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# A STUDY ON THE INTERACTIVE EFFECT OF DIFFERENT FUNGICIDES WITH RHIZOBIUM IN LENTIL (*LENUS CULINARIS*)

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***Abstract:*** **The study reports the effects of the legumes have been considered, form time immemorial, as an important source of protein, which is an indispensable protoplasmic constituent of all the bio system. Because of their higher protein contains as compared to cereals , legumes attain the significance of a great food value for human diet particularly in the contry like india majority of the people are vegetarian in their food habits. Objective of the study : Taking the significance of problem and the dearth of literature of the present research entitled studies on the interactive effects of different fungicides with rhizobia in lentil'' was planed with the following objectives; to screen out rhizobial isolate for their interactivity and tolerance against selected fungicides. Research Methodology: the materials used and the methods adopted in the present investigation "studies on the interactive effects of different fungicides with rhizobia. In lentil'' are given below: material experimental details: details of Treatments: Fungicides: Cultural Operations: Samples of grain and straw were over dried and ground in a "willey mill" in this way prepared sample were collected. Analysis and interpretation of Data is the two type of Soil Analysis and Plant Analysis. Need and Scope of the Study : It is evident form the results that seed inoculation with rhizobium strain and increased the yields of grains and straw significantly over corresponding uninoculated control. Expected Outcomes of the Study : The crops were harvested at maturity.the total yields of grins and straw were recorded separately. Scope and Significance of the Study: Prophylactic seed Treatment of lentil with some selected fungicides in order to project the plants form fungal disease and soil application of fungicides to project the crop form disease damage are in vogue in modern agriculture.**

***Keywords:*** **Rhizobium-Lentil, Plantand Soil- Fungicides.**

## I. INTRODUCTION

Legumes have been considered, form time immemorial, as an important source of protein, which is an indispensable protoplasmic constituent of all the bio systems. Because of their higher protein contents as compared to cereals, legumes attain the significance of a great food value for human diet particularly in the country like india majority of the people are vegetarian in their food habits. The per capita availability of pluse 80.3g which is lowest form another countries, which indicates that most of the people of the country do not receive adequate protein for their physiological needs. It is estimated that india will required around 230-240 million tons of food grains by 2020AD putting greater demand on chemical fertilize to the tune of 25 million tones as compared to the current level of 13 million tones. Therefore, it is a stupendous task to achieve this goal production without adequate supply to plant nutrients and other inputs. Many centuries before the discovery was made that bacteria exit in the root nodules of leguminous plants and that these bacteria live in symbiosis with the plants, thus enriching the soil with combined nitrogen the practical agriculturist come to

consider the growth of legumes on his land as equivalent to manuring or fertilizing the soil for the succeeding crop. The use of leguminous plants for green manuring was disrobed in great detail by greek and roman writers, notably virgil,varro, and columella. The classical studies of boussingault, published in 1837-1838. These French agronomist and chemist eas the first to develop systematically the idea of nitrogen nutrition of leguminous and cereals plants (Waksman,1952) The causative organism responsible for nitrogen fixation in pure culture was isolated in 1888 by beijerinck, who named it bacillus radicicala. The bacterium is present in the soil in the form of small needs which can penetrate the root hairs of the leguminous plants and form there are transferred to the "infectious tissue" (Waksman, 1952) It is impossible to sterilized the soil completely, especially be the use of high doses of disinfectants, without injuring the plants. The amount of disinfectant necessary to destroy the pathogenic organisms in the soil in considerably less than that necessary to sterilize the soil as a whole various chemical very greatly in this respect. Mercuric chloride is far more active that organic murcuriates; the microbicidal does for mercuruy compounds is about the same as the antiseptic does, where as for copper salts the antiseptic does is much lower than the microbicidal. When soil is sterilized, the fungi and other plant and animal parasites are readily destroyed. Once certain parasitic organisms are introduced, however, they may develop readily in the treated soil and even cause alarger amount of infection. Treatment of soil with a disinfecting agent fallowed by inoculation with saprophytic fungi may prove to be most efficient in increasing the value of the treatment. Whether the saprophytic fungus used up the available nutrients rendered should on steaming of soil or whether the favorable effect is due to the production of a substance directly injurious to the plant pathogen, remains to be determined Waksman (1952). Nitrogen is a major growth element is the nutrition of plants. A good deal of researches on the biological fixation of elemental nitrogen in the plant system have been done all over the world. Attempts have also been made by several workers to find out interaction between different fungicides with Rhizobium. Researches carried out so far in the line under study are presented below under different objectives of reviews: Effect on rhizobium inoculation on the yield of pluse crops and on the fertility of soils. Effect of fungicides and inoculation of the rhizobium on the nodulation of leguminous crops. Effect of fungicides applied alone and in conjunction with Rhizobium inoculation on the yield,nutrient concentration and their uptake by Lentil.

