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# NODULATION AND YIELD OF CHICKPEA (*Cicer arietinum* L.) AS INFLUENCED BY MACRO AND MICRONUTRIENT UNDER RICE BASED CROPPING SYSTEM IN *VERTISOL*

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**ABSRACT**

**Chickpea (*Cicer arietinum* L.) is a important legume crop which is well fit in the cropping system under both irrigated and rainfed condition. This is not only a protein source to the vegetarian population but it also maintains the soil health because chickpea is nodules formation in different stages for nitrogen fixation from atmosphere as well as maintain the biological properties of soil. Result of effect of secondary and micronutrient on nodulation of chickpea in vertisol were studied for chickpea nodulation and yield. Maximum number of nodule has been recorded in 60 DAS than 30 DAS and 45 DAS. The result indicated that among the sulphur and zinc treatment through $MgSO_4$ and $ZnSO_4$ gave the higher number of nodules per plant (36 nodules/plant) at the 60 DAS of growth. Fresh and dry weight of nodules had significantly higher under treatment ($T_8$) 100% RDF + ZnSO4 @ 25 kg/ ha + $MgSO_4$ @ 25 kg/ha. than other treatment at the all date of observation. The maximum yield (12.12 q/ha) was recorded under ($T_8$) 100% RDF + $ZnSO_4$ @ 25 kg/ha + $MgSO_4$ @ 25 kg/ha and mínimum yield (8.95 q/ha.) was recordad under control.**

***Key Words :*** *Rice, chickpea, nodulation, cropping system, macro nutrients, micronutrient.*

Chickpea (*Cicer arietinum* L.) is the third most important legume in the world. It is one of the promising pulse crop grown for grain and green vegetables mainly in *Rabi* season. It is also rich source of protein and malic acid. Chickpea is used as 'Dal' and has a high nutritive with 21.1% protein, 61.5% carbohydrate, 4.5% fat and good amount of calcium.

Chickpea is an important pulse accounting for more than a third of the area and 40% of the pulse production of the country. India alone has a chickpea production of nearly 75% of the world average and an area 6.93 million hectare with production of 5.60 million tones and productivity of 808 kg per hectare. In Chhattisgarh, Chickpea occupies an area of 0.23 million hectare with production of 0.16 million tones and productivity of 705 kg per hectare (1).

Chickpea has a capacity to fix atmospheric nitrogen and add sizeable amount of nitrogen to the soil so at plays an important role in sustaining soil productivity. In biological nitrogen fixation process by legume, the root nodules bacteria (*Rhizobium*) and the host plant play key role. The successes of root nodule bacteria depend on inoculants, and other constraints. These include host, quality of inoculants, soil nitrogen and phosphorus, high native Rhizobial population, soil moisture and interaction among these factors. There is a considerable scope to enhance N fixation by legumes through host plant selection in addition to selection of Rhizoidal strains for high N fixation.

## MATERIALS AND METHODS

The field experiment was conduct on research farm of Indira Gandhi Agriculture University, Raipur. The experiment was consisting in randomized block design in 12 treatments with three replication. The gross plot size of 4.5x5=22.5$m^2$ and net Plot size 3.9x4.4 =17.16 $m^2$. The treatments consisted of three primary nutrients, two secondary nutrients and one micro nutrient. The different secondary and micronutrient to rice crop only and residual effect of these treatment was assessed in succeeding chickpea crop . In Kharif along with secondary and micronutrient RDF i.e. 100:60:40 was applied to rice and in Rabi 20:40:20 N : $P_2O_5$ : $K_2O$ was applied to chickpea crop. Two continuous plants in the second row from east after 50 cm from beginning of the row were uprooted with the help of pick-axe. Roots were carefully washed in water can and by jet of

**Table-1 :** Details of the treatment.

| Notation | Treatments |
|---|---|
| $T_1$ | Control ($N0P_0K_0$) |
| $T_2$ | $MgSO_4$ @ 25 kg/ha |
| $T_3$ | 100% RDF |
| $T_4$ | 100% RDF + $MgSO_4$ @ 25 kg/ha |
| $T_5$ | 100%RDF + MgO @ 5 kg/ha |
| $T_6$ | 100 % RDF + S @ 6.7 kg/ha |
| $T_7$ | 100% RDF + ZnSO4 @25 kg/ha |
| $T_8$ | 100% RDF + $ZnSO_4$ @ 25 kg/ha + $MgSO_4$ @ 25 kg/ha |
| $T_9$ | 100% RDF + S @ 20 kg/ha |
| $T_{10}$ | 75% RDF + $MgSO_4$ @ 25 kg/ha |
| $T_{11}$ | 75% RDF + $ZnSO_4$ @ 25 kg/ha |
| $T_{12}$ | 75% RDF + $ZnSO_4$ @25 kg/ha+ $MgSO_4$ @ 25 kg/ha |

