comparable to that in T_3 and T_2 (3280, 3190 kg/ha respectively)The lowest grain yield of 2833 kg/ha was recorded in T, (100 %NPK), which was 17.7 % lower than that in T_6. The stover yield was high in T_6 treatment (6.8 t/ha), which was comparable to the treatments of T_3 and T_2 registering the yield of 6.6 and 6.3 t/ha respectively. The lowest yield of 5.2 t/ha was recorded in T_1 (100% NPK), which was 23.5% lower than that in T_6. Surendra Singh and Sarkar (2001) also reported a yield increase of 33 %with higher dose of NPK application (210:90:150 NPK kg/ha) over recommended level (100:60:40 NPK kg/ha).

From this experiment, it may be concluded that soil application of 100% NPK coupled with foliar spray of 1% DAP + 1%MOP + 0.5% ZnSOo4 + 0.2% B + 1% $FeSO_4$ twice at knee high and tasseling stages influenced the growth, yield attributes and yield of hybrid maize under irrigated conditions of North Western agro climatic zone of Tamil Nadu.

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Research Notes

Survival of microbial inoculants on seeds in premonsoon sowing

A. RAMALAKSHMI AND S. ANTHONI RAJ
Department of Agrl. Microbiology, Tamil Nadu Agricultural University, Coimbatore - 3.

The premonsoon sowing of millets, pulses and cotton is a practice adopted in most of the rainfed area where the seeds are sown well ahead of monsoon and remain in the soil until receipt of rain. The seeds remain buried in dry soil for 2-3 weeks and germinate after the receipt of the rains if the season is normal and the farmers are lucky. Otherwise they have to take up another sowing particularly when rain is delayed beyond a month. The seeds remain in the soil and subjected to heat stress and information on the survival of biofertilizer organisms inoculated on the seeds is much limited. Therefore the present study

Table 1. Survival of inoculant bacteria on cotton seeds sown in soil in premonsoon condition

Treatments	Population (cfu g^{-1} of seeds on dry weight basis)							
	Azospirillum ($x10^8$)				Phosphobacteria ($x10^6$)			
	0 DAS	7 DAS	14 DAS	21 DAS	0 DAS	7 DAS	14 DAS	21 DAS
Azospirillum	3.5	5.4	9.2	9.2	-	-	-	-
Phosphobacteria	-	-	-	-	26.1	25.7	25.0	28.5
Azophos	2.8	3.5	5.4	9.2	25.4	24.5	24.6	27.0
Azophos + mycorrhiza @2%	2.4	2.8	3.5	5.4	24.5	22.3	24.1	26.3
Control* (uninoculated)	1.0	2.0	2.0	2.0	0.7	1.4	1.4	1.4

*$10^{-3}g^{-1}$

was undertaken to know whether the inoculants survive or perish on treated seeds in the transient period between sowing and monsoon rains.

The experiments were carried out at Agricultural college and Research Institute, Madurai during 2001-2002. The black cotton soil brought from ARS, Kovil Patti was filled @ 10kg in earthern pots of 30cm diameter and compacted to simulate the field condition. Then the top surface was stirred and KC2 cotton seeds treated with bacterial inoculants *viz*., Azospirillum, phosphobacteria individually and in combination with mycorrhiza were sown @ 2 seeds per hole. These pots were kept dry with out any watering so as to simulate the rainfed field condition. At different intervals *viz*., 0, 7, 14 and 21 days after sowing, the seeds were removed from soil for enumeration of phosphobacteria and Azospirillum. The load of different bacterial inoculants adhering to cotton seeds enumerated after serially diluting lg treated seeds and plating the appropriate dilution in the respective media. The population of Azospirillum was estimated by MPN technique employing semisolid N-free malate medium (Baldani and Dobereiner, 1980) and the population of phosphobacteria was estimated by using Sperber's hydroxy apatite agar medium (Sperber, 1957).

The initial inoculum of Azospirillum adhering to the seeds just after seed treatment ranged from 2.4-3.5 x 10^8 g^{-1} and subsequently there was an increase in its load on seed. A higher inoculum load of Azospirillum on seed was observed in the Azospirillum and Azophos inoculated seed at 21 DAS. Initially the phosphobacterial population ranged from 24.5-26.1 x 10^6 g^{-1} of cotton seed and subsequently it increased in all bacterial inoculants. A higher population of 28.5 x 10^6 g^{-1} phosphobacteria was observed in phosphobacteria treated seeds at 21 DAS (Table 1). This might perhaps be due to the capabilities of these bacteria to survive during adverse conditions in the

form of spores (Neeru Narula *et al.,* 1998). The inoculated seeds also showed a small number of Azospirillum and phosphobacteria on the surface of seed which was only to the tune of 1.0 - 2.0 x 10^3 g^{-1} and 0.7 - 1.4 x 10^3 g^{-1} respectively (Table 1). This might be due to the adhering native soil bacterial flora.

It is concluded that the beneficial organisms coated to seeds showed a greater chance for its multiplication in spermosphere and rhizosphere. On sowing a seed in the soil, it is colonized by a variety of micro flora when it initiates germination and the radical that emerges also invites a galaxy of microbes in its surroundings. In addition to these beneficial organisms coated to seeds may multiply in the soil and increase manifolds and benefit the crop. But in the present investigation, seeds remained quiescent and no germination activity commenced because of low soil moisture. The results showed that the Azospirillum and phosphobacteria adhering to the seeds increased manifold in a short period indicating not only their survival when covered by the soil but also their multiplication on seed. It might be due to the multiplication of inoculants strain on seed utilizing the nutrients available on seed surface although the multiplication of soil bacteria utilizing the nutrients in the carrier coated with its residual nutrients is not ruled out. The contribution of soil adhering to the enhanced microflora on seeds is also not ruled out.

The uninoculated seeds also showed a small number of Azospirillum and Phosphobacteria, which multiplied on seed sown in soil. It is likely that these organisms are brought into contact with seeds in the post harvest handling process through dust and soil. It is concluded that any biofertilizer added will survive for longer period and fix atmospheric nitrogen or solubilize the mineral nutrients even when seeds are sown in low moisture dry soil. The result of the present studies once for all seal the question whether the inoculated biofertilizers will survive in the premonsoon sowing and benefits the crop.

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