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RESPONSE OF NITROGEN, *RHIZOBIUM* AND CUTTING MANAGEMENT ON NODULE BEHAVIOUR OF FENUGREEK

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ABSTRACT

The experiment was carried out to study the response of nitrogen, *Rhizobium* and cutting management on nodule behaviour of fenugreek under West Bengal condition. The findings revealed that higher doses of nitrogen upto 40 kg/ha produced more number of nodules/plant (232.4) which is 20.2% increase over control. Seed inoculation with *Rhizobium* showed a marked increase (222.9). The highest nodule dry weight (0.832 g) was obtained with 40 kg nitrogen/ha. *Rhizobium* inoculation also resulted in significant increase in nodule dry weight/plant (0.767 g), whereas, it was only 0.710 g with uninoculation. The response of cutting was not significant. So far as the leghaemoglobin content was concerned it showed an increasing trend upto 40 kg/ha of nitrogen (225.58 mg/g). Whereas, with increasing doses of nitrogen from 0 to 60 kg/ha the dry metter/plant was increased, the highest being 13.09 g/plant with 60 kg/ha. The maximum green and seed yield (57.16 and 11.84 q/ha, respectively) was obtained with 60 kg nitrogen/ ha. There was a negative influence of cutting in seed yield.

INTRODUCTION

Fenugreek is one of the important seed spices and often used as an indispensable item in day to day cooking all over the world. It has various medicinal values and used to prevent some diseases including diabetes and knee pain (Pandey and Bhonde, 2001). Being a legume crop it responds to inoculation of *Rhizobium* and supplemented with appropriate levels of nitrogen (Bajpai *et al.*, 1975). Actually a symbiotic association develops with the root nodules and *Rhizobium* and atmospheric nitrogen is fixed within the nodules in a usable form to the plant. Nodule behaviour study of legumes is gaining momentum day by day for undertaking their improvement programme as the number, weight and leghaemoglobin content of nodule were considered as useful selection indices (Chattopadhyay, 1996). There are evidences of appreciable influence of cutting management and nodulation on green and seed yield of fenugreek but we have very little information, so far, regarding the relationship between cutting and nodulation. Keeping this in view, it is considered worth to carryout an investigation to study the response of nitrogen, *Rhizobium* and cutting mangement on nodule behaviour of fenugreek under West Bengal condition.

MATERIAL AND METHODS

The investigation was carried out at Horticultural Research Station, Mondouri, BCKV during winter season (3rd week of November) of 2001-2002. The soil was gangetic alluvial with sandy clayloam texture having good water holding capacity and medium soil fertility status. The treatment consists of four levels of Nitrogen (0, 20, 40 and 60 kg/ha) with two levels of *Rhizobium* (with or without *Rhizobium*) and three frequencies of cuttings (no cutting, one cutting and two cuttings). The experiment was designed in three factor factorial randomized block design. The fenugreek cultivar, Pusa Early Bunching from IARI, New Delhi, was used for sowing in plot size 1.5 x 1 m^2 at a spacing of 30 x 20 cm properly nodulated with *Rhizobium meliloti*. Apart from FYM (30 ton/ ha) inorganic PK fertilizers were applied at a dose of 25 : 50 kg/ha along with N @ 0, 20,

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40, 60 kg/ha. PK fertilizers were applied basally whereas N in split with 1/2 at the time of sowing and the rest in two equal splits after each cutting (30 DAS and 60 DAS) and in case of no cutting after 30 and 50 DAS (DAS : days after sowing). Irrigation, weeding and thining were done as and when necessary. Harvesting of seed was done in about 120 days when the pod was fully ripened. The statistical analysis of data was done as per Gomez and Gomez (1984).

RESULTS AND DISCUSSION

It is revealed from Table 1 that number of root nodules per plant was significantly influenced by nitrogen application and also by seed inoculation (*Rhizobium meliloti*). The cutting management along with the above two treatments had no impact on number of nodules/plant. Increasing doses of nitrogen upto 40 kg/ha increased the number of nodules/plant (232.4) and thereafter declining trend was observed with 60 kg N/ha. Excess application of nitrogen might have some detrimental effect on the production of nodule. With inoculation of rhizobium root nodule number of per plant (222.9) showed a marked increase which is 10.07% higher than control. This is due to the fact that *Rhizobium* increase the nodule production because of its compatibility with the legume fenugreek. The combined effect was positively correlated with the application of 40 kg nitrogen/ha along with inoculation which produce 236.8 root nodule/ plant.

