Trends in Biosciences 10(5), Print : ISSN 0974-8431, 1321-1324, 2017

SHORT COMMUNICATION

Impact of Integrated Application of Phosphorus and Farm Yard Manure on Yield, Nutrient Uptake and Fertilizer Requirement in Chickpea [*Cicer arietinum* (L.)]

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ABSTRACT

A field experiment was conducted during *rabi* 2013 in *Vertisol* at Instructional farm of Indira Gandhi Agricultural University; Raipur (C.G) to study the *Impact of integrated application of phosphorus and Farm yard manure on yield, nutrient uptake and fertilizer requirement of Chickpea [Cicer arietinum (l.)].* The objectives of the study were to estimate the nutritional requirement, efficiency of fertilizer, soil test and organic source (FYM), to estimate the fertilizer requirement of Chickpea crop based on soil test levels using INM approach. Chickpea crop required 0.46 kg P to produce one quintal of grain. Fertilizer and Soil test efficiencies estimated were 10.01 and 30.03 percent, respectively for phosphorus. The FYM contribution for P nutrient were estimated as 4.42.

Key words *Soil test, Vertisol, Chickpea, nutritional requirement, INM approach.*

India ranks Ist in Chickpea production. In India Chickpea is grown in area of 8.98 million hectares with an annual production of 8.57 million tonnes and productivity 954 kg/ha. (Annon., 2015). The area and production of chickpea in Chhattisgarh are 259.2 thousand hectare and 245.1 thousand tones respectively. Chickpea productivity in Chhattisgarh is about 946 kg ha^{-1} (Agriculture and Cooperation Report, Ministry of Agriculture, Government of India 2014-15). The fertilizer application practices based on targeted yield approach indicated the possibility of enhancing production potential of chickpea crop. During recent years, there has been rapid decline of phosphorus nutrient in soil which has to be replenished through external supply. At the present level of crop production and fertilizer use, there is an estimated gap of about 10 million tonnes between the quantity of nutrients removed by the crop and the quantity of nutrients added through fertilizer. The organic resources available (organic manure, crop residues and bio-fertilizers) presently could meet this gap but the present level of organic sources used in agricultural production is only one third of the potential availability. Hence, the fertility status of the soil is fast declining and in the long run, it may affect the productivity and its sustainability. Therefore, it is essential to protect the soil health by adopting balanced fertilization through soil testing and organic source as an INM approach. The present study was undertaken to develop balanced fertilizer schedule with FYM application for desired yield targets of chickpea in *Vertisols* of Chhattisgarh state. The effective fertilizer recommendation should consider crop needs and nutrient already available in the soil. Continuous use of inorganic nutrients may adversely affect the physico-chemical properties of soil and thereby affect the crop yields. In order to sustain the yield and reduce the dependency on inorganic fertilizer use, conjunctive use of organic manures and fertilizers is essential.

MATERIALS AND METHODS

A field experiment was conducted at the farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) on soil test crop response correlation with chickpea (JG-130) during rabi season, 2013 in Vertisol. The soil of the experimental field comes under the soil order of Vertisol. This soil is locally known as *Kanhar* and identified as Arang II series. It is clayey in texture with 24.3 % Sand, 21.4% silt and 54.3% clay, dark brown to black in color, neutral to alkaline in reaction due to presence of lime concretion in lower horizon. The soil is deep to 1 -1.5 meter. The structure varied from coarse angular blocky to massive and cloddy and in few cases from prismatic or columnar. Soil is represented as typical *fine montmorillonitic, hyperthermic, udic chromustert.* Some physico-chemical properties of experimental soil were 8.03 pH (1:2.5), 0.18 EC (dSm-1), 36.32 CEC (Cmol (p+) kg-1), 5.80 Organic C (g kg-1), available N 238 kg ha-1, available S 27.08 kg ha-1 available P 19.3 kg ha-1, available K 486 kg ha-1. A special field technique developed by Ramamurthy *et al.* (1967) was used for this study. The field was divided in to three equal long strips and denoted as L_0, L_1 and L_2. Prior to conducting the actual field experiment, a fertility gradient was created by applying the graded doses of N, S, P and K fertilizer for obtaining the appropriate variation in soil fertility in different strips. The source of P were used as Diammonium-phosphate. Each strip was divided in to three equal sizes for three levels of FYM (0, 5 and 10 t ha-1) and was treated as block. A representative sample of FYM applied was analysed for nutrient content and resulted as 0.40, 0.30 and 1.00 per cent N P and K respectively. The 24 selected fertilizer treatments constituted 4 levels of each of P_2O_5 (0, 30, 60 and 90 kg ha -1). These were distributed in each block of the strips having 8 treatments in each block. Soil samples were analysed for available P (0.5M NaHCO3 at pH 8.5 as described by Olsen *et al* 1954).

RESULTS AND DISCUSSION

Establishment of Fertility Gradient

Soil available nutrient: The range and mean values of available nutrient P (Table 1) indicate that soil test P varied with different fertility strips although soil test P variations with respect to fertility strip were marginal.