## II. OBJECTIVE OF THE STUDY

Taking the significance of problem and the dearth of literature of the present research entitled studies on the interactive effects of different fungicides with rhizobia in Lentil" was plaaned with the fallowing objectives; To screen out rhizobial isolate for their interactivity and tolerance against selected fungicides. To study the effects of different fungicides on the viability of Rhizobial cells for different period of time. To study the effects of different fungicides with Rhizobium and inoculation on the nodulation of Lentil. To find out the effects of different fungicides with Rhizobium and inoculation on the yield (grains and straw of Lentil). To study the effects of different fungicides with Rhizobum and inoculation on the uptake of Nitrogen and phosphorus by Lentil.

## III. RESEARCH METHODOLOGY

The materials used and the methods adopted in the present investigation "studies on the interactive effects of different fungicides with Rhizobia. In Lentil" are given below:-

### *3.1 Material*

***Experiment Details***

Screening of rhizoboial isolates for their fungicidal tolerance:- The effect of different seed dressent fungicides on the survive of Rhizobium on seed surface. Medium for Rhizobium: Rhizobium strains:- Preparation of broth culture:- Fungicides:- To work out the interactive effects of different fungicides with rhizobium form seed treatment and soil application of fungicide for crops of Lentil ,Pot culture experiment:- Preparation of soil:-Filling of pot:- Fertilizer doses:- Method of fertilizer application:- Seed Treatments:- Soil Treatments:-

***Details of Treatments***

Fungicides:- Cultural operations:-

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***Sampling***

Samples of grain and straw were over dried and ground in a "willey mill" in this way prepared sample were collected.

***3.2 Analysis and Interpretation of Data***

***Soil Analysis***

Mechanical analysis of soil was done by international pipette method (Piper, 1950). Ph of 1:2 soil water suspension was determined with the help of Bechman's ph mater. Electrical conductivity of soil was determined with the help of conductivity bridge. Organic carbon in soil was determined by rapid titration method of walkaley and black **(Piper, 1950).** Total phosphorus is soil was determinedby pemberton's method **(Piper, 1966)**. Total nitrogen is soil was determined by kjeldahl's method **(Jackson, 1968).** Total potash in soil was determined by cobalitinitrite method **(Piper, 1966).** Cation exchange capacity of soil was determined by neutral ammonium acetate method **(Piper, 1966).**

***Plant Analysis***

Nitrogen content in grains and straw was determined by Micro Kjeldal method. **(Jackson, 1967).** Phosphorus content in grains and straw was determined by vanadate- molybdate yellow method of kltson and melon **(Chapman and Pratt, 1961).**

***Result***

***Screening of rhizobial isolates for their interactively and tolerance against selected fungicides***

The data present in Table-1 depict the interactivity and tolerance of efficient strains of Lentil rhizobia to various fungicides in vitro. A great variations in interactivity and tolerance were observed due to different fungicides. Thiram was not found inhibitory to the growth of all rhizobial strains upto 500 ppm but rather at these concentration. This fungicide was found stimulatory for their growth. However, at the concentrations at 1000 ppm and above, the fungicide was inhibitory. But this is extremely high concentration. There was no adverse effect of Capton upto the extent of 500 ppm. But at the concentration of these fungicides at 1000 ppm and above, the growth of strains of rhizobia was adversely affected. Dithane, M-45 showed no adverse effect upto 50 ppm but 100 ppm. growth of two strains namely KLO-05 and LBM-21, was adversely affected. At 500 ppm and above all the strains were adversely affected. Dethane Z-78 showed no inhibitory zones upto 500 ppm but at concentrations of 1000 ppm above the growth of all strains were adversely affected.