**Note :** RDF Recommended dose of fertilizer, S= Sulphur, MgO = Magnesium Oxide, $ZnSO_4$ = Zinc Sulphate, $MgSO_4$ = Magnesium Sulphate).

wash-bottle. Nodules were detached from roots, counted and averaged to have number of nodules/ plant. The observations were recorded at 30, 45, 60 and 75 DAS. About 30 cm space in row was left each time to uproot fresh samples at each successive stage. After counting the number, the nodules were transferred to small paper envelopes and kept in an oven to dry at $60^0$C for 24 hours to obtain constant dry biomass. Total dry weight was recorded and averaged at different crop stages.

**Table-2 :** Effect of secondary and micronutrient on number of nodule/plant.

| Treatment | Number of nodules/plant | | | |
|---|---|---|---|---|
| | 30 DAS | 45 DAS | 60 DAS | 75 DAS |
| $T_1$ | 16.67 | 17.33 | 20.67 | 17.00 |
| $T_2$ | 17.67 | 21.00 | 22.00 | 17.67 |
| $T_3$ | 20.33 | 27.33 | 29.00 | 20.67 |
| $T_4$ | 20.67 | 28.33 | 31.33 | 21.00 |
| $T_5$ | 18.33 | 22.33 | 22.67 | 18.33 |
| T6 | 21.33 | 31.33 | 35.33 | 22.00 |
| T7 | 21.00 | 29.67 | 33.00 | 21.67 |
| T8 | 22.33 | 32.67 | 36.00 | 22.33 |
| T9 | 19.33 | 23.00 | 26.33 | 19.67 |
| T10 | 19.00 | 25.67 | 24.67 | 19.33 |
| T11 | 19.68 | 25.00 | 27.33 | 20.00 |
| T12 | 20.00 | 26.00 | 28.67 | 20.33 |
| Sem ± | - | 1.58 | 1.24 | - |
| CD (P = 0.05) | NS | 4.65 | 7.62 | NS |

## RESULTS AND DISCUSSION

### Nodulation Study

The number of nodulation had significantly more in $T_8$ (100% RDF + $ZnSO_4$ @ 25 kg/ha + $MgSO_4$ @ 25 kg/ha) and signifiantly lower under $T_1$ (Control ($N_0P_0K_0$) at all date of observation (Table-2). The nodulation gradually increased from 30 DAS to 60 DAS there after reduced to 75 DAS. Significantly higher number of nodules in $T_8$ (100% RDF + $ZnSO_4$ @

**Table-3 :** Effect of secondary and micronutrient on Fresh and dry weight of nodules/plant (g).

| Treatment | Fresh weight of nodules/plant (g) | | | | Dry weight of nodules/plant (g) | | | |
|---|---|---|---|---|---|---|---|---|
| | 30 DAS | 45 DAS | 60 DAS | 75 DAS | 30 DAS | 45 DAS | 60 DAS | 75 DAS |
| $T_1$ | 0.58 | 0.60 | 0.60 | 0.61 | 0.060 | 0.041 | 0.050 | 0.044 |
| $T_2$ | 0.59 | 0.62 | 0.74 | 0.62 | 0.061 | 0.043 | 0.053 | 0.046 |
| $T_3$ | 0.66 | 0.74 | 0.85 | 0.70 | 0.062 | 0.064 | 0.071 | 0.052 |
| $T_4$ | 0.68 | 0.77 | 0.87 | 0.70 | 0.068 | 0.067 | 0.076 | 0.052 |
| $T_5$ | 0.60 | 0.63 | 0.76 | 0.63 | 0.063 | 0.048 | 0.058 | 0.047 |
| $T_6$ | 0.73 | 0.80 | 0.97 | 0.76 | 0.071 | 0.072 | 0.088 | 0.055 |
| $T_7$ | 0.70 | 0.79 | 0.88 | 0.73 | 0.072 | 0.070 | 0.081 | 0.053 |
| $T_8$ | 0.74 | 0.87 | 1.01 | 0.77 | 0.072 | 0.076 | 0.093 | 0.057 |
| $T_9$ | 0.62 | 0.67 | 0.79 | 0.65 | 0.061 | 0.053 | 0.063 | 0.049 |
| $T_{10}$ | 0.61 | 0.66 | 0.77 | 0.64 | 0.060 | 0.049 | 0.060 | 0.048 |
| $T_{11}$ | 0.63 | 0.70 | 0.80 | 0.66 | 0.061 | 0.058 | 0.064 | 0.050 |
| $T_{12}$ | 0.65 | 0.72 | 0.83 | 0.68 | 0.061 | 0.061 | 0.069 | 0.051 |
| Sem± | 0.04 | 0.03 | 0.04 | 0.04 | 0.003 | 0.004 | 0.005 | 0.003 |
| CD (P= 0.05) | 0.11 | 0.10 | 0.13 | 0.11 | 0.010 | 0.012 | 0.013 | 0.010 |

