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IMPROVEMENT OF CARRIER MATERIAL FOR DEVELOPMENT OF RHIZOBIAL INOCULANTS

K. S. JAUHRI and M. GUPTA
Division of Microbiology,
Indian Agricultural Research Institute,
New Delhi 110 012, India.

ONE of the fundamental criteria necessary for longer survival of rhizobia in carrier is its high moisture-retaining capacity. There is considerable evidence to show how moisture loss from carrier adversely affects the survival of rhizobia[1,2]. Moisture loss may also tend to increase concentration of harmful soluble salts in carrier[3]. Recently, a change in packing material of inoculants from cans and bottles with lids/stoppers/or screw caps to pliable low

Table 1 *Survival of red gram Rhizobium (cowpea sp.) ARS-83 in charcoal-soil (3:1) carrier amended with soymeal or gelatin at 28–30°C (Av. of 3 replications)*

	No. of viable cells $\times 10^8$/g of carrier			
	Weeks after inoculation			
Carrier	0	12	24	Mean
Carrier	90.00 (29.00)	3.75 (14.00)	0.02 (4.00)	31.26 (15.67)
Carrier + soymeal (1%)	95.00 (28.33)	9.00 (16.00)	0.08 (8.00)	34.69 (17.44)
Carrier + soymeal (2%)	95.00 (28.72)	13.00 (17.60)	0.10 (10.40)	36.03 (18.91)
Carrier + soymeal (5%)	100.00 (27.81)	16.00 (20.67)	0.86 (17.40)	38.95 (21.96)
Carrier + soymeal (10%)	90.00 (30.80)	46.50 (29.00)	3.10 (24.00)	46.53 (27.93)
Carrier + gelatin (1%)	94.67 (29.84)	1.40 (14.00)	0.06 (7.60)	32.04 (17.15)
Carrier + gelatin (2%)	95.00 (27.22)	2.00 (20.00)	1.93 (16.00)	32.97 (21.07)
Mean	94.24 (28.82)	13.09 (18.75)	0.88 (12.49)	

	S. Em	*C. D. at 5%*
Treatment (*T*)	1.05 (0.65)	3.02 (1.86)
Period (*P*)	0.69 (0.42)	1.97 (1.22)
$T \times P$	1.83 (1.13)	5.23 (3.22)

Figures in parentheses are moisture contents (%) in carrier.

ND–Not detectable.

density polythene bags for ease in handling inoculant during storage and transit also resulted in the rapid loss of moisture from inoculants. Low density polythene permits high gas exchange and moisture transmission from inoculants. Approximately 45–50% decline in the moisture content of polythene-packed inoculant was found during storage[4] at 26°C.

In India, inoculants are generally prepared either in charcoal-soil[5] (3:1) or in lignite[6] carrier which possesses low water-holding capacity in comparison with standard peat. Besides, low density polythene bags which are used for packing inoculants, allow rapid loss of moisture leading to heavy reduction in viable rhizobial population in inoculants.

The present paper deals with improving the water-retaining capacity of charcoal-soil carrier material for longer survival of rhizobia. The above carrier is suitably amended with soymeal and gelatin which are known for their water-retaining capacity and the effect of such amendment on the survival of rhizobia in carrier was studied. The results of the study are reported here.

The charcoal-soil (3:1) mixture was sun-dried and powdered to pass through 100 mesh sieve. It was then mixed with finely powdered calcium carbonate (0.2%) and K_2HPO_4 (0.5%). This mixture was amended separately with 1 and 2% of gelatin and 1, 2, 5 and 10% of soymeal. To each of these samples 10% water was added before autoclaving at 1 kg/cm^2 for 4 hr. An efficient strain of red gram *Rhizobium* (cowpea sp.) ARS-83 was grown in yeast-extract-mannitol (YEM) broth medium[7] by shaking it continuously for 4 days at 28–30°C on a rotary shaker having 120 rpm. The broth culture of *Rhizobium* sp. ARS-83 containing 18×10^9 cells per ml of broth was added to the carrier samples and the moisture contents were brought to 30% of their water-holding capacity, inclusive of the water carried by the broth culture. After inoculation, 200 g of each sample was packed in a polythene bag which was then incubated at 28–30°C in a B.O.D. incubator. The rhizobial population in carrier was enumerated at regular intervals of storage by dilution-plate count method using YEMA medium containing congored[7]. The moisture contents of the samples were also determined at these intervals of storage.

It was observed that the addition of gelatin (1–2%) or soymeal (1–10%) in the carrier material helped in maintaining higher moisture contents and rhizobial population in carrier for longer duration (table 1). The moisture-retaining capacity was found to increase with the quantity of soymeal or gelatin added to the carrier. Gelatin was better than soymeal in this regard as its 2% quantity was enough to retain 16% moisture in carrier till the end of 24th week of storage whereas soymeal added at the same rate could retain only 10.4% moisture. The rhizobial population was also found to increase with the quantity of soymeal in the carrier. Gelatin, however, showed a marginal increase in rhizobial population with increase in its quantity in carrier. This confirms the earlier findings[8] that addition of gelatin and casein gave no response to the multiplication of rhizobia in pellets, but increased the water-retaining capacity of the inoculant carrier.

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EMBRYOLOGY OF *EUPHORBIA MADDENI* AND *EUPHORBIA NIVULIA*

R. K. BHANWRA
Department of Botany, Panjab University, Chandigarh 160 014, India.

EUPHORBIA Linn. is a large genus consisting of about 2,000 species[1]. About 52 species have been recorded from India[2]. The genus includes herbs, shrubs and trees of widely diverse habitats. The present studies which deal with the embryology of *E. maddeni* Boiss. and *E. nivulia* (Buch.) Ham. were undertaken mainly with a view to finding if there are any habitual differences in the reproductive features of the herbaceous and dendroid forms.