EFFECT OF DIFFERENT FERTILIZER DOSE AND BIO-FERTILIZER INOCULATION ON GROWTH AND YIELD OF CHICKPEA *(Cicer arietinum L.)*

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By

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CERTIFICATE

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DECLARATION

I hereby declare that the project work entitled **"Effect of different fertilizer dose and bio-fertilizer inoculation on growth and yield of chickpea** ***(Cicer arietinum L.)''*** is an authentic record of my work carried out by Lovely Professional University as requirement of project work for the award of degree of Master of Science in Agronomy, under the guidance of Er. Nitin Madan Changade, Department of Soils, School of Agriculture, Lovely Professional University, Phagwara, Punjab.

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INTRODUCTION

Pulses are one of the major food item to be included in a vegetarian diet and are the cheapest source proteinand is also considered as poor man's meat. In a country like India where majority of the population comes under vegetarian, the importance of these pulses just increases. Pulses contribute 16-18 percent of total protein of Indian average diet. In addition, their contribution in maintaining soil fertility and health through natural nitrogen fixation is significant and thus play a crucial role in sustainable agriculture. They possess an imperative position in multiple cropping patterns. Be that as it may, the production of pulses in the nation is very low and has not possessed the capacity to keep pace with the expanding population. India is the world's biggest producer of the pulses and occupies an area of 23.89 million hectares with the production of 15.12 million tons *(Anon., 2009),* which is comparatively very low to the average pulse yield (857 kg/ha) of the world. In 2014 the area and the production were increased to 26.40 million hectares and 18.24 million tons respectively with the productivity of 690 kg/ha *(Anon.,2013).*

Chickpea *(Cicer arietinum L.)* belongs to a Leguminoceae or Fabaceae family which is commonly known as Bengal gram in English and black chana in Hindi. It is an annual rabi crop having leaves that are pinnately compound with one terminal leaflet. They have a tap root system and the flowers are typical papallionaceous, consisting of five petals and five sepals. The color of the flower are usually pink or bluish. The pod is 2cm long and it generally have two seeds which are spherical in shape, wrinkled and have a pointed beak. The colour of the pod ranges from brownish to yellowish-orange. The ripened seeds of chickpea are consumed in the form of processed foods which are boiled, roasted, fried, steamed, sprouted. It is also used as a dal or as a flour(besan). Fresh green seeds are also consumed as green vegetable. It is also used for preparing a variety of snacks, sweets and condiments. Chickpea is a good source of protein, carbohydrate, fat, minerals (calcium, phosphorus and iron) and vitamins. It is also useful as an animal feed and has a good forage value*(Dinesh.,2014).*It is the largest produced food legume in South Asia and globally the third largest after common bean *(Phaseolus vulgaris L.)* and field pea *(Pisum sativum L.).*India is the largest chickpea producing country representing 64% of the global chickpea production. *(Gaur et.al., 2010).* India is the major chickpea growing country in the world which accounts for about 76 percent of total area and 67 percent production of the world. In India, the total area employed is about 9.18 million hectares with total production of 8.22 million tons and an average productivity of 900 kg/ha *(Anon., 2013).*The major chickpea producing states are Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka and Andhra Pradesh which contributes 92% of the production and 95% of the area in the country altogether (FAOSTAT, 2014).

Although chickpea is very important pulse crop in our daily diet and also in agricultural production, its productivity is very low. The low production of this crop is because of improper utilization of fertilizers, weed competition, ill-advised time of sowing and seed rate, pest and disease management and no utilization of bio-fertilizers, for example, Rhizobium, PSB and VAM fungi. Out of all the above-mentioned reasons affecting the productivity of this crop, nutrient management is known to be the most important factor. Nitrogen plays an imperative role in synthesis of chlorophyll, amino acids and other organic compounds which add to the building units of proteins in the plant system. The photosynthetic action of the plants and their ability to use available nutrients increases by nitrogen application. It increases the growth and development, dry matter production and yield of crops even under dry land conditions. *(Dinesh,2014).*

Phosphorus is one of the most important major nutrient of plant and chickpea varieties also respond significantly to its application. It has central role in energy transfer and protein metabolism and also associated with increased root growth and early maturity of crops. *(Siag,1995).*It is considered important for formation and translocation of carbohydrates, fatty acids, glyceroids and other essential intermediate compounds. The major effect of application of phosphorus is observed in the root system of plants. It gives rise to formation of lateral and fibrous roots, which results in more nodule bacteria and ultimately increases the rate of nitrogen fixation in leguminous crops.*(Dinesh,2014).* A large portion of phosphorus get converted to insoluble form soon after it is applied to the soil. The phosphate solubilizing microorganisms like bacteria have the ability to solubilize the insoluble phosphates and are made available to the plants.*(Prajapati, 2014).*