**Table 1:** Interactivity and tolerance of Lentil rhizobia to different fungicides.

| **Fungicide concentration in ppm** | **Rhizobia strains** | | | | **Mean** |
|---|---|---|---|---|---|
| | **KLO-05** | **KLU-05** | **LMO-21** | **LSB-05** | |
| **Thiram** | | | | | |
| 0 to 500 | NE* | NE* | NE* | NE* | - |
| 1000 | 7.8 | 7.5 | 8.0 | 7.2 | 7.6 |
| 2000 | 10.7 | 10.4 | 10.8 | 9.8 | 10.4 |
| 5000 | 14.0 | 13.8 | 14.2 | 13.6 | 13.9 |
| **Captan** | | | | | |
| 0 to 500 | NE* | NE* | NE* | NE* | - |
| 1000 | 11.0 | 10.2 | 10.6 | 10.8 | 10.6 |
| 2000 | 13.2 | 12.2 | 12.6 | 12.9 | 12.7 |
| 5000 | 14.6 | 14.2 | 14.6 | 14.8 | 14.5 |
| **Dithane M-45** | | | | | |
| 0 to 50 | NE* | NE* | NE* | NE* | - |
| 100 | 7.5 | NE | 7.0 | NE | 7.2 |
| 500 | 10.6 | 9.4 | 10.2 | 9.0 | 9.8 |
| 1000 | 12.3 | 11.8 | 12.0 | 10.8 | 11.7 |
| 2000 | 13.8 | 13.0 | 13.4 | 12.8 | 13.2 |
| 5000 | 16.2 | 15.5 | 15.8 | 14.8 | 15.5 |

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| | | | | | |
|---|---|---|---|---|---|
| **Dithane Z-78** | | | | | |
| 0 to 500 | NE* | NE* | NE* | NE* | - |
| 1000 | 10.5 | 9.5 | 10.2 | 9.8 | 10.0 |
| 2000 | 12.5 | 11.6 | 12.0 | 11.8 | 11.0 |
| 5000 | 15.5 | 15.0 | 16.0 | 15.4 | 15.4 |

Diameter of inhibition zones, In mm.

**NE = No effect**

***Effect of Different Fungicides with Rhizobium Inoculation on the Nodulation of Lentil***

The data presented in Table 3 & Fig. 1 show the individual and interactive effects of fungicides and inoculation on the nodulation of Lentil crop under pot house conditions. Rhizobial inoculation increased the number of nodules significantly at 30, 60 and 90 days stage of crop growth over uninoculatec control. All the fungicides when used in combination with inoculation increase the number of nodules over inoculation alone. Effect of combined application of Thiram and inoculation, Capton and inoculation Dithane M-45 and inoculation, Dithane Z-78 and inoculation was much pronounced over other corresponding treatments fungicides had no adverse effect on the nodulation as evidenced from number of nodules taken at all the 3 stage. Instead, fungicides like Thiram, Captan, Dithan M-45 and Dithane Z-78 increased the number of nodules significantly over the activity of native flora. Interactive effect of fungicides and inoculation was also found significant.

**Table 2:** Effect of different fungicides with Rhizobium and inoculation on the nodulation of Lentil.

| **Treatment** | **30 Days** | | **60 Days** | | **90 Days** | | **Mean** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Un-inoculated** | **Inoculated** | **Uninoculated** | **Inoculated** | **Un-inoculated** | **Inoculated** | **30** | **60** | **90** |
| Control | 4 | 6 | 6 | 8 | 3 | 4 | 5.0 | 7 | 3.5 |
| Thiram | 5 | 8 | 7 | 13 | 4 | 8 | 7.5 | 10 | 6.0 |
| Captan | 3 | 5 | 5 | 9 | 3 | 5 | 4.0 | 6 | 3.0 |
| Dithane M-45 | 4 | 8 | 6 | 11 | 3 | 6 | 6.0 | 8.5 | 4.5 |
| Dithane Z-78 | 4 | 9 | 6 | 12 | 3 | 7 | 6.5 | 9.0 | 5.0 |
| Mean | 4 | 7.6 | 6 | 10.2 | 3 | 5.8 | 5.8 | 8.1 | 4.4 |
| | 30 Days | | | 60 Days | | | 90 Days | | |
| | 1* | F* | 1 x F | 1* | F* | 1 x F | 1* | F* | 1 x F |
| S.E. (m) ± | 0.338 | 0.535 | 0.756 | 0.420 | 0.664 | 0.940 | 0.416 | 0.658 | 0.931 |
| C.D. at 5% | 0.711 | 1.124 | NS* | 0.882 | 1.394 | NS* | 0.875 | 1.333 | NS* |

I = Inoculation
F = fungicides,
NS = Non significant

## IV. NEED AND SCOPE OF THE STUDY

It is evident from the results that seed inoculation with rhizobium strain and increased the yields of grains and straw significantly over corresponding uninoculated control. All the fungicides increasedthe yield of grains and straw significantly over control (without fungicides). Amongst fungicides, application of Dithane Z-78 gave highest yield of given 23.95 g/pot closely followed by Dithane M-45, Captan and Thiram. Almost similar trend was observed in case of straw yields of grain and straw over inoculation alone interaction effect of fungicides and inoculation were found significant in both the cases of grains and straw yields. But maximum beneficial M-45 and inoculation, Dithane Z-78 and inoculation Captan, inoculation and Thiram and inoculation in case of grains yield almost similar trend was observed in case of straw production.

