL) Project, USA, FAO Fertilizer and Plant Nutrition Service, Land and Water Development Division, 1984, *Legume Inoculants and Their Use*, Food and Agriculture Organization of the United Nations, Rome, Italy.

Peaceful Valley Farm and Garden Supply, *Legume Seed Inoculation, Product Guide*, Web Grow Organic, 24 JUL 2009, Web 07 JAN 2014, <http://www.groworganic.com/>.

Johnny's Selected Seed, *Inoculants*, Web Johnny's Selected Seed, FEB 2013, Web 20 OCT 2013, <http://www.johnnyseeds.com/assets/information/inoculantstechsheet.pdf>.