Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; SP1: 999-1001

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Effect of nitrogen levels and micronutrients on yield of chickpea (*Cicer arietinum* L.) in indo gangatic plain of Varanasi

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Abstract
The field experiment was conducted during the *rabi* season. The experiment was conducted in randomized block design (RBD) with three replicated and chickpea, var. - K-468. The soil applied N at 20 kg N ha^{-1} alone or in combination with B, Mo or Fe significantly increased the number of pods per plant as compared to control. Maximum number of pod (25.77) was recorded treatment T_5 and minimum pod number was found control (17.85). The application of nitrogen alone and in combination with micronutrients namely B, Mo and Fe significantly increased the grain yield as compared to control. Plots treatment T_5 (20 kg N ha^{-1} + Fe @ 10 kg ha^{-1}) produced significantly higher yield as compared to other treatments and minimum yield was recorded with control. All the treatments were able to significantly increase the stover yield as compared to control. The initial soil characteristics (table 2) in the experimental field of soil reaction (soil pH) were noticed neutral (pH 7.34). The physical and chemical conditions were conducive chickpea cultivation under nitrogen levels and micronutrients condition of cultivation practice.

Keywords: nitrogen levels, micronutrients, yield of chickpea, indo gangatic plain (IGP) varanasi

Introduction

Nutrient imbalance in soil system is the major reason for the declined yield and nutritional quality of the pulses. Low yield of pulses are often associated with lack of major as well as micronutrients. Among pulses gram also known as "chickpea" (*Cicer arietinum* L.) occupies 12.0 million hectare with the production of 9.2 million tonne in world and in India gram occupying an area of 6.3 million hectare with production of 7.34 million tonne.

All the pulses are legumes and can assimilate nitrogen directly from the atmosphere by nitrogen fixation or can take up mineral nitrogen from the soil. Mo is an essential micro nutrient in the symbiotic N fixation and is an essential component of the N fixing enzyme "nitrogenase". So presence of Mo in adequate amount in soil increases the yield and quality of produce. Boron is recognized as an essential micronutrient for vascular plants and is believed to be involved in nucleic acid metabolism, cell division, sugar biosynthesis and translocation, active nutrient absorption, regulation of rate of photosynthesis and nodulation process [9].

The application of S, Mo, and *Rhizobium* (in the form of seed inoculation) alone or in combination significantly increased the vegetative growth, number of nodule, grain and straw yield of black gram as compared to control [15]. The seed and stover yield of mungbean (*Vigna radiata)* significantly increased with the application of 4 kg Fe ha^{-1} [23]. The effect of nitrogen, phosphorus and sulphur on growth, grain yield and nutrient content of black gram [20, 21]. The application of phosphorus, sulphur and molybdenum was nutrients had significant effect on number of nodule, grain and straw yield of rainfed black gram [4]. There significant increase in grain and straw yield of chickpea over control by the application of P and Fe, [16].

The use of micronutrients in soybean significantly contributed in the yield and yield attributing characters hence ultimately resulted in increased productivity of soybean [14]. Application of these micronutrients individually to seed or leaves has little effect but their combined application was more important in augmenting the efficiency of nitrogen fixation and soybean yield [2]. Application of Zn and B also increased the seed yield indicating positive effect of Zn and B in Lucerne [11]. Found that the applications of micronutrient under the recommended level of major nutrient with FYM significantly increased the yield of soybean [13]. The effect of Mn and Mo with *Rhizobium* culture was yield and protein content of cowpea [17, 18]. The effect of N, Mo and liming significantly increased the grain and straw yield of lentil [7].

Application of nitrogen in general caused significant increase in growth and yield of soybean

(*Glycine max*. L) [8, 12].

Material and Method

Experimental site

The field experiment was conducted during the *rabi* season of 2008-09 at research plot of Udai Pratap Autonomous College Varanasi, adjoining Department of Agriculture Chemistry and Soil Science.

Experimental detail

The experiment was conducted in randomized block design (RBD) with three replicated. The seeds were sown variety chickpea, var. - K-468. Treatments of this study, T_0: Control, T_1: 20 kg N ha^{-1}, T_2: 40 kg N ha^{-1}, T_3: 20 kg N ha^{-1} + Mo @ 1 kg ha^{-1}, T_4: 20 kg N ha^{-1} + B @ 5 kg ha^{-1}, T_5: 20 kg N ha^{-1} + Fe @ 10 kg ha^{-1}.

The half dose of nitrogen and full doses of micronutrients (molybdenum, boron and iron) were applied as basal dose before sowing of gram. No input was provided in control plots. Remained half dose of nitrogen was applied accordance with treatment, after 25 days of sowing.

Laboratory studies

Soil sampling

Soil samples were collected before sowing and dried soil samples were crushed and passed through 2mm sieve.

Soil analysis

Soil pH and Electrical conductivity (EC): Soil water suspension was prepared in the ratio of 1:2.5 the help of glass electrode digital pH and EC meter [5].

Bulk density: Bulk density of soil samples was determined using Pycnometer as described [5].

