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Research Article

EFFECT OF INOCULATION OF SALT TOLERANT MUTANT BGR CN-6M ON GROWTH AND YIELD OF BLACKGRAM VAR ADT - 5 AT GRADED LEVELS OF NITROGEN

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ABSTRACT

The performance of salt tolerant mutant BGR CN-6M was better than BGR CN-7M and their wild parents and also reference strain, BGR AU-1 in acid soil. The inoculation of BGR CN-6M to blackgram in acid soil significantly increased the growth parameters such as plant height and dry matter production and yield parameters such as number of branches plant^{-1}, number of pods plan^{-1}, number of dusters plant^{-1}, test weight and grain yield at all levels of N tested. The acid tolerant mutant rhizobial BGR CN-6M can be used as a potential biofertilizer for blackgram grown in salt soil of Cuddalore and Nagapattinam districts of Tamil Nadu under rainfed condition with moderate level of nitrogen i.e. 10 kg N ha^{-1} which is 50 % of recommended dose. The application of rhizobial biofertilizer helps inreducing the fertilizer by 50 % (10 kg N ha^{1}) and the input cost by nearly 20 per cent. Besides the yield ofblackgram significantly improved in salt soil.

INTRODUCTION

Salinity in the soil and irrigation water is an environmental problem and a major constraint for crop production. Currently, 20% of the worlds cultivated lands affected by salinity, which results in the loss of 50% of agriculture yield (Aslam *et al*., 2006; Bartels and Sudhakar, 2005). At present, there are nearly 954 million hectares of saline soil on the earth's surface. All these salt affected soils are distributed throughout the world. A large bulk about 320 million hectares and of lands in South and South East Asia is under grip of salinity. Salinity tolerance among rhizobia varies species to species. *R.meliloti* strains tolerate 100mM NaCl (Mandal, 2014), *R. leguminosarum* have been reported to be tolerant to NaCl concentration up to 350mM NaCl in broth culture (Mashhdy *et al*., 1998). Its evident from several investigation that symbiotic effectiveness is positively correlated with high tolerance under saline condition (Shamsheldin *et al*., 2006). Therefore, they may be scope for selecting a *Rhizobium- legume* symbiosis that is better adapted to saline condition. Mutation could be used to add desirable characters to an already effective inoculant strain. Mutagens have proved to be wonderful tools in the hands of scientists to allow the tailoring of rhizobia.

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Mutants of Rhizobium with altered symbiotic interaction have been reported (Kuykendall, 1981). Efficient rhizobial mutants have been derived by using chemical mutagens such as N-methyl-N-nitro-N-nitrosoguanidine (NTG), ethyl methane sulphoiiate (EMS), etc, (Allan paau, 1989; Sidorova *et al.,* 1995).

Mutants were obtained by using 0.8 per cent EMS treated seeds of Vigno mungo. These mutants were taller and had more and larger root nodules, higher number oFpods plant ^{1} and increased yield plant^{1}. The mutants showed 1.1 to 1.9 per cent higher protein content, without any significant change in aminoacid composition and trypsin inhibitor activity.

MATERIALS AND METHODS

A field trial was conducted at Eriyodu under rain fed conditions to study the effect of inculation of salt tolerant blackgram rhizobia BGR CN-6M at graded levels of nitrogen *viz*., 0,50,75 and 100per cent recommended dose 40:20:20 on blackgram var ADT-5. The soil temperature of the cropping period ranged between 36°C to 51.5°C. The mean maximum and minimum temperature ranged from 3.2 to 35.5°C and 17.3 to 23.5°C respectively. The relative humidity throughout the cropping period was above 80 per cent and there were two rainy days recorded during the cropping season. The blackgram var.ADT-5 was raised with a spacing of 60x30 cm in a plot size of 4x3 m in a Randomized block design (RBD) with five replications with following treatments.

Treatments: (l) Control; (2) 50% N; (3) 75% N; (4) 100% N; (5) Rhizobium + BGR CN-6M inoculation; (6) Rhizobium + BGR CN-6M + 50%N; (7) Rhizobium + BGR CN-6M + 75%N; 8. Rhizobium + BGR CN-6M + 100%K.

Different levels of nitrogen viz., 50% (20 kgN ha^{-1}), 75% (30 kgN ha^{-1}) and 100% (40 kgN ha^{-1}) was used in split doses. First half at the time of sowing and the second half at 30DAS. Phosphorus (20kg P_2 0_5 ha^{-1}) and K as nutriate of potash (20 kg P_2 $O_5 ha^{-1}$) were kept as constant and applied as basal for all the treatments except the control. Blackgram rhizobia BGR CN-6M were inoculated as lignite based inoculate through seed and soil.

Seed bacterization; ADT-5 seeds were surface sterilized with 0.1% sodium hypochloride for 2 min. washed with several changes of sterile distilled water. The lignite based inoculum (lOOg) containing minimum of 10^8 cells g^{-1} of lignite was mixed with 75 ml of rice gruel, mixed with the seeds of blackgram shade dried for 30 min and then used for sowing.

Soil bacterization: For soil application, 200g of lignite based inoculum was mixed with 2.0 kg of finely sieved soil and then uniformly applied before sowing. The observations were recorded as detailed below.

Determination of growth components

Plant height: The height of the plants was measured from the ground to tip of the main shoots on 30,60 and 90 DAS were recorded.

Dry matter production: Five plants were randomly selected from each treatment and collected. washed and dried in an oven at 80°C till constant weight was observed. The plants were weighed and dry matter production was expressed in kg ha^{-1} on 30, 60 and 90 DAS.