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## V. EXPECTED OUTCOMES OF THE STUDY

The crops were harvested at maturity. The total yields of grins and straw were recorded separately. Studies on interactive effects of different fungicides with Rhizobia" are being given under the following heads:- Screening of rhizobial isolates for their interactivity and tolerance against selected fungicides. Survival of rhizobial cells is chemically treated seeds of Lentil. Effect of different fungicides with Rhizobium and inoculation on the nodulation of Lentil. Effect of different fungicides with Rhizobium and inoculation on the grain and straw yields of Lentil. Effect of different fungicides with Rhizobium and inoculation on the percent nitrogen and phosphorus contents and their uptake by Lentil.

## VI. SCOPE AND SIGNIFICANCE OF THE STUDY

Prophylactic seed treatment of lentil with some selected fungicides in order to project the plants from fungal disease and soil application of fungicides to project the crop from disease damage are in vogue in modern agriculture. Simultaneously, pressowing seed bacterization of Lentil with effective strains of specific schizoid for the purpose of obtaining appured optimum yield under tropical and subtropical conditions has also been necessary a practice of Lentil cultivation. Thus, obviously, et become pertinent aspect of modern agriculture work out the interactivity of both these inevitable agriculture practices i.e. prophylactic use of fungicides and rhizobial inoculants. Motivated by this,in present project entitled or **"a studies on interactive effect of fungicides with selected Rhizobium in Lentil"** was under taken extensively under 'in vitro' pot conditions to arrive at a definite conclusion of practical agriculture sigmificance.

***General Discussion***

The experimental observations given in the preceding chapter have been discussed under the following heads:

***Interactivity and tolerance of some selected Rhizobium species of fungicides:***

Studies for tolerance of foals strains of Lentil rhizobia (KLO-05, KLU 05 LBM-21 and LSB-05) to different non-mercurous and murcuras fungicides through inhibition zone formation by agar plate diffusion technique were undertaken 'in Vitro' conditions. The results showed no spectacular variation in general, for their fungicidal tolerance. Lentil rhizobia strains were appeared to be more sensitive. The strains showing inhibited growth between 100-500 ppm concentration of Thriam, Captan & dithane Z-78. and 50 ppm concentration of dithane M-45. Amongest non mercurous fungicides, Dithane M-45 was observed in general to be the most toxic showing safe limit only between 20-50 ppm. While Dithane Z-78, Thiram & Captan were found to be least toxic showing the safe limit as high as 1000 ppm to 5000 ppm depending upon the type of species. This result is in close conformity with the finding of curley and Burton (1975) but is in disagreement with the observations recorded by Diatloff (1970) who reported that thiram was more toxic than Captan. The degree of toxicity of various fungicides to Rhizobium sp. could be arranged in the descending order as follows :

***Lentil Rhizobium***

Dithane M-45 > Captan > Dithane Z-78 > Thiram. Thus it could be said in nut shell that Thiram was the safest fungicide for all species of Rhizobia while the Dithan M-45 was the most toxic non-murcurous fungicide. The variation in the degree of toxicity of different fungicides to Rhizobia has also been reported by Diatloff (1970). It was interesting to note that some of the fungicides like thiram was rather stimulatory for the Rhizobial growth particularly at lower concentrations, say at 10 to 100 ppm. The stimulatory effect of this fungicides on the growth might be due to their nutritional (Carbon and for energy source) influence upto certain permissible concentration, which undoubtedly open a new venue for further nutritional studies on *Rhizobium.* Khatry and Choksey (1973) reported stimulatory effect of dithane on the growth of Lentil Rhizobium, However, under the present investigation, Dithane either M-45 or Z-78 showed no stimulatory effect on the growth.