Particle density: Particle density was determined by using Pycnometer as described [5].

Water holding capacity: Water holding capacity of the soil samples was determined by Keen Roczkows Box [9].

Porosity: The determination of the total porosity was made with the help of measured value of bulk density and particle density. Porosity was calculated with the help of following formula.

$$\text{Porosity\%} = 1 - \frac{Bulk\ density}{Particle\ density} \times 100$$

Organic carbon: Soil organic carbon content was determined by the Rapid Titraton Method [22].

Available nitrogen: Available soil nitrogen was determined, using alkaline permanganate method [19].

Available phosphorus: The Olsen's method [10] was used for determination of available phosphorus in soil.

Available potassium: Potassium content in the extract was determined Flame photometrically [6].

Fruiting observation

The fruiting observation was done treatment wise very carefully. Fruiting was started at 5 to 6 days after flowering.

Number of pods plant^{-1}: Counting of the number of pods per plant was done at complete fruiting stage, when the entire flower bears fruits.

Harvesting and threshing: The crop was harvested at maturity and was allowed to dry in sun. Separate bundles were made for each plot and weighted. The after drying harvest was threshed manually.

Grain and Stover yield: After threshing the weight of grain was recorded treatment wise and grains were dried at optimum moisture level for safe storage and reducing pest hazard. Stover yield was calculated by deducting the grain yield.

Results and Discussion

3.1 Pod count palnt^{-1}

The effect of different treatments on pod count plant^{-1} were recorded and presented (table 1). The result showed that soil applied N at 20 kg N ha^{-1} alone or in combination with B, Mo or Fe significantly increased the number of pods per plant as compared to control. Maximum number (25.77) was recorded with T_5. Effect of all the three micronutrients was statistically at par. The minimum pod number was found with control (17.85).

The maximum number of pod plant^{-1} in the treatment, where 20 kg N ha^{-1} + Fe @ 10 kg ha^{-1} was applied may be attributed due to better development through efficient utilization of soil resources by the plant, where primary growth elements were available in sufficient amount. The minimum number of pods plant^{-1} may be attributed due to deficiency of essential macro and micro nutrients at the time of flowering and seed setting stage of plant, because at this stage nutrients are required by the plant to complete each important growth stages like that of flowering and seed setting.

Table 1: Effect of treatments on pod number and yield

Treatments	Pod count plant^{-1}	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})
T_0	19.10	7.92	11.85
T_1	22.21	11.83	17.74
T_2	21.00	10.23	14.12
T_3	23.11	12.42	19.90
T_4	24.33	15.27	23.56
T_5	25.77	17.72	27.52
SEm±	1.21	0.94	1.20
CD (P = 0.05)	2.69	2.10	2.67

3.2 Grain yield

The application of nitrogen alone and in combination with micronutrients namely B, Mo and Fe significantly increased the grain yield (table 1) as compared to control. Plots treated with T_5 (20 kg N ha^{-1} + Fe @ 10 kg ha^{-1}) produced significantly higher yield as compared to other treatments. Minimum yield was recorded with control. The better grain yield may be due to that all plant parameters like number of pods per plant, number of grains per pod, 1000 grain weight. Reduction in yield may be due to nutritional imbalance and deficiency of certain important growth nutrients at various important growth stages like that of flowering, seed formation and seed maturity. The effect of micronutrient application (molybdenum, boron, cobalt and iron) was recorded the maximum number of nodule plant^{-1}, nodule weight plant^{-1}, plant height, biomass production and grain yield of black gram [1]**.** The effect of nitrogen and boron fertilization was increase of growth, nodulation and grain yield of cowpea [4].

3.3 Stover yield

The treatments were able to significantly increase (table 1) stover yield as compared to control. Stover yield varied from 11.85 to 27.52 q ha^{-1}. All the treatments significantly differ from each other. Maximum and minimum yield were respectively recorded with T_5 and T_0. Treatment T_5 was found to be significantly superior over other treatments.

Initial soil characteristics of the experimental field

The initial soil characteristics (table 2) in the experimental field of soil reaction (soil pH) were noticed neutral (pH 7.34). The organic matter content, plant available nitrogen and potassium were found low range of rating chart for soil test values; whereas plant available phosphorus was in medium range. The water holding capacity porosity in the soil was observed good for chickpea cultivation. The physical and chemical conditions were conducive chickpea cultivation under nitrogen Levels and Micronutrients condition of cultivation practice.

Table 2: Initial soil characteristics of the experimental field

S. No	Soil properties	Values
1	Bulk density (Mg m^{-3})	1.42
2	Particle density (Mg m^{-3})	2.67
3	Porosity (%)	46.81
4	Water holding capacity (%)	42.98
5	pH	7.34
6	E.C. (dS m^{-1})	0.62
7	Available nitrogen (kg ha^{-1})	196
8	Available potassium (kg ha^{-1})	123
9	Available phosphorus (kg ha^{-1})	19
10	Organic carbon (%)	0.52

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