Biofertilizers are selected strains of beneficial soil microorganisms which are cultured in the laboratory and packed in a suitable carrier. They can be used either for seed treatment or soil application. On application, they help in generating solubilized plants essential nutrients like nitrogen and phosphorus through their activities in the soil or rhizosphere and make it available to plants gradually.*(Prajapati. 2014).*The inoculation of seeds with proper strains of *Rhizobium* bacteria enhances the atmospheric nitrogen fixation resulting in better growth and increase in the crop yield. The phosphorus solubilizing bacteria (PSB) aids in converting the insoluble phosphate which is chemically fixed into available form which eventually results in higher crop yields *(Gull et al., 2004).*

Vermicomposting is a simple biotechnological process of composting, in which certain species of earthworms are used to enhance the process of waste conversion and produce a better end product. It is an environmental friendly and an effective way of recycling agricultural waste. Vermicompost is considered as a potential source as it contains readily available macro and micro plant nutrients, growth promoting substances like auxins and gibberellins. It also contains good amount nitrogen-fixing and P-solubilizing beneficial microorganisms *(Sultan, 1997).* The application of vermicompost has positive effect on the physical and biological properties of the soil. It increases the macro pore space and thus improves air water relationship. Its application showed positive impact on soil Ph, microbial population and soil enzyme activities as well *(Maneswarippa et al., 1999).*

Keeping the above facts in mind, the present research study entitled "**Effect of different fertilizer dose and bio-fertilizers inoculation on growth and yield of chickpea *(Cicer arietinum L.)*** *"* was undertaken with the following objectives:

1. To assess the effect of different fertilizer doses on growth and yield of chickpea.
2. To find out the best combination of inorganic fertilizer and biofertilizer in relation of yield and vegetative growth of chickpea.
3. To compare the performance of the crop on the application organic fertilizer combined with biofertilizer.
4. The economic evaluation of chickpea under different combination of fertilizer doses.

REVIEW OF LITERATURE

EFFECT OF CHEMICAL FERTILIZERS ON CHICKPEA

Due to the rising population, chemical fertilizers are excessively utilized in order to achieve maximum production which has led to degradation of the agricultural lands. Therefore, to restore the health and quality of the soil, simple agronomic practices like judicious utilization of recommended chemical fertilizers can be effectively employed to combat these problems. According to the package and practices given by the Punjab Agricultural University (PAU) for rabi crops of Punjab, chickpea requires Nitrogen and Phosphorus for their growth and development. The recommended dose of N: P: K is 6:8:0 (kg/acre) which is supplemented by the application of Urea and Single super phosphate at the rate of 13 and 50 kg/acre.

Kumar et al. (2014) after conducting an experiment to study the "production potential of chickpea as influenced by levels of fertilizers and biofertilizer" concluded that higher profit can be achieved by fertilizing chickpea crop @ 75% RDF along with *Rhizobium* and PSB both as seed treatment or *Rhizobium* as seed treatment + PSB as soil application or *Rhizobium* as seed treatment + VAM as soil application.

Prajapati (2014) conducted a field experiment on "Integrated phosphorus management on Chickpea" during rabi season by supplementing phosphorus with SSP and Rock phosphate along with biofertilizer. After checking the interaction between phosphorus levels and biofertilizer, they recommended the use of 100% RDP through SSP with PSB and AM and also 75% RDP through SSP + 25% RDP through rock phosphate with PSB and AM.

Thenua and Shrama (2011) conducted a study in Uttar Pradesh and reported that application of phosphorus at the rate of 60 kg/ha showed significant impact on growth and development of the chickpea plant.

Thenua *et al*. (2010) worked on a research for two consecutive years to study the performance of chickpea variety Pusa 256 and found that application of phosphorus in the form of SSP was better with respect to plant height, nodule plant-1 and nodule dry weight when compared with rock phosphate.

Ali *et al*. (2010) studied the effect of nitrogen and phosphorus on growth and yield parameters of chickpea. They reported that fertilizer dose 24:60 kg/ha of N:P gave better results in vegetative growth as well as in yield attributes. Also, they mentioned that by supplying 39 kg nitrogen and 90 kg phosphorus per ha, biological yield can be achieved in chickpea cultivation.