Nodule dry weight/plant was significantly influenced by nitrogen and *Rhizobium* treatments. The response of cutting was non significant. The highest nodule dry weight (0.832 g) was obtained with 40 kg N/ ha. This might be due to the fact that increase in basal dose helps the plants to get good crop stand thereby increasing the nodule dry weight. Increasing dose of nitrogen to 60 kg/ha produced the lowest (0.704 g) nodule dry weight because higher dose of nitrate fertilizer inhibit the attachment of *Rhizobium* to root hairs and also slowing down the nodule growth. The result was supported by the finds of Miller *et al.* (1986). Rhizobium inoculation also resulted in signfiicant increase in nodule dry weight/plant (0.767 g), whereas, it was only 0.710 g with uninoculation. The possible reason might be that inoculation of *Rhizobium melitloti*, which is more compatible with legume fenugreek, promoted the nodule growth unlike in uninculation where native *Rhizobium* species present already in the soil. The interaction between nitrogen and cutting was found to be significant. It is clear from Table 1 that there was a boosting effect between these two variables only upto the application of nitrogen @ 40 kg/ha.

It was observed from Table 1 that the leghaemoglobin content was influenced significantly with nitrogen. With every dose of nitrogen increment upto 40 kg/ha the content of leghaemoglobin was increased, thereafter it decreased with 60 kg N/ha. Higher leghaemoglobin content (225.58 mg/g) was due to increased basal dose of nitrogen resulting in a very good crop stand which increase healthier nodules thereby increasing the leghaemoglobin content.

All the three treatments influenced significantly the dry matter production. An increasing trend of dry matter was obained with increasing dose of nitrogen from 0 to 60 kg/ ha. The highest foliage dry weight of 13.09 g/ plant was found with 60 kg N/ha. In leaves, the major part of dry weight is contributed by nitrogen. Due to this reason foliage dry weight was found to be increased with highest dose of nitrogen application (Thapa, 1999). With *Rhizobium* inoculation the highest of 12.41 g dry matter was found, whereas without inoculation the value was only 12.03 g. This is probably due to the fact that inoculation of *Rhizobium* increase the nitrogen availability

Table 1. Effect of nitrogen, *Rhizobium* and cutting on the root nodule number per plant, nodule dry weight per plant and leghaemoglobin content of fenugreek

	Nitrogen (N) kg/ha														
	Root nodule no./plant					Nodule dry weight/plant (g)					Laghaemoglobin content (mg/g)				
	0	20	40	60	Mean	0	20	40	60	Mean	0	20	40	60	Mean
Rhizobium (R)															
Without R	179.2	198.1	228.1	197.6	202.5	0.627	0.702	0.809	0.700	0.710	93.33	142.83	189.00	124.33	137.37
With R	207.4	229.9	236.8	204.5	222.9	0.710	0.793	0.856	0.709	0.767	127.00	187.17	262.17	145.00	180.33
Mean	193.3	214.0	232.4	201.0		0.669	0.747	0.832	0.704		110.17	165.00	225.58	134.67	
Cutting (C)															
No cut (C_0)	194.1	214.5	229.5	203.3	212.9	0.663	0.744	0.845	0.720	0.743	107.50	150.00	229.25	133.00	154.94
One cut (C_1)	193.8	210.5	235.8	203.1	213.3	0.671	0.749	0.854	0.710	0.746	109.75	163.75	220.75	130.75	156.25
Two cuts (C_2)	192.0	216.6	232.0	196.8	211.8	0.672	0.749	0.798	0.683	0.726	113.25	181.25	226.75	140.25	165.38
Mean	193.3	214.0	132.4	201.0		0.669	0.747	0.832	0.704		110.17	165.00	225.58	134.67	
Rhizobium (R)		C_0	C_1	C_2	Mean		C_0	C_1	C_2	Mean		C_0	C_1	C_2	Mean
Without R		203.3	200.7	203.4	202.5		0.714	0.708	0.705	0.710		139.00	132.63	140.50	137.37
With R		222.6	225.9	220.3	222.9		0 772	0.783	0.746	0.767		170.88	179.88	190.25	180.33
Mean		212.9	213.3	211.8			0.743	0.746	0.726			154.94	156.25	165.38	
		S. Em (±)			C.D. at 5%		S. Em (±)			C.D. at 5%		S. Em (±)			C.D. at 5%
N		1.830			5.353		0.004			0.012		3.034			8.874
R		1.294			3.785		0.003			0.009		2.146			6.277
C		1.585			N.S.		0.004			N.S.		2.628			N.S.
NC		3.170			N.S.		0.007			N.S.		5.256			N.S.
RC		2.241			N.S.		0.005			N.S.		3.716			N.S.
NR		2.288			7.57		0.006			0.018		4.291			12.551
NRC		4.482			N.S.		0.019			N.S.		7.433			N.S.

