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Performance of chickpea under organic and inorganic sources of nutrients at different soil moisture regimes in chickpea-okra cropping system

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Abstract

An investigation was conducted in *Rabi* season of 2015-16 at Model Organic Farm, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh to evaluate the performance of chickpea under organic and inorganic sources of nutrients at different soil moisture regimes in chickpea-okra cropping system. The results of the study revealed that growth, yield attributes, seed and straw yield of chickpea were statistically increased with irrigated condition and nutrient management practices. Under irrigated condition, 15.20% and 16.43% higher seed yield and net returns per rupee invested, respectively were recorded over *rainfed* condition. Organic nutrient management recorded significantly higher chickpea seed yield (10.60 q/ha) as compared to other treatments, followed by integrated nutrient management (INM). Organic nutrient management recorded higher values of net returns of Rs. 58692 ha^{-1} and net returns per rupee invested of 2.05. The available nutrient status of soil (NPK) was significantly higher under organic nutrient management as compared to inorganic nutrients.

Key words: Chickpea, inorganic, irrigated, organic, rainfed.

Chickpea with a high amount of good quality stored protein is the most important pulse crop of the world which plays a significant role in the low input agriculture by reducing the dependence on inorganic nutrients. Chickpea seeds on an average contain 23% proteins, 64% total carbohydrates, 5% fat, 6% crude fiber, 3% ash and a high mineral content (Oberoi *et al.*, 2010). It is a significant contributor towards agricultural sustainability due to its nitrogen fixation ability and for this reason it is considered as a good rotational crop. Its presence improves soil health by promoting microbial population activity. Although chickpea fixes nitrogen from atmosphere, there is strong evidence that nitrogen fertilizer increases seed yield, those of seed protein and amino acids. However, its requirements for nitrogen fertilizers are lower than those of other crops to obtain higher yield and improved seed quality (Dhima *et al.*, 2015).

Use of chemical fertilizers in imbalanced and indiscriminate manner has developed many problems like decline of soil organic matter, deterioration of soil health, increase in salinity and sodicity, deterioration in the quality of crop produce and increase in hazardous pests and diseases etc. Continuous use of inorganic fertilizers has not only brought loss of vital flora and fauna but also resulted in loss of secondary and micro-nutrients (Chakarborti and Singh 2004). In such a situation, a renewable, eco-friendly farming practice that is organic farming has emerged as a sustainable alternative. Therefore, in the presents study, an attempt has been made to evaluate the performance of chickpea to organic and inorganic sources of nutrients.

Materials and Methods

The present investigation was carried out during *Rabi* season of 2015–16 at Model Organic Farm, Department of Organic Agriculture, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur situated at $32^{0}.4$ N latitude and $76^{0}.3$ E longitudes at an elevation of about 1224 meters above mean sea level. The experiment was conducted on silty clay loam soil having acidic reaction, high organic carbon, low

available nitrogen, high available phosphorus and medium available potassium. The experiment was laid out in split plot design with three replications. The experiment consisted of 8 treatments comprising of two irrigation treatments *i.e.* irrigated and *rainfed* in main plots and combinations of four nutrient management practices *i.e.* organic (soil treatment with jeevamrit & seed treatment with *Rhizobium* + PSB, vermicompost (VC) @ 5 t/ha + 3 sprays of vermiwash), inorganic (recommended NPK), integrated (2.5 t/ha VC + 50% of recommended NPK) and farmer's practice (1.25 t/ha VC + 25% of recommended NPK) in sub plots. Chickpea 'Himachal Chana–1' was sown on 7th November, 2015 keeping 25 cm distance from row to row. Seed rate of 40 kg/ha was used for experimental crop. The recommended dose of NPK (60:30:30) was applied in both *rainfed* and irrigated conditions under inorganic treatments, whereas the dose was reduced to half in integrated nutrient management (INM) and to one fourth in farmer's practice. Two hand weedings were done for weed management at 60 and 90 days after sowing (DAS). After pre sowing irrigation, crop was irrigated twice with flood irrigation at pre flowering and pod development stage. Rainfall data during the whole period of experimentation depicted that rainfall received during crop period was 50 mm and there was uniform distribution of rainfall from February to May. Soil samples were collected before sowing of crop and after crop harvest. The available N content of soil was analysed by Micro–kjeldahl's method, P by Olsen's method and K by flame photometer method. Net returns per rupee invested was worked out by dividing net returns (/ha) with cost of cultivation (/ha).