RESULTS AND DISCUSSION

Inoculation of blackgram with acid tolerant mutant BGR CN-6M increased the plant height over uninoculated levels of N applied (Table 1). However, the per cent increase decreased with increase in N levelsin the inoculated blackgram. The inoculation of acidtolerant mutant rhizobial BGR CN-6M at different levels of 50, 75 and 100 per cent recommended N recorded. 50.27,46.26, 47.25 percent increase over control and the values observed.

Inoculation of blackgram with acid tolerant mutant BGR CN-6M increased the plant dry matter production over uninoculated with levels of N applied (Table 2), however the percent increase decreased with increase in N levels in the inoculated blackgram.

Table 1. Effect of inoculation of acid tolerant mutant BGR CN-6M at graded levels of nitrogen on the plant height of blackgram var. ADT-5

S. No.	Treatments	Plant height (cm)			
		30 DAS	60DAS	At harvest	% increase over control at harvest
1	Control	23.24	33.75	43.24	-
2	50% N	26.27	40.25	55.19	28.12
3	75 % N	30.41	30.45	58.94	36.80
4	100 % N	34.12	47.89	63.18	46.87
5	BGR CN-6M	26.82	45.37	50.74	43.30
6	BGR CN-6M + 50% N	31.71	48.36	64.82	50.27
7	BGR CN-6M+75% N	33.64	49.2	62.99	46.26
8	BGR CN-6M+100% N	35.27	50.13	64.12	47.25
9	S.E.	1.33	2.65	2.00	-
10	CD (p=0.05)	2.69	5.38	4.12	-

Table 2. Effect of inoculation of acid tolerant mutant BGR CN-6M at graded levels of nitrogen on the dr\ matter production of blackgram var. ADT 5

S. No.	Treatments	Dry matter production (g $plant^{-1}$)			
		30 DAS	60DAS	At harvest	% increase over control at harvest
1	Control	2.94	39.93	51.14	-
2	50% N	3.14	46.65	58.23	16.26
3	75 % N	3.95	47.18	61.14	21.87
4	100 % N	4.23	53.85	68.31	37.50
5	BGR CN-6M	4.06	49.19	64.33	28.12
6	BGR CN-6M + 50% N	4.3	59.24	69.01	37.87
7	BGR CN-6M+ 75% N	4.56	60.12	70.41	40.62
8	BGR CN-6M+ 100% N	3.94	64.85	71.28	43.87
9	S.E.	0.16	2.69	1.87	-
10	CD (p=0.05)	0.38	5.38	3.79	-

Table 3. Effect of inoculation of acid tolerant mutant BGR CN-6M at graded levels of nitrogen on the yield parameters of blackgram var, ADT - 5

S.No.	Treatments	No. of **B**ranches $plant^{-1}$	No. of pods $plant^{-1}$	No. of cluster $plant^{-1}$	Test weight 1000 grain Weight	Grain yield q ha^{-1}	Protein (%)
1	Control	2.96	41.25	15.51	20.38	8.82	21.55
2	50% N	3.25	51.12	17.21	30.13	10.12	21.99
3	75 % N	3.91	53.57	19.56	38.93	12.83	22.93
4	100 % N	4.27	59.50	19.92	49.16	13.12	24.25
5	BGR CN-6M	3.10	56.18	18.95	39.36	12.75	22.01
6	BGR CN-6M + 50% N	3.92	60.72	21.43	49.51	13.76	24.85
7	BGR CN-6M+75% N	4.69	64.38	21.92	49.96	14.28	22.74
8	BGR CN-6M+100% N	4.97	77.85	22.96	50.11	14.83	22.98
9	S.E.	0.26	3.76	0.87	3.90	0.73	0.40
10	CD (p=0.05)	0.52	7.52	1.74	7.80	1.46	0.90

The inoculation of acid tolerant mutant rhizobia BGR CN-6M at different levels of 50, 75 and 100 recommended N recorded 37.87, 40.62, 43.87 percent increase over control.

Inoculation of blackgram with acid tolerant mutant BGR DD-3M increased the different yield parameters such as number of branches plant^{-1}, number of pods plant^{1}, number of clusters plant^{1} (pod bearing clusters), test weight (1000 seed wt.), grain yield and protein percent over uninouculated with levels of N applied (Table 3). However, the percent increase decreased with increase in N levels in the inoculated blackgram. The treatement with 100% N BGR CN-6M recorded the maximum of 4.97 branches plant^{-1}, 77.85 pods plant^{-1},22.96 cluster plant^{-1} and test weight (1000 seed weight) of 50.11g and grain yield of about 14.83q ha^{-1} and protein per cent of 22.98.

Significant increases in plant height and dry matter production have bgeri achieved in acid soil as a result of *Rhizobium leguminosarum* biovar *phaseoli* (BGR cn-6M) mutant inoculation. The inoculant effect was more pronounced with 50% of recommended N than at 75% and 100% doses. The increase in plant height and dry matter production is accomplished by the increase in root volume, root length and more number of lateral roots and also by increased mineral uptake besides increased nitrogen fixation. Increased root biomass of the inoculated plant could be explained for the higher nutrient uptake and concomitant increased yield. The inoculation of *Rhizobium* significantly enhanced plant height and dry matter accumulation of blackgram at various stages of crop growth (Shivash Sharma *et al.,* 2000).

The inoculation of salt telerant mutant blackgram rhizobia BGR CN-6M at graded N levels namely 50% of recommended N (10kg ha-1) 75% recommended N (15 kg ha-1) and 100% recommended N (20 kg ha-1) increased the growth and yield of blackgram var. ADT -5 grown under field conditions in acid soil as rainfed crop. The inoculation of BGR CN-6M (mutant) at moderate levels (50%) of recommended N produced maximum effect on crop than at height levels (75% and 100% of application).

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