Singh *et al*. (2010) lead a research study to find out the impact of farmyard manure (FYM) phosphorus and phosphate solubilizing bacteria (PSB)on the growth and grain yield of kabuli chickpea. The application of FYM improve the dry weight of nodules and grain yield. Whereas application of phosphorus showed significant improvement in grain yield and nodulation. Toward the completion of the trial they presumed that uses of 5t FYM and 20 kg P2O5/ha are basic for acquiring high grain yields and in addition net returns of kabuli chickpea.

Kanwar and Paliyal (2004) reported that grain yield and P uptake of was maximum at 50 kg P2O5/ha applied along with vermicomposting.

Jadhao *et al.* (2002) observed in their experimental research that application of 50% RDN through chemical fertilizer + 50% vermicompost to sorghum gave higher grain yield over the one which is is solely treated with 100% RDN through inorganic fertilizer.

EFFECT OF BIOFERTILIZERS ON CHICKPEA

Bio-fertilizers are environment-friendly, less expensive as compared to inorganic fertilizers, prepared strains of beneficial microorganisms which aid in supplementing plants with required nourishment in term of nitrogen assimilation and phosphorus solubilization. Thus, bio-fertilizers are sound mean of reducing external input of chemical fertilizers.

Giri and Joshi (2010) conducted a pot experiment and studied “the growth and yield response of chickpea to seed inoculation with *Rhizobium* sp.” In the study, they found that plants which are inoculated with Rhizobium gave significant results with respect to growth and yield compared to non-inoculated plants

Tagore *et al*. (2013) noted that the *Rhizobium* + PSB was found most effective in terms of growth parameters and also showed its positive effect in enhancing all the yield attributing parameters, grain and straw yields.

Namvar *et al.* (2011) conducted a field test to examine the impact of natural and inorganic nitrogen on growth parameters and yield attributes. Two different fertility levels treated with biofertilizer had shown significant results. The growth parameters of the plants were seen to be higher when 100 kg/ha urea was supplied along with Rhizobium inoculation. However, higher yield is obtained from the inoculated plants grown on treated plot with 75 kg/ha.

Qureshi *et al.* (2011)at Pakistan studied "the effects of co-inoculation of PSB and *Rhizobium* for improving growth and yield of mungbean (*Vigna radiata* L.)." They concluded that at highest fertilizer level (25-50 kg N-P ha-1) with co-inoculation gave better growth and yield as compared to un-inoculated pots with lower levels of fertilizers.

Gangwar and Dubey (2012) observed that on application of recommended dose of fertilizer with ammonium molybdate (1 kg/ha) + *Rhizobium* + PSB recorded the maximum branches per plant, nodule per plant, number of pods per plant and seed yield etc .

Thenua and Sharma (2011) at Uttar Pradesh reported that seed inoculated with PSB grown on a field treated with 60 kg/ha phosphorus and 80 kg/ha sulphur recorded the highest content and uptake of N and P in chickpea crop.

EFFECT OF VERMICOMPOST ON CHICKPEA

Vermicomposting is an eco-friendly and effective way to recycle agricultural wastes. The application of vermicompost not only adds plant nutrients and growth regulators, but also improves the physico-chemical properties as well as enhances the microbial population and carbon content of the soil. Previous studies and researches on the effect of vermicompost on growth and yield of various crops have reported many results.

Jat and Ahlawat (2002) studied that application of vermicompost @ 3t/ha significantly increased the growth and yield attributes of the plant which is superior over no Vermicompost application.

Patel (2011) showed in his experimental work that vermicompost treatments has significant effect on yield parameters. The application of vermicompost @ 1.25 t/ha gave higher seed yield showing significant superiority over no vermicompost application.

Chouhan (2012) worked on "the performance of chickpea varieties under different levels of fertility and vermicompost." After completing his experiment he concluded that application of vermicompost @5 t/ha had shown significant effect on growth and yield attributes.

Ramesh *et al.* (2010)stated that combination of vermicompost 1.5 t/ha + cow dung manure 2 t/ha gave the highest seed yield which is at par with the yield obtained by the usage of advised dosage of chemical fertilizers.

Sinha *et al.* (2010) observed that plant grown in the field treated with Vermicompost gave maximum effect in growth attributes such as root and shoot length, number of branches, number of leaves, flowers, pods and root nodules.