***Survival of Rhizobial cells on chemically treated seeds of Lentil***

For the effective nodulation, it is imperative that symbiosis may take place with the tested efficient introduced stain and for which maximum possible viable cells on the seeds may be one of the favourable ecological factors. In modern agriculture, prophylactic seed treatment with some fungicides to protect the plant against some soil pathogens is in vogue. It was, therefore, through was the while to examine the extent of survival of rhizobia on the seeds of legume in association with various fungicides at different intervals. The results presented in Table 2 show that in case of Lentil after one hour of

seed inoculation with peat base inoculum, 72% of the initial rhizobial cells were recovered under control treatments (Without fungicides). The results revealed that even seed coat surface of legumes had detrimental effect on the viability of cells reducing the viability from 27-62% within one hour of inoculation. This was probably due to either the presence of antagonistic substance in seed Coat of legume (Thompson, 1960) and/or dry surface area of the seed. More survival of rhizobial cells was reported on the surface of glass seeds as compared to seed surface (Vincent, 1958) which clearly indicated the toxic influence of seed Coat substance of the legumes on rhizobial cells.

The results presented in Table 2 indicated that further incubation of storage of inoculated seeds from 4 hours to 14 days resulted in gradual decrease in the viability of cells in legume tested. In control treatment (Wihtout fungicides), more than 50% of the viable cells were recovered after 24 hours of storage. After 7 days of storage of inoculated seeds (Control), about 14.25% of the viable cells were recorded with the lentil rhizobia. In same days of inoculation showing the counts of viable cells in the order of $10^3$/seed. After 14 days inoculation, viability considerable decreased to the order of $10^3$ viable cells/seed most of the cells of Lentil seed showed to viable cells/seed. In case of fungicidal treatment, the recoveries of viable cells after one hour of inoculation from the thiram treated seeds, were to the tune of 64% and 66% which were higher to that of control one. Thus thiram appeared to be safe fungicide giving viable cells count upto $10^3$ seeds even upto 7 days. Although application of Captan slightly reduced the viability of cells in comparison to control, yet the viability of cells was maintained at standard level of $10^3$ viable cells/seed. The satisfactory survival of rhizobial cells on the Captan treated soubean seed was also reported by Burton and Curly (1965). The stimulatory effect of thiram upto the concentration of 100 ppm was also obtained on the growth of rhizobia in paper disc inhibition studies under the present investigation (Table 1) which further confirmed the better survival of cells on the seeds treated with these two fungicides. The survival of all the species of rhizobia under the present test was studied upto 14 days of inoculation with the treatment of zinc containing fungicide dithane Z-78. Although viability of cells was lesser as compared to control treatment showing the adverse effect of dithane Z-78 on the survival, yet the viable cells left over were presumably sufficient for good nodulation as viable cells to the $10^3$/seed have been reported for good nodulation in natural conditions (Burton and Curley, 1965). Dithane M-45 is an antifungal antibiotic viz. aureofungin, a metabolic product of strep to *Verticillium cinnamoneum* var. terricolum appeared to be more toxic to rhizobia than Ditahne Z-78 and there was a considerable reduction in the viability of cells. More susceptibility of slow growing rhizobia as compared to the fast growers was reported by Kazzublak (1966). Which fall in the line of present findings. In general, the standard viable cells of $10^3$ seed was maintained with these fungicides for 4 hours of seed inoculation. The injurious effect of Ditane Z-78 and Ditane M-45 on rhizobial viability might be due to the presence of heavy metals like zinc and manganese as the constituents of afore mentioned compound and (holding and Lowe, 1971).

## VII. SUMMARY & CONCLUSION

Prophylactic seed treatment of Lentil with some selected fungicides in order to project the plants from fungal disease and soil application of fungicides to project the crop from disease damage are in vogue in modern agriculture. Simultaneously, pressowing seed bacterization of Lentil with effective strains of specific schizoid for the purpose of obtaining appured optimum yield under tropical and subtropical conditions has also been necessary a practice of Lentil cultivation. Thus, obviously, et become pertinent aspect of modern agriculture work out the interactivity of both these inevitable agriculture practices i.e. prophylactic use of fungicides and rhizobial inoculants. Motivated by this, in present project entitled or **"a studies on interactive effect of fungicides with selected Rhizobium in Lentil"** was under taken extensively under 'in vitro' pot conditions to arrive at a definite conclusion of practical agriculture significance. The summary of the results obtained and inferences drawn under the present investigations are given below :

