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IMPACT OF ZINC TOLERANT STRAINS OF *AZOTOBACTER* AND *BACILLUS* ON *TRIGONELLA-FOENUM GRAECUM*

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Abstract
In Modern day, intensive crop cultivation requires the use of more chemical fertilizers. The rapid expansion in the field of bacterial genetics had its impact on the study of Nitrogen fixing and phosphate solubilising microorganisms. Zinc is micronutrient and bacteria absorbs it at higher concentration, and its concentration highly affects the lag, exponential and stationary growth of bacteria. The presence of heavy metal influences the uptake of the others nutrients in the soil. Zn- adapted strains of *Azotobacter* and *Bacillus* is useful in improving crop as well as fulfills the deficiency of the soil. In present study, both the Zn- strain shows the maximum growth as comparative with wild strain. The height of plant, branches, No. of pods, grain yield and test weight were obtained maximum in metallic strain application.
Keywords- Zinc, *Azotobacter*, *Bacillus* and *Trigonella*

Introduction:

Industries producing chemical fertilizers depend on fuel. The demand of fuel has been increased tremendously leading to increase the cost of fuel therefore, consequently increase in the cost of fertilisers. In view of this, it is essential to have other cheep sources of nitrogen. This could be solved to some extent by using biofertilisers. The biofertilisers enhance the soil fertility and yield of crops by rendering non-available sources of elemental nitrogen, bound phosphates and decomposed plant residuces into available forms and thus facilitate the plants to absorb the nutrients. In recent years emphasis has been placed by conducting field trials throughout India in regard to the use of biofertilisers. In view of high cost of chemical fertilisers. It is becoming the financial constraints on the farmers that leading to find other sources of fertilisers.

Killian and Fether (1939) were busy in Russia on several problems relating to interaction between plant and soil microorganisms. The Australian group led by Vincent (1954) was very active in study of all aspects of nodulation, particularly in understanding the enviornmental factors in legume root nodulation as evidenced by work Gibson (1965). While other Australian workers like Date (1974) and Brockwell (1963, 1977) were concentrates in the development of techniques involved in inoculant production and application to seed, Burton (1967, 1979) was chiefly responsible for the establishment of legume inoculant research in North America with all its industrial implications.

Microbial inoculant are carrier-based preparations containing beneficial microorganisms in a viable state intended for seed or soil application and designed to improve soil fertility and help plant growth by increasing the number and biological activity of desired microorganisms in the root environment.

Raulin (1969) who reported first the essentiality of Zn for plants. But Sommer (1926) presented convincing evidence of essentiality of Zn for plants. Zinc is an essential element for an organism because of its central role as enzyme co-factor in many metabolic processes (Vallee, 1959; Malstorm and Neilands, 1964 and Evans and Sorger, 1966). Zinc affects the chlorophyll content at high concentration (De Filippis and Pallaghy, 1976; Rai and Kumar, 1980 and Rai et al, 1981)

Material and Methods:

I) Collection and isolation of *Azotobacter chroococcum* and Bacillus megaterium Wild/lab (W) strain

Azotobacter and *Bacillus* were collected and isolated from rhizosphere of plant soil of various field from Nagpur district by Soil Dilution Method (Gaur, 1990 and ISI, 1979) and cultivated in Jensen's (1942) and Pikovskaya's (1963) media respectively. These wild/lab strains were maintained in laboratory.

II) Preparation of heavy metal (Zn-t) strain

The culture medium with Zinc of different dilution of stock were made separately and growth of *Azotobacter* and *Bacillus* were determined microscopically and by using Spectrophotometer. After about 35 generations adapted metal tolerant strain at Zn-t 0.36 and 0.40 respectively were developed.

III) Field application of biofertilisers and chemical fertilisers

Field experiment was conducted as per Factorial Randomised Block Design (FRBD) with four treatments replicated in three times. The amount of biofertilisers strains inoculated 1ml/ seedling plant.