Hosseinzadeh *et al.* (2016)found that the Vermicompost treatment under no stress conditions significantly increased total chlorophyll content intercellular carbon dioxide concentration, net photosynthetic rate and transpiration rate. The vermicompost addition at 10% and 20% significantly enhanced the chlorophyll content at the flowering stage. They concluded that positive effect of the VC fertilizer on photosynthesis of chickpea was observed.

MATERIAL AND METHODS

A field experiment on '**Effect of different fertilizer dose and bio-fertilizers inoculation on growth and yield of chickpea** ***(Cicer arietinum L.)*** is being conducted during *rabi* season 2017 at agricultural farm of Lovely Professional University located in the village Hardaspur of Kapurthala District under open condition. The details of the material and methods and the experimental techniques which are to be followed during the course of investigation are presented below.

Experimental site: The experimental site is located at 31^0 22' 31.81" N and 75^0 23' 3.02" E longitude with an altitude of about 252 above mean sea level which fall under Tansgenic Gangetic plain region of Punjab agro climatic region.

Experimental details:

T0: Control

T1: 100%RDF

T2: 75% RDF + Rhizobium + PSB

T3: 50% RDF + Rhizobium + PSB

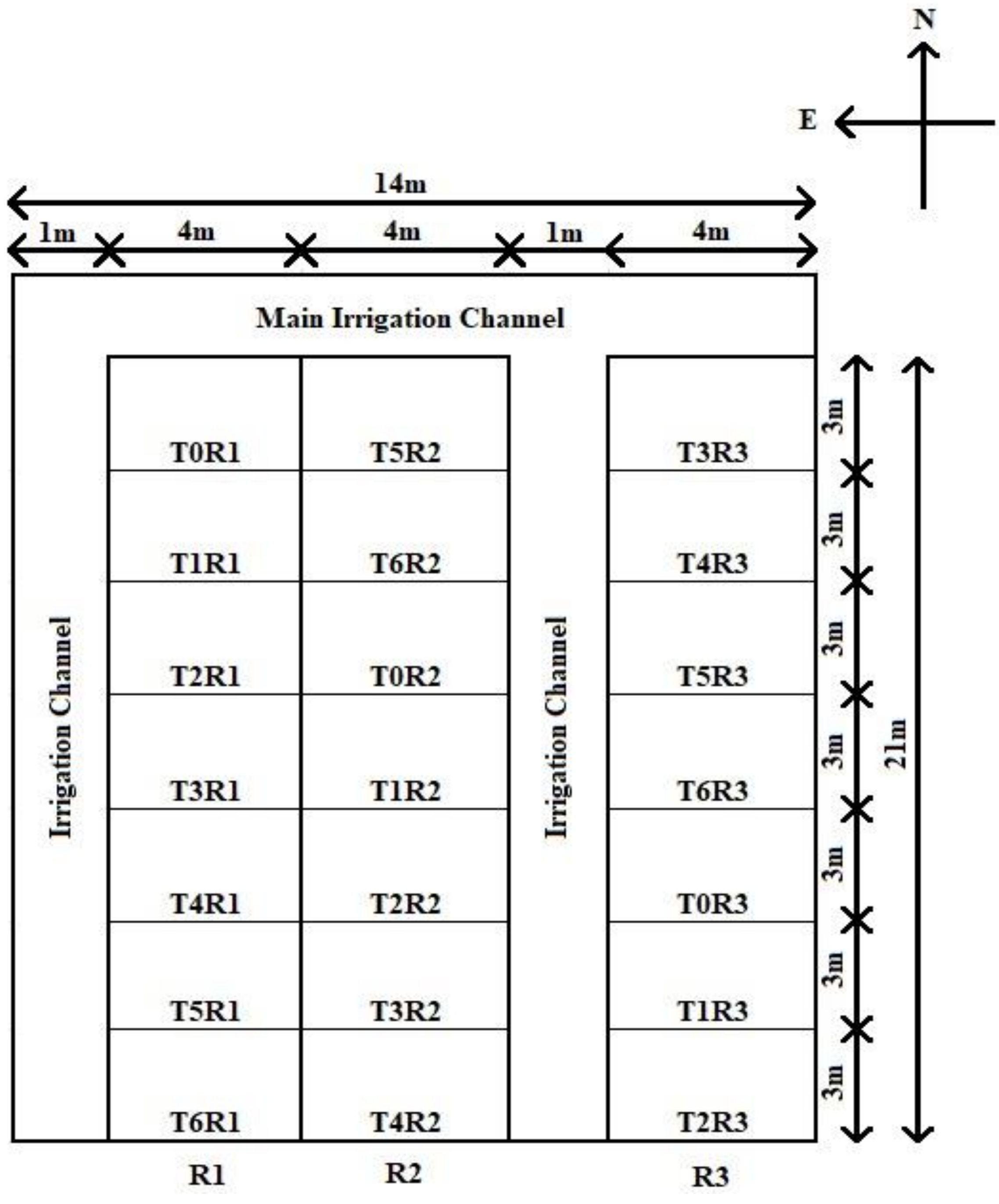
T4: 5 t/ha Vermicompost

T5: 3 t/ha Vermicompost + Rhizobium + PSB

T6: 2.5 t/ha Vermicompost + Rhizobium + PSB

Design and Layout

The experiment is laid out in a Randomized Complete Block Design (RCBD) with three replications. The gross plot size was 4.0m x 3.0m with net plot of 3.7m x 2.5m



Experimental details:

1. Year of experimentation: 2017
2. No. of treatments : 7
3. No. of replications : 3
4. Total no. of plots : 21
5. Plot size : 4.0 m x 3.0 m
6. Date of sowing : 7/11/2017
7. Experimental design : Randomized Complete Block Design (RCBD)
8. Crop and Variety : Pusa-362
9. Plant to plant distance : 10 cm.
10. Row to row distance : 30 cm.
11. Estimated area needed : 300 sq. m

Analytical methods to be followed:

Serial no.	**Test parameters**	**Methods**	**References**
Soil parameters			
1.	pH(1:2.5)	Glass electrode	Sparks (1996)
2.	E.C(1:2.5)	Conductivity meter	Sparks(1996)
3.	Organic Carbon	Wet digestion	Walkley and Black (1934)
4.	Available Nitrogen(N)	Alkaline & potassium permanganate method	Subbiah and Asija (1956)
5.	Available Phosphorus	Olsen method depending upon pH	Olsen et al., 1954
6.	Available Potassium (K)	Flame photometer	Jackson (1973)

Observations to be recorded:

A periodical observation will be undertaken during the experiment for the following parameters DAS and at the time of harvesting for the chickpea crop.