***Interactivity of some selected Rhizobium species with fungicides under 'in vitro' condition***

Interactivity and tolerance of some selected of Lentil rhizobia against some selected fungicides was assessed to the extent of inhibition zone formation through agar plate diffusion technique. The results in brief are summarized below: Although, this was no spectacular strain variation for their fungicidal tolerance, however strain KLU-05 of Lentil appeared to be less sensitive to Dithane M-45. Among non mercurous fungicides, Dithane Z-78 was observed to be the most toxic showing safe limit between 0 and 50 ppm while Thiram, Captan and Dithane M-45, the safest fungicide, showed the safe limit as high as to 5000 ppm depending upon the type species of Rhizobia. Some of the non-mercurous fungicides like Thiram, exerted stimulatory effect on Rhizobial growth at their lower concentration.

## REFERENCES

[1] Abu,shaker and bassiri,A. (1972) : Effect of inoculationand nitrogen fertilization on nodulation, seed yield and quality of soybean J.Agric Sci. (Landon),78 (2) :179-182.

[2] Alexander,M.(1961): Introduction to soil microbiology John Wiley and Sons, INC., New York and. Pp.326-[[[[50.

[3] Anonymous(1976): Annual report of all india Co-ordinated scheme on pluse improvements.I.C.A.R. New Delhi.

[4] Ashour, N.I;Moawad, A.A. and EI-Shefif, A.F.(1969): 6th Arab Science congress Damascus 1-7 Nov.,Part 2 pp. 443-448.

[5] Bajpai, P.D.; Lahari, L.K. and Pathak, A.N. (1974) : Effect of inoculation with Rhizobium strains on yield of leguminous crop, Proc znd Natl. National Socio., Acad. Pt. B.Biol.,Sci., 40 (5) : 571-575.

[6] Bajpai, P.D.; Lehri, L.K. and Pathak, A.N. (1974): Symposium on legume inoculants science and Technology, New Delhi 23-25 Oct. 1972. Abstract of paper Indian National Science Academy.

[7] Baldwell,B.E. and Vest, G. (1970) : Crop sci. 10 : 10-19.

[8] Bhargava, J.K.; Sexena M.C. and Tilak K.V.B.R. (1972) : Symposium on legume inoculants Science and Technology, New Delhi 23-25 Oct. 1975. Abstract of papers Indian National Science Academy.] Brady Nyle, C. (1974): The nature and properties of soils 8th edition, macmillan publishing New York.

[9] Chaudhury,S.K.;Hana, Nath, D.K. and Bandyopydnyay, D.C. (1977): Science and Culture, 43 (9) : 416.

[10] Habish, H.A. and Ishaq, H.M. (1974) : Nodulation on legume in sudan 3 experimental Agi., 10 (1) : 40-50.

[11] Ham, G.E., Cardwell, V.B. and Johnson, H.W. (1971): Agron. J. 63 : 301-303.

[12] Ham, G.E.; Lawn, R.J. and Brun, W.A. (1976) : International Biolgoical Programme 7, Editade by P.S. Nutman.

[13] Hera, C. (1976) : International biological Programme 7. Edited by P.S. Nutman.

[14] Holding, A.J. & Lowe, J.F. (1971) : Plant and soil special Val. 153-160.

[15] Hussein, AHA; Abou-zeid-NM; Hussan-ME (1991) : effect of N, P fertilizers, Rhizobium inoculation and seed fungicides on yield, yield components, nodulation and seed contents of faba bean.

[16] Jagdish, P.; Ram, H. and Prasad, J. (1996) : effect of zinc, copper and Rhizobium inoculation on their availability and uptake and yield of green gram. Agropedology, 6 : 75-78.

[17] Jan, H. Subhan-M; Yaqoobi-M; Jan-R, Khan-SB (1994) : effect of fertilization, *Rhizobium* inoculation and carbofuran on nodulation and yield of lentil Sarhad J. Agri. 10:4, 425-430.

[18] Jethmalani, S.C.; Tiwari, K.L., Motiramani, D.P. (1969) : Indian Farming 19 (4) : 17-18.

[19] Johson, B.J. and Jellum, M.D. (1969) : Agron. J. 69 : 379.

[20] Jorden D.C. & Garrad, E.H. (1951) : Can. J. Bot. 29 : 360-372.

[21] Kamal, M. and Arshad, M. (1967) : W. pak. J. Agric. Res. 5 (1) : 90-95.

[22] Kaszubiak, H. (1966) : Acta. Microbial. Polon. 15: 357.

