J.Phytol. Res. 4 (1), 1991

PHYTOTOXIC INFLUENCE OF SODIUM AZIDE ON THE GROWTH AND NODULATION IN *VIGNA MUNGO* L.

S.K. MAHNA, REKHA GARG and M. PARVATEESAM*
Department of Botany, University of Ajmer, Ajmer, India.
* PG Department of Botany, Government Autonomus College, Ajmer-305001, India.

Seeds of *Vigna mungo* L. were treated with various concentrations of NaN_3. Rhizobial suspension of native strain and M3 strain were added to determine the effect on growth and nodulation. Plants inoculated with native strain showed better growth, nodulation and total N content than the plants inoculated with M3 strain where the toxic effect of the mutagen was more. Plants treated with various concentrations of NaN_3 exhibited reduced plant growth and nodule formation except in 0.0012 M concentration, where increased plant growth, nodulation and total N content was recorded.

Keywords : Native strain; M3 strain; Sodium azide; Nodulation; *Vigna muugo*.

Introduction

Chemical mutagens and gamma rays have been used to induce genetic variability in different legume species for bacterial nodulation and during the course of induced mutagenesis, various types of nodulating mutants like super-nodulating, copious-nodulating and non-nodulating have been recovered (Bruner and Zapata, 1981; Carroll *et al.*, 1986; and Park and Buttery, 1988). But investigations demonstrating the influence of gamma rays and chemicals on bacterial nodulation in treated leguminous plants (M_1 population) are rare (Migahid *et al.*, 1959; Gottschalk and Wolff, 1983; and Rosaiah *et al.*, 1987). Therefore, the present study was designed to study the effect of sodium azide (NaN_3), a well known potent mutagen (Lalman and Singh, 1989), on the growth of *Vigna mungo* L. (black gram) as well as to test the efficacy of two rhizobial strains for their ability to nodulate the normal and NaN_3 treated plants employing pot culture sterlized soil experiments.

Materials and Methods

Presoaked seeds of *V. mungo* L. var T_9 were treated with freshly prepared solutions of NaN_3 (0.0012, 0.0015, 0.0100, 0.0125 M) pH, 5.4 prepared

in 0.1 M phosphate buffer, for 5 h at 28 °C ± 1. The mutagenized M_1 seeds were rinsed in running tap water for 5 to 10 min and were sown along with untreated seeds in sterilized pots containing sterilized soil, autoclaved at 15 PSI for 1 hr for three sucessive days. Two millilitter ($10X10^7$ count per ml) suspension of rhizobial inoculum Viz. native strain, isolated from nodules of locally grown host plants and M3 strain obtained from International Crops Research Institute for Semi Arid Tropics (ICRISAT), Hyderabad was added separately in each pot after three days of sowing except in one set of pots with untreated seedlings.

The plants from various pots were uprooted after 40 days of vegetative growth and analysed for root/shoot length, dry weight of root (with nodules)/shoot, number of lateral roots and nodules/plant and total nitrogen content measured by micro Kjeldahl method (Jackson, 1962).

Results and Discussion

Observations based on plant growth and nodulation clearly indicated that, of the two strains used in the present study, plants inoculated with native strain showed better growth and produced more nodules/plant as compared to M3 strain inoculated plants. Also, the high frequency of nodules/plant was associated with increased number of lateral roots/plant and total nitrogen content (Table 1).

Mutagenic treated plants, raised after seed treatment with 0.0012 M NaN_3, inoculated with native strain or M3 strain, produced more dry phytomass, number of lateral roots and nodules/plant and total nitrogen content than that of respective controls. However, no significant variation in root/shoot length in 0.0012 M NaN_3 treated plants was observed. In conclusion, the increase in number of nodules/plant and total nitrogen content was greater in 0.0012 M NaN_3 treated plants inoculated with native rhizobia than in M3 rhizobia inoculated 0.0012 M NaN_3 treated plants (Table 1).

Compared to control, the plant growth and nodule formation was considerably reduced in plants raised after seed treatment with higher doses (0.0015 M to 0.0125 M) of NaN_3.

Statistical analysis of the data recorded for all the four doses of NaN_3 (Percentage average of occurence) revealed that with regard to number of nodules/plant and total nitrogen content, the toxic effect of NaN_3 was more pronounced in treated plants inoculated with M3 strain as compared to native strain.

In general, reduction was observed in all the seven parameters of growth and nodulation in NaN_3 treated plants, inoculated either with native strain or M3 strain, were highly dose dependent as ths values of Karl Pearson's

Table 1 : Influence of Sodium Azide on growth and nodulation in *vigna mungo*. L.