Serial no.	Parameters	Frequency of observations
A. Growth Parameters		
1.	Plant population	30 days interval
2.	Plant height	
3.	No. of branches per plant	
4.	Dry matter production (g/plant)	
5.	No. of root nodules/plant	
B Yield Parameters		
1.	No. of pods per plant	At harvesting
2.	No. of seeds per pod	
3.	Seed yield	
4.	Stover yield (kg net per plot)	
C. Quality Studies		
1.	Protein content	After harvesting
2.	Nutrient content	
3.	Nutrient uptake	

D. Soil parameter		
1.	Soil pH and EC	Before sowing and after harvesting
2.	Organic Carbon	
3.	Available nitrogen, Phosphorus and Potassium	
E. Meteorological observations		
1.	Rainfall	
2.	Relative Humidity	
3.	Evaporation	
4.	Bright sunshine hour	

Expected outcome:

In this experiment seven (7) major treatments are being conducted in which one is control, two are treated with recommended dose of fertilizers, one with organic and the other with inorganic. The remaining four is treated different levels of fertilizers combined with biofertilizer.

By the use of organic substances like biofertilizer, we are expecting to get good results with respect to growth and yield attributes. Biofertilizer are environmental friendly and it increases the nitrogen fixation from the atmosphere due to which the required chemical dose can be reduced. As increasing population demands for more and more production, the productivity of the agricultural lands are deteriorating due to imbalance and excessive use of chemical fertilizers which makes the soil infertile and compact by changing its chemical properties. It is high time we promote sustainable agriculture which can supply to the need of current population without compromising the access of future generation to meet their needs. Use of organic manures like Vermicompost combined with biofertilizer will not only benefit the crop but will also improve the soil health.

REFRENCES

Ali, A., Ali, Z., Iqbal, J., Nadeem, M. A., Akhtar, N., Akram, H. M., & Sattar, A. (2010). Impact of nitrogen and phosphorus on seed yield of chickpea. *Journal of Agricultural Research*, *48*(3).

Anonymous, (2009). Indian Institute of Pulses Research, Kanpur, Annual Report. pp. 43-45.

Anonymous, (2013). Statistical year book, India 2013. Ministry of statistics and programme implementation. http://www. http://mospi.nic.in/Mospi_New/upload/SYB2013/index1.html

Anonymous (2014)www.FAOSTAT.com

Chouhan, T. (2012). Performance of chickpea (Cicer arietinum L.) varieties under different levels of fertility and vermicompost (Doctoral dissertation, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya).