[23] Kern Kamp, M.F. (1948): Phytopathology, 38 : 955-959.

[24] Khatry, A.A, & Choksey, (1973): Science and culture 39, 282.

[25] Lopes-E.S. Tella-R.D.F., Rocha-J.L.V.D.A. and Igue, T, (1972): Inoculation of groundnut seeds. Bragnatia 31 (Nata No-6) 27-34.

[26] Magu, S.P.; Gaur, A.C. and Sadasivam, K.V. (1972) : Symposium on legume Inoculants Science and Technology New Delhi 23-25 Oct. Abst. of papers, Indian National Science Academy.

[27] Mishra, K.C. and Gaur, A.C. (1972) : Symposium on legume inoculants science and Technology, New Delhi 23-25 Oct. Abst. of papers, Indian National Science Academy.

[28] Mukewar, P.M. & Bhide, V.P. (1969) : Hindustan Antibiot. Bull. 11 : 172-176.

[29] Oblisami, G., Balraman, K., Venkataramanan, C.V. Rangaswami, G. (1972) : Mad. Agric. J. 60, 462.

[30] Ostwal, K.P. and Gaur, A.C. (1971) : Hindustan Antibiot. Bull. 13 (3), 73-74.

[31] Pant, L.M.; Dwivedi, G.K. and Katiya A.K. (1999) : survival and response to inoculation of *Rhizobium leguminosarum* b.v. phaseoli of French bean grown under temperate condition. J. Indian Soc. of Soil Sci. 47 : 558-560.

[32] Pareek, R.P. and Gaur, A.C. (1970) : Plant and soil 33 : 297-304.

[33] Patel, FM, and Patel, L.R. (1991) : response of green gram varieties to phosphorus and Rhizobium inoculation Indian J. of Agronomy, 36 (2) : 295-297.

[34] Pawar, N.B.; Ghulghule- JN (1978) : compatibility study of pesticides and *Rhizobium* of gram (*Cicer arietinum* L.) Tropical- Grain-Legume-Bulletin. 1978 No. 11-12, 40-42.

[35] Pena, cabriales, J.J. and Alexander- M (1983) : growth of Rhizobium in unamended Soil Science Am. J. 47 : 81-84.

[36] Poi- S.C., and Ghosh (1986) : Response of lentil (*Lens esculenta*) and chickpea (*Cicer arietinum*) to inoculation with different strain of *Rhizobium leguminosarum* Eco. 4 : 630-632.

[37] Prashant, Gupta; Dwivedi; S.K.; Jha, S-K.; Sunil- Kumra, Sanjeev, Malaiya, charu Sharma (2004) : effect of different doses of various insecticide and herbicides on chick pea- *Rhizobium* symbiosis under sterilized condition J. Plant Archives 4 (2) : 487-490.

[38] Prashant, Gupta; Dwivedi; S.K, Charu Sharma, Alok Srivastava, Verma,-S (2004): microbiological studies on different doses of pesticides in chickpea (*Cicer aretinum* L.) *Rhizobium* symbiosis J. Plant Archives 4 (2) : 413-471.

[39] Raicheva, L. (1976): International Biological Programme 7, Edited by P.S. Nutman.

[40] Rao, D.N.L.; Sharma, P.C. and Gill K.S. (1994) : response of pigeon pea to alkalinity and Rhizobium inoculation J. Indian Soc. of Soil, 42 : 381-389.

[41] Rewari, R.B.; Kumar, V.; Bhatnagar, R.S. and Jain M.K. (1972) : 7th Pulse workshop (5-8 Jan. 1972) at Banglore, Reported on Microbiological work at I.A.R.I. and other centres.

[42] Rewari, R.S.; Kumar, V.; Verma, O.P.; Bhatnagar, R.S. and Subba, N.S. (1974) : Rabi pulse workshop (18-21 sep. 1974) held at U.P.I.A.S. Kanpur.

[43] Roughley, R.J. (1976): International Biological Programm 7, Edited by S.S. Nutman.

[44] Ruschel, A.P. and Costav, W.F. (1966) : pesq. Agropec. Bras. 1 : 147-149.

[45] Salim, K.G.; Mahmoud, S.A.Z. (1970) : Plant and Soil 33 : 325-329.

[46] Salim, S.H.; Szeci, J.; and Gulyas, F. (1971) : Agrokemia Taljtan 20 (4) : 581-589.