**Table-4 :** Seed and straw yield of chickpea (q/ha).

| Treatments | Yield of Chickpea (q/ha) | |
|---|---|---|
| | Grain | Straw |
| $T_1$ - Control | 8.95 | 12.90 |
| $T_2$ - $MgSO_4$ @ 25 kg/ha | 9.51 | 14.17 |
| $T_3$ - 100% RDF | 11.25 | 16.87 |
| $T_4$ - 100% RDF+ $MgSO_4$ @ 25 kg/ha | 11.14 | 17.50 |
| $T_5$ - 100% RDF+ MgO @ 10.135 kg/ha | 10.13 | 17.91 |
| $T_6$ - 100% RDF +S @ 6.7 kg/ha | 11.58 | 16.57 |
| $T_7$ - 100 % RDF + $ZnSO_4$ @ 25 kg/ha | 11.99 | 17.93 |
| $T_8$ - 100% RDF +$ZnSO_4$ @25 kg/ha + $MgSO_4$ @ 25 Kgha | 12.22 | 17.29 |
| $T_9$ - 100% RDF +S@ 20 kg/ha | 10.83 | 17.65 |
| $T_{10}$ - 75%RDF + $MgSO_4$ @ 25 kg/ha | 11.15 | 17.92 |
| $T_{11}$ - 75% RDF + $ZnSO_4$ @ 25 kg/ha | 10.32 | 17.02 |
| $T_{12}$ - 75% RDF + $ZnSO_4$ @ 25 kg/ha + $MgSO_4$ @ 25 kg/ha | 11.10 | 17.35 |
| SEm± | 0.954 | 1.066 |
| CD | 2.80 | 3.13 |

**Note :** RDF = Recommended dose of fertilizer, S = Sulphur, MgO = MagnesiumOxide, $ZnSO_4$ = Zinc sulphate, $MgSO_4$ = Magnesium sulphate

25 kg/ha + $MgSO_4$ @ 25 kg/ha) was due to the fact that higher dose of residual effect of nitrogen associated with phosphorus, zinc and sulphur led to more root growth which provides more space for growth of nodules and ultimately resulted in higher number of nodules per plant. Similar results was found by (2).

It was evident that nodule on the lateral roots may be more important during later phases of growth (3). (4) suggested that decline in nodulation is a result of changes in source sink relationship resulting in a greater supply of carbohydrate to developing pods and reduced supply to nodules.

**Fresh and Dry weight of nodules/plant (g)**

The number of nodules and their fresh and dry weight was remarkably higher in 100 % RDF + $ZnSO_4$ @ 25 kg/ha + $MgSO_4$ 25 kg/ha ($T_8$) than other treatments (Table-3). This might be due to better root growth and favorable condition available for infection of bacteria to form nodules under Zinc sulphate and Magnesium sulphate treatment. Similar resulted were also reported by (5) that sulphur significantly increased the biomass of nodules. The fresh and dry weight of nodule of chickpea was significantly lower under $T_1$ (control). The number of nodulation is less under control treatment might be less fresh and dry weight of nodule.

**Yield**

The mean yield of seed varied between 8.95 to 12.22 q/ha and mean yield of straw varied between 12.90 to 17.93 q/ha, the yield of chickpea was almost at similar level in all the treatments (Table-4). Yield of chickpea increased by various treatment applied. The maximum yield (12.22 q/ha) of chickpea was recorded by 100 % RDF + $ZnSO_4$ @ 25 kg/ha + $MgSO_4$ 25 kg/ha ($T_8$). this might be due to combined effect of zink, sulphur, magnesium and maximum availability of these nutrient to the plant. This result is in close agreement with the findings of (5).

## CONCLUSION

Rice-chickpea cropping sequence with recommended dose of fertilizer also increased the fertility status of soil. The maximum chickpea yield, maximum nodule formation of root and higher fresh and dry weight of nodule was observed with the application of 100% RDF + $ZnSO_4$ @ 25 kg/ha + $MgSO_4$ @ 25 Kg/ha.

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