Gaur, P. M., Tripathi, S., Gowda, C. L. L., Ranga Rao, G. V., Sharma, H. C., Pande, S., & Sharma, M. (2010). Chickpea Seed Production Manual. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 28 pp. Abstract.

Giri, N., & Joshi, N. C. (2010). Growth and yield response of chick pea (Cicer arietinum) to seed inoculation with Rhizobium sp. *Nature and science*, *8*(9), 232-236.

Gull, M., Hafeez, F. Y., Saleem, M., & Malik, K. A. (2004). Phosphorus uptake and growth promotion of chickpea by co-inoculation of mineral phosphate solubilising bacteria and a mixed rhizobial culture. *Australian Journal of Experimental Agriculture*, *44*(6), 623-628

Hosseinzadeh, S. R., Amiri, H., & Ismaili, A. (2016). Effect of vermicompost fertilizer on photosynthetic characteristics of chickpea (Cicer arietinum L.) under drought stress. *Photosynthetica*, *54*(1), 87-92.

Jat, R. S., & Ahlawat, I. P. S. (2002). Effect of vermicompost, biofertilizers and phosphorus on chickpea and their residual effect on succeeding fodder maize. In *Extended summaries of Second Intern. Agron. Congress* (Vol. 1, pp. 369-370).

Kumar, D. (2014). Production potential of chickpea (Cicer arietinum L.) as influenced by graded levels of fertilizers and biofertilizers under South Gujarat condition (Doctoral dissertation, Agronomy Dept., NM College of Agriculture, Navsari Agricultural University, Navsari).

Maheswarappa, H. P., Nanjappa, H. V., & Hegde, M. R. (1999). Influence of organic manures on yield of arrowroot, soil physico-chemical and biological properties when grown as intercrop in coconut garden. *Annals of Agricultural Research*, *20*(3), 318-323.

Namvar, A., Sharif, R. S., & Khandan, T. (2011). Growth analysis and yield of chickpea (Cicer arietinum L.) in relation to organic and inorganic nitrogen fertilization. *Ekologija*, *57*(3).

Patel, A. R. (2011). Effect of vermicompost, Diammonium Phosphate and Zinc sulphate on yield and quality of chickpea *(Cicerarietinum L.)* (Doctoral dissertation, Anand Agricultural University,Anand).

Prajapati, B. (2014). Integrated phosphorus management in chickpea (Cicer arietinum L.) (Doctoral dissertation, Agronomy Dept., NM College of Agriculture, Navsari Agricultural University, Navsari).

Siag, R. K. (1995). Response of kabuli chickpea (Cicer arietinum) genotypes to phosphorus. *Indian Journal of Agronomy*, *40*(3), 431-433.

Singh, G., Sekhon, H. S., Ram, H., & Sharma, P. (2010). Effect of farmyard manure, phosphorus and phosphate solubilizing bacteria on nodulation, growth and yield of kabuli chickpea. *Journal of Food Legumes*, *23*(3and4), 226-229.

Singh, R. K. (2012). Effect of organic sources of nutrients on growth and yield of late sown chickpea (Cicer arietinum L.) and field pea (Pisum sativum L.) (Doctoral dissertation, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi).

Sinha, J., Biswas, C. K., Ghosh, A., & Saha, A. (2010). Efficacy of Vermicompost against fertilizers on Cicer and Pisum and on population diversity of N2 fixing bacteria.

.**Sultan, A. I. (1997).** Vermicology – The Biology of Earthwarms.Pp. 47-57.

Tagore, G. S., Namdeo, S. L., Sharma, S. K., & Kumar, N. (2013). Effect of Rhizobium and phosphate solubilizing bacterial inoculants on symbiotic traits, nodule leghemoglobin, and yield of chickpea genotypes. *International Journal of Agronomy*, *2013*.

Thenua, O. V. S., Singh, S. P., & Shivakumar, B. G. (2010). Productivity and economics of chickpea (Cicer arietinum)-fodder sorghum (Sorghum bicolor) cropping system as influenced by P sources, bio-fertilizers and irrigation to chickpea. *Indian Journal of Agronomy*, *55*(1), 22-27.

Thenua, O. V. S., & Ravindra, K. (2011). Effect of phosphorus, sulphur and phosphate solubilizing bacteria on productivity and nutrient uptake of chickpea. *Annals of Agriculture Research New Series*, *32*, 116-119.