Table 1. Range and mean values of available P (kg ha-1)

Soil Nutrients	L_0	L_1	L_2	SD	CV %
Olsen's-P	11.00-17.67 (13.91)	13.40-24.56 (18.53)	18.76-39.93 (27.89)	6.81	33.86

Table 2. Range and mean of grain yields of Chickpea (Var JG-130) yield (q ha-1)

Fertility Strips	Grain yield (q ha^{-1})			SD	CV %
	Minimum	Maximum	Average		
L_0	7.33	22.21	15.56	4.21	27.07
L_1	9.09	22.44	16.39	3.81	23.23
L_2	10.19	23.51	17.10	3.99	23.33
All strips	7.33	23.51	16.35	4.00	24.47

Crop yield: Table 2 gives the range and averages of chickpea yield in relation to different fertility strips. It was observed from the results that there was increasing trends in chickpea yields from L_0 to L_2 fertility strips due to increasing P level. Highest yield of 23.51 q ha-1 was observed in L_2 strip with a good response to the application of highest dose of fertilizer and 7.33 q ha-1 was observed in the L0 strip without fertilizer (Control).

Relationship between yield and Nutrient Uptake

The chickpea yields showed the close association with total P uptake. This relation was used to estimate t he nutrient requirement for chickpea (Table 3). The nutrient requirement (NR) is defined as the amount of nutrient required to produce per unit amount of yield. The nutrient requirement can be given by the regression co-efficient (b1) of yield (Y) and total nutrient uptake (U).

$Y = b1\ U$ or $U = 1/b1 * Y$

Where, 1/ b1 give the NR.

Nutrient requirement and Development of basic parameters

Results presented in Table 4 show the nutrient requirement (NR) for P (kg q-1), efficiency of fertilizer (Ef), Soil test (Es) and FYM were estimated. The Chickpea required about 0.46 kg P to produce one quintal of grain. Fertilizer efficiencies for P was less than soil test efficiency.

Table 3. Relation of chickpea yield (Y) with total nutrient uptake (U)

Nutrient	Chickpea	
	Y = b1 U	R^2
P	Y = 2.165 U	0.99

Contrary to this, efficiency of FYM was found to be less with P.

In the present investigation, presence of adequate variability in Chickpea grain yield and P uptake was observed due to operational range of soil test values. Olsen's-P were found to be the highest in strip III(L2) followed by strip II(L1) and least in strip I(L0). The marked fertility gradient built up was reflected in terms of grain yield and nutrient uptake. Similar kind of trend for mean nutrient uptake was observed in the experiment. Mean nutrient requirement for producing one quintal of chickpea grain was 0.46 kg P.

Estimation of Fertilizer adjustment equation

Based on the basic parameters viz. nutrient requirement efficiencies of fertilizer, soil test and organic source FYM fertilizer adjustment equations were evolved for chickpea to achieve a definite yield goal.