Table 2. Effect of nitrogen, *Rhizobium* and cutting management on dry matter production, green yield and seed yield of fenugreek

	Nitrogen (N) kg/ha														
	Dry matter production (g/plant)					Green yield (q/ha)					Seed yield (q/ha)				
	0	20	40	60	Mean	0	20	40	60	Mean	0	20	40	60	Mean
Rhizobium (R)															
Without R	11.19	11.90	12.14	12.87	12.03	42.18	46.20	52.30	56.56	49.31	10.53	10.90	11.88	11.80	11.18
With R	11.56	12.29	12.47	13.32	12.41	43.28	47.93	54.76	57.77	50.93	10.65	11.07	11.52	11.87	11.38
Mean	11.38	12.09	12.31	13.09		42.73	47.06	53.53	57.16		10.59	10.98	11.70	11.84	
Cutting (C)															
No cut (C_0)	10.90	13.34	12.06	12.80	11.78	-	-	-	-	-	12.27	12.68	12.96	13.07	12.75
One cut (C_1)	11.56	12.33	12.34	13.23	12.36	17.04	17.96	22.84	24.06	20.47	10.82	11.14	12.40	12.36	11.68
Two cuts (C_2)	11.67	12.61	12.53	13.24	12.51	68.42	76.17	84.96	90.27	79.95	8.70	9.14	9.73	10.07	9.41
Mean	11.58	12.09	12.31	13.09		42.73	47.06	53.53	57.16		10.59	10.98	11.70	11.84	

Rhizobium (R)	C_0	C_1	C_2	Mean	C_0	C_1	C_2	Mean	C_0	C_1	C_2	Mean
Without R	11.56	12.14	12.38	12.03	-	20.14	78.85	49.31	12.68	11.83	9.33	11.28
With R	11 99	12.59	12.64	12.41	-	20.81	81.05	50.93	12.81	11.53	9.49	11.38
Mean	11.78	12.36	12.51		-	20.47	79.95		12.75	11.68	9.41	

	S. Em (±)	C.D. at 5%	S. Em (±)	C.D. at 5%	S. Em (±)	C.D. at 5%
N	0.037	0.108	0.427	1.249	0.050	0.146
R	0.026	0.076	0.302	0.883	0.055	0.102
C	0.032	0.094	0.302	0.883	0.043	0.126
NC	0.064	0.187	0.603	1.764	0.087	N.S.
RC	0.045	N.S.	0.427	N.S.	0.081	N.S.
NR	0.052	N.S.	0.603	1.764	0.071	N.S.
NRC	0.091	N.S.	0.853	N.S.	0.122	N.S.

through the process of biological nitrogen fixation. This result may be supported by the findings of Choudhury (1999). Cutting treatment also influenced the dry matter production/plant signficantly. The maximum of 12.51 g/plant of dry matter was recorded with two cuttings. Increase in number of of cuttings tends to induce more number of branches which produces more number of leaves thereby increasing the dry weight of foliage. The combination effect of nitrogen and cutting influenced the dry matter significantly producing 13.24 g. Other combinations did not show any significant effect.

The green yield and seed yield was significantly varied with different doses of nitrogen application. It was revealed from Table 2 that maximum green yield of 57.16 q/ha and seed yield of 11.84 q/ha was obtained with 60 kg of N/ha. The increase in seed yield is 11.80% higher than control. The highest green yield is due to the pronounced vegetative growth through nitrogen application and increase in seed yield was mainly due to increased number of pods/plant and that of number of seeds/pod. Similar trend was earlier recorded by Kaswan *et al.* (1994), Halesh *et al.* (1998), Mandal and Maiti (1992). Like nitrogen, inoculation of *Rhizobium* significantly increased the green and seed yield (50.93 and 11.38 q/ha, respectively). Bhati (1991) and Shivran *et al.* (1995) reported about the favourable effect of *Rhizobium* inoculation on green and seed yield. Whereas, in case of cutting management there was a decreasing trend in seed yield with the frequency of cuttings. The highest seed yield was obtained with no cut treatment (13.07 q/ha). So far as the green yield the maximum (90.27 q/ha) was obtained with more frequencies of cutting. The interaction effect of nitrogen x cutting and nitrogen x *Rhizobium* was found significantly only in case of green yield whereas other combinations were observed non significant both in green and seed yield ripened.

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