All bioertilisers used in this treatment were wild or laboratory strain, and Zn-t. Total six treatments were made to study the influence of each biofertilisers on every *Trigonella* plant. Soil of the experimental field was analysed for physico-chemical parameters. The field was medium black, rich in available nitrogen, potash and medium in available phosphorus and slightly alkaline in reaction.

Bacterial treatments as follows-

No treatment (T_0) = T
Treatment with W-strain of *Azotobacter* = T_1
Treatment with W-strain of *Bacillus* = T_2
Treatment with (T_1+T_2) = T_3
Treatment with Zn-t strain of *Azotobacter* = T_4
Treatment with Zn-t strain of *Bacillus* = T_5
Treatment with (T_4+T_5) = T_6

Results and Observation:

Effect of wild strains of *Azotobacter and Bacillus* on *Trigonella foenum – graecum*- In this treatment, the wild strains of *Azotobacter and Bacillus* were used as biofertilisers. Table 1 indicate that the maximum plant height 18.9cm, 14 branches, 18 pods/plant, grain yield 4.50 gm/plant and test wt. 2.84/100 gm were obtained due to combined application of wild strain of biofertilisers. The combined application of biofertilisers shows maximum growth than individual application.

Effect of zinc strains (Zn-t) of *Azotobacter and Bacillus on Trigonella foenum – graecum*- Table 1 indicates that both the Zn-strains of biofertiliser application showed comparatively highest growth and production when compared with single strain of wild and Zn as well as even dual inoculation of wild strains . The maximum plant height 21.5 cm, 18 branches, 20 numbers of pods with grain weight 4.80 gm/plant having 2.89 gm per 100 seeds, were obtained due to application both zinc strains of biofertiliser.

Table-1 Effect of Wild and Zn-t strains of *Azotobacter* and *Bacillus* on *Trigonella foenum-graecum* plant

Treatment	T	T_1	T_2	T_3	T_4	T_5	T_6
Plant height (cm)	12	18.5	18.5	18.9	20.1	20.3	21.5
No. of branches/plant	08	12	12	14	14	14	18
No. of pods/plant	10	17	16	18	18	18	20
Grain wt/plant	2.51	4.20	3.81	4.50	4.52	4.50	4.80
Test wt/100 seeds(gm)	2.2	2.82	2.84	2.84	2.83	2.87	2.89

Discussion:

Effect of wild strains of *Azotobacter* and *Bacillus* on *Trigonella foenum – graecum*-

The maximum growth and yields in *Trigonella* obtained due to the application of wild strains in mixed form as compared with single application of wild strain (no treatment). *Azotobacter* and *Azospirillum* inoculation treatments were superior over uninoculated control and recorded higher tuber in sweet potato. The combined inoculation of *Azotobacter* and *Azospirillum* recorded higher tuber than with application of 75 Kg N/ha alone (Jadhav et al, 1998). The application of natrin significantly increased the percentage of seed germination, average root and shoot length, root/shoot ratio and yield in all the vegetable, coriander, spinach, tomatoes, brinjal and safflower were studied and compared to the untreated control (Dhumal, 1992). Similar results were recorded in vegetables like onion, chillies, brinjal and bhendi (Shende et al, 1977).

Effect of zinc strains (Zn-t) *Azotobacter* and *Bacillus* on *Trigonella foenum – graecum*-

The zinc strain of biofertilisers significantly influence over all the parameters as compared with single and combined applications of wild strains and single application of Zn-strain of both the biofertilisers. The higher phosphorus content and uptake by potato tissue with increased zinc levels could mutually be antagonistic only when either of the elements exceeded some threshold value and may be because of the reason that higher level of zinc might have recorded lower phosporus uptake. Zinc uptake was numerically increased with increasing levels of zinc (Boawn and Leggett, 1964) and zinc uptake recorded with increase in the applied zinc level (Brown and Graham, 1978). Increase in dry matter yield with the addition of zinc reported by many workers Patel and Mehta (1973), Singh et al (1980) and Elsokkary et al (1981).

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