FP = 4.60 Y - 3.00 SP - 0.44 FYM

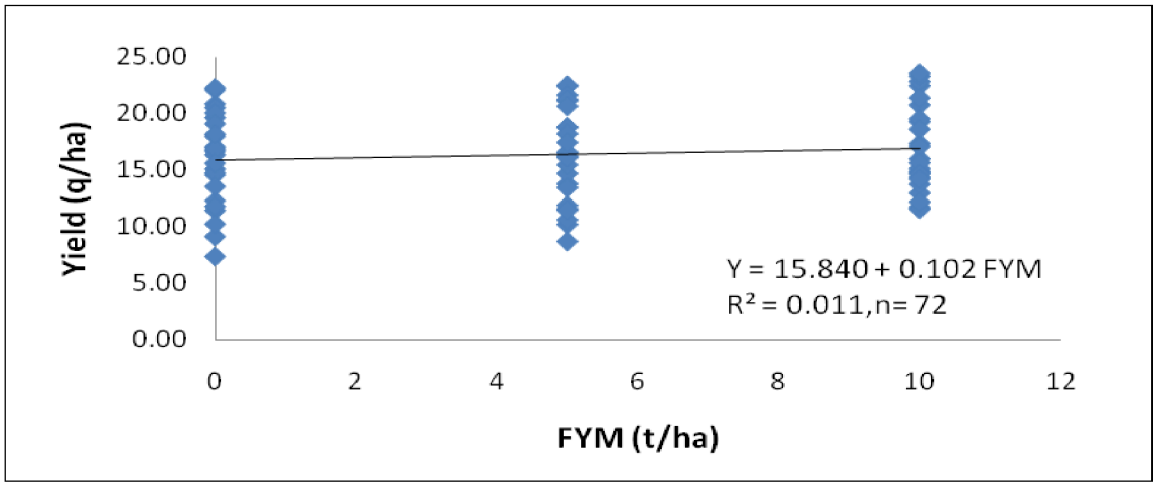

Fig. 3. Chickpea grain yield response to FYM application

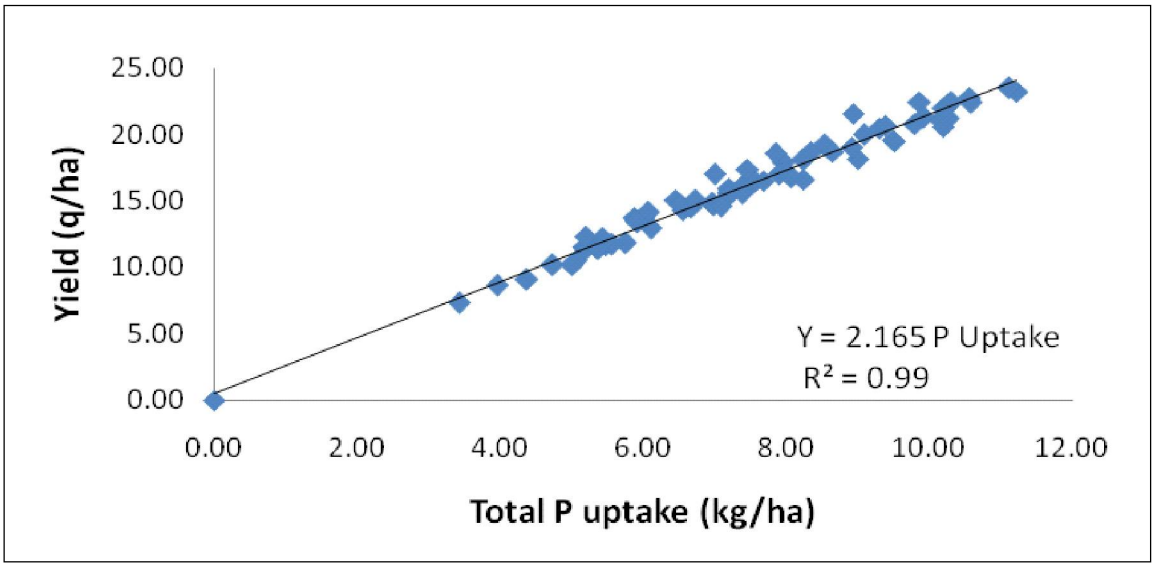

Fig. 1. Relationship between Chickpea grain yield and Total P uptake

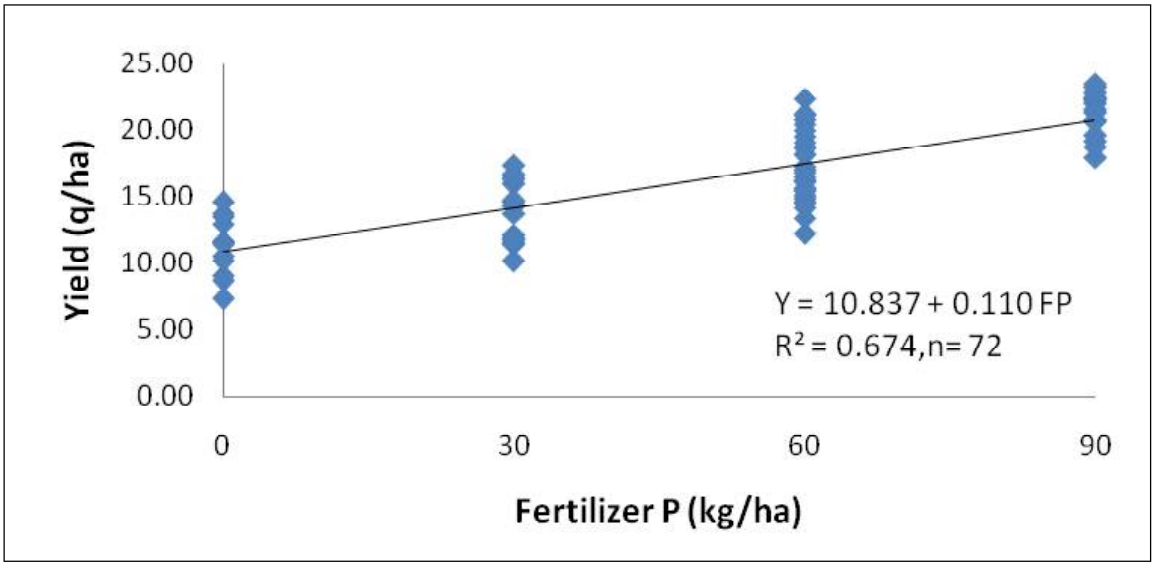

Fig. 2. Chickpea grain yield response to fertilizer P application

Table 4. Nutrient requirement, fertilizer, soil and FYM efficiencies

Nutrient	NR (kg q^{-1})	Fertilizer Efficiency (%)	Soil Test Efficiency (%)	FYM Efficiency (%)
P	0.46	10.01	30.03	4.42

Where, FP are fertilizer P_2O_5 (kg ha -1), FYM is Farm Yard Manure (t ha-1). SP are soil test values (kg ha-1) for Olsen's P and Y is crop yield in q ha^{-1}. Such kind of fertilizer prescription equations for different crops (rice, wheat, maize, mustard, rapeseed) have also been documented by Mahajan *et al.*(2013), Milapchand *et al.*, (2006).

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Received on 26-01-2017 *Accepted on 03-02-2017*