[47] Sanjeev, Kumar; Upadhyay, J-P (2002) : combined effect of pesticides and Rhizobium seed treatment on emergence and nodulation of chickpea (Cicer arietinum) J. of Applied-Biology 12 (1/2) : 77-80.

[48] Santosh, C.E.R.S.; Stamford, N.P. and Santosh D.R. (1992) : effect of refuse compost supplemented with phosphorus and inoculation with brady *Rhizobium* on cowpea, Revista Brasileria De sole, 16 (1) : 25-30.

[49] Saxena, M.C.; Tilak, K.V.B.R. and Yadav, D.S. (1970) : Plant and soil 33 : 325-29.

[50] Saxena, M.C.; Tilak, K.V.B.R. and Yadav, D.S. (1975) : Ind. J. Agron. 20 (4) : 321-324.

[51] Sharma, L.C.; Redoly, B.N. and Saxena, S. (1981) : Rhizobium inoculation for pulse in Rajstan pulse crop news letter, 1 (1) : 106.

[52] Sharma, R.D.; Pareek R.D. and Chandra R. (1995) : Residual effect of phosphate and Rhizobium inoculation in chickpea on succeeding maize and fodder sorghum. J. India Society of Soil Science 43 (4) : 600-603.

[53] Shrirama Raju and K and Samvel, A.V. (1976) : Mad. Agric. J. 63 : 11-12.

[54] Singh, Kalyan, Prasad Rajendra and Chaudhury, S.L. (1976): Ind. J. Agron. 21 (1) : 49-52.

[55] Singh, P.P; Yadav-R.P.; Singh-B (2002) : effect of insecticides and Rhizobium used as seed treatment on plant moratality and nodulation in field pea (*Pisum sativum* L.) S. Crop- Research- Hisar 2002, 24:2, 394-397.

[56] Sriramachandrasekharan, MV. Vaiyapuri-V (2003) : influence of granular insecticide- carbofuran in association with *Rhizobium* on nodulation growth and yield of block gram J. Ecobiology 15:2, 10-111.

[57] Subba Rao, N.S. (1976): International Biological programme-7. Edited by P.s. Nutman.

[58] Subba Rao, N.S.; Singh, C.S. and Tsuru, S. (1984) : A study on the nature of *Rhizobuim* Azotobacter and Azosprllum in Japanese soil amended with organic and inorganic manure znetralbaltt. Filar microbial 139 (8) : 607-613.

[59] Takankhar, V.G.; Mane, S.S. Kamble, BG. and Indulkar, B.S. (1997): Grain quality of chick pea and influenced by phosphorus fertilization and *Rhizobium* inoculation J. Indian Soc. Soil Sci. 45 (s) : 369-397.

[60] Thompson, T.A. (1960): Nature, London 187-619.

[61] Trotus, E; Ghizdavau- I, Guran-M (1996) : experimental results concerning the compatibility among different fungicides, insecticides and bacterial preparation (*Rhizobium spp*.) sued for treating bean seeds A. cencertari-Agronomic-in-Moldova 1996, 29 : 1-2, 105-109.

[62] Udaiyan, K; Manian-S; Muthukumar-T; Greep –S (1995) : biostatic effect of fumigation and pesticide drenches on an endomycorrhizal- Rhizobium-legume tripartite association under filed conditions. Ab. Biology and fertility of soils, 20:4, 275-283.

[63] Vidyasekaran, P.; Balaraman, N, Deviveekasundaram, M., Viswanathan, G. & Ranga Swami, G. (1973): Ind. J. of Microbiology 13 : 23-26.

[64] Viltos, A.J. & Preston, D.A. (1949): Phytopathology 39 : 706-714.

[65] Vincent, J.M. (1958): In E.G. Halls worth, ed. Nurtition of legumes, Academic press New York, 1958, pp. 108-123.

[66] Vojinovic, Z.D. (1976) : International biological Programme 7, Edited by P.S. Nutman.

[67] Waksman (1952): Soil Microbiology John Wilsey and Sons; Inc; New York.

[68] Yadav, K.; Devendara Prasad, C.R., and mandol-K (1992): effect of in rice compost and Rhizobium culture on yield of green gram. J. Indian Soc. Soil Sci. 40 : 71-75.

[69] Zaied K.A, EI-AdI,-A.M.; Nassef,- M-A; Zehry, A-A (2002) : response of faba bean to inoculation with fungicide auxotropic mutants induced in *Rhizobium leguminosarum* biover Viceae Eg. J. Microbiology 37 (3) 213-231.