Treatments	Root length (Cm) Mean	S.E.±	Shoot length (Cm) Mean	S.E.±	Dry weight of root/plant (gm)	Dry weight of shoot/plant (gm)	Number of lateral roots/plant Mean	S.E.±	Number of nodules /plant Mean	S.E.±	Tolal N content
Untreated ptant without inoculum	11.8	±0.12	10.7	±0.10	0.064	0.19	11.8	±0.14	—	—	5.0
Untreated plants with native strain	13.6	±0.14	11.7	±0.01	0.074	0.26	13.9	±0.10	09.9	±0.08	6.29
Untreated plants with M3 strain	12.0	±0.10	11.1	±0.17	0.066	0.22	13.7	±0.07	08.0	±0.07	6.00
NaN_3 treated plants with Native strain											
0.0012 M	13.0	±0.08	11.5	±0.18	0.100	0.23	16.9	±0.08	18.0	±0.07	7.70
0.0015 M	09.4	±0.07	09.7	±0.12	0.056	0.16	10.7	±0.07	08.6	±0.08	6.40
0.0100 M	08.5	±0.10	08.7	±0.07	0.048	0.12	09.9	±0.16	04.4	±0.05	4.80
0.0125 M	09.0	±0.14	07.2	±0.03	0.049	0.10	09.0	±0.17	03.3	±0.12	3.00
Coefficient of (r) = correlation	-0.7655		-0.9257		-0.6939	-0.8899	-0.7652		-0.7512		-0.9389
Percentage (Xx) = average of occurence	09.01		08.14		00.051	00.11	09.84		04.75		04.29

1	2	3	4	5	6	7	8	9	10	11	12
NaN_3 treated plants with M3 strain											
0.0012 M	11.9	±0.02	10.8	±0.07	0.090	0.34	14.9	±1.14	12.6	±0.14	6.90
0.0015 M	09.8	±0.04	09.0	±0.09	0.066	0.21	12.9	±0.13	07.6	±0.08	5.50
0.0100 M	08.6	±0.09	08.4	±0.12	0.054	0.21	09.9	±0.14	03.3	±0.07	3.30
0.0125 M	08.3	±0.07	07.9	±0.10	0.054	0.19	09.8	±0.10	03.0	±0.05	3.00
Coeficient of (r)=correlation	-0.8929		-0.8544		-0.4520	-0.5030	-0.9394		-0.8727		-0.8894
Percentage (Xx)= average of occurence	08.67		08.30		00.06	00.20	10.26		03.85		03.54

100 Seeds per treatment in Three replicates were used.

coefficent of correlation (r) were highly significant with a few exceptions like reduction of root/shoot dry weight of treated plants inoculated with M3 strain and root dry weight of treated plants inoculated with native strain where it was less does dependent because of moderately significant values.

Variations in nodule morphology Viz., bilobed, trilobed, fanshaped and clusters as compared to unilobed, in normal plants were also observed in the treated plants.

Previous investigations on nodutation have demonstrated that growth and nodule pattern is greatly influenced by various factors including strains of rhizobia (Buttery *et al.*, 1987; and Yoo *et al.*, 1988). Likewise in the present study, the observed superiority of the native strain over foreign strain with regard to nodule formation indicated the better adaptation of the native strain under similar soil conditions.

Migahid *et al*, (1959) have observed that bacterial nodule number as well as lateral roots/plant were promoted in two species of legume plants exposed to high dose rates of gamma rays and relatively, at low doses of gamma rays, only a slight increase in the number of nodules and lateral roots were noticed. According to them, since the bacterial nodules are morphologically similar to tumor, the enhancement of nodule number in the irradiated plants is an expected event. On the contrary, present finding indicated that unlike gamma rays, NaN_3 showed an entirely different effect as, at low dose it caused promotion in growth as well as nodule formation and at higher doses, it adversely affected growth and nodulation. Adverse effect of higher doses of NaN_3 on growth and nodulation can be attributed to the physiological disturbances caused in the host plants due to phytotoxic effect of NaN_3 as suggested by earlier workers (Katyayani *et al.*, 1980; Rao and Rao, 1983; and Nadarajan *et al.*, 1985).

Acknowledgement

Financial assistance from CSIR, New Delhi is gratefully acknowledged.

Accepted July, 1991.

References

Bruner H and Zapata F 1981, *Mutat. Breed. News Letter* **17** 11

Buttery BR, Park SJ and Findlay WI 1987, *Can. J. Plant Sci*, **67** 425

Carroll JB, Mcneil DL and Gresshoff PM 1986, *Plant Sci.* **47** 109

Gottschalk W and Wolff G 1983, Induced Mutations and Plant Breeding (Springer verlag, Meidelberg, New York.)

Jackson ML 1962, Soil Chemical Analysis.

Katyayani M, Rao D and Rao S 1980, *J. Indian Bot. Soc.* **59** 144

Migahid AM, Elnady AF and Abd el Rahman AA 1959, *Plant and Soil* **2** 139

Nadarajan N, Ramalingam RS and Sivasamy N 1985, *Madras Agric. J.* **72** 301

Park SJ and Buttery BR 1988, *Can J. Plant Sci.* **68** 199

Rao SRM and Rao D 1983, *Indian J. Bot.* **6** 40

Rosaiah G, Kumar DS, Satyanaryana A and Seenaiah P 1987, *Indian J. Agric. Sci.* **57** 271

Yoo ID, Kin CJ, Rhee Y, Kim SD and Hong EH 1988, *J. Korean Soc. Soil Sci. and Fertiliser* **21** 55