Results and Discussion

Plant height and dry matter accumulation of chickpea crop

The plant height was significantly influenced by irrigated condition as compared to *rainfed* condition at all growth stages except at 30 DAS which might be due to sufficient availability of moisture in root zone which increased the availability of plant nutrients to chickpea crop (Singh 2017). Among nutrient management, application of organic nutrient management recorded significantly taller plants as compared to other treatments at all the growth stages, but at 30 DAS it was statistically at par with INM (Table 1). INM was the second best treatment which recorded significantly taller plant height as compared to

Table 1. Effect of treatments on plant height and dry matter accumulation of chickpea

Treatment	Plant height (cm)				Dry matter accumulation (g/m^2)			
	30 DAS	90 DAS	150 DAS	Harvest	30 DAS	90 DAS	150 DAS	Harvest
Soil moisture regime								
Rainfed	4.52	13.32	39.12	55.95	4.22	14.33	49.93	61.75
Irrigated	5.30	16.40	44.57	60.42	5.05	17.03	57.01	65.83
CD (P=0.05)	NS	2.08	2.13	0.38	0.68	0.36	3.83	1.36
Nutrient Management								
Organic	5.40	17.68	47.48	63.42	6.04	19.52	60.16	69.64
Inorganic	4.68	13.62	41.55	56.98	3.85	15.47	52.45	62.42
Integrated	5.16	15.28	42.42	58.98	4.86	16.23	54.90	66.10
Farmer's practice	4.41	12.85	35.93	54.35	3.79	11.51	46.40	57.20
CD (P=0.05)	0.62	0.52	1.57	3.60	0.78	0.46	1.80	1.21

inorganic and farmer's practice at 150 DAS and at harvest. Increase in plant height could be attributed to the higher production of plant growth promoting factors by beneficial microbial inoculants present in organic manures which might have resulted in more intense root system and increased shoot growth by enhanced nutrient uptake (Singh and Sharma 2011).

Significantly higher dry matter accumulation was produced under irrigated condition as compared to *rainfed* condition at all growth stages. It might be due to the fact that enough soil moisture was maintained by providing irrigation which led to higher photosynthetic assimilation and as a result plant growth improved and led to higher accumulation of dry matter. Maleki *et al.* (2010) also reported that application of irrigation significantly increased dry matter accumulation as compared to *rainfed* conditions. Among nutrient management, organic nutrient management significantly increased dry matter accumulation as compared to other treatments under all stages of growth. INM was the second best treatment which recorded significantly higher dry mater accumulation as compared to inorganic and farmer's practice. Jat and Ahlawat (2004) reported that application of vermicompost resulted in higher dry matter accumulation. It might be due to the fact that vermicompost contained all the essential plant nutrients and gave steady supply of these nutrients during entire crop period, which ultimately increased the dry matter accumulation of plants.

Yield attributes and yield of chickpea crop

Irrigated condition resulted in significantly more number of pods/plant (18.37), seeds/pod (1.64) and 1000 seed weight (160.01) over *rainfed* condition (Table 2). It might be due to sufficient soil moisture in root zone which have enabled the plant to provide more number of pods (Singh 2017). However, plants/m^2 remained unaffected by both moisture regime and nutrient management treatments. Among nutrient management, organic nutrient management produced significantly higher number of pods/plant (20.44), seeds/pod (1.73) and 1000 seed weight (163.23) as compared to farmer's practice and was statistically at par with INM and inorganic nutrient management for 1000 seed weight. Similar findings were also observed by Siag and Yadav (2004) who reported that application of vermicompost resulted in more pods per plant.

Significantly higher seed (9.70 q/ha) and straw yield (21.23 q/ha) of chickpea were obtained under irrigated condition over *rainfed* condition. Irrigated condition significantly increased the seed yield by 15.20% than *rainfed* condition. Maleki *et al.* (2010) reported that the seed yield in full irrigation treatment and inoculated with *Rhizobium* bacteria was significantly higher than the other treatments. Singh *et al.* (2004) has also reported that two

Table 2. Effect of treatments on yield attributes and yield of chickpea

Treatment	Plants/m^2	Pods/plant	Seeds/pod	1000 seed weight (g)	Seed yield (q/ha)	Straw yield (q/ha)
Soil moisture regime						
Rainfed	18	16.55	1.39	155.85	8.42	18.76
Irrigated	19	18.37	1.64	160.01	9.70	21.23
CD (P=0.05)	NS	1.06	0.16	2.49	0.35	2.10
Nutrient Management						
Organic	20	20.44	1.73	163.23	10.60	23.83
Inorganic	18	16.57	1.48	158.79	8.84	19.73
Integrated	19	17.10	1.55	161.32	9.88	21.37
Farmer's practice	17	15.73	1.30	148.38	6.95	15.07
CD (P=0.05)	NS	1.49	0.12	4.60	0.26	1.23

irrigations gave higher seed yield of chickpea over no or one irrigation. Among nutrient management, organic nutrient management resulted in significantly higher seed yield (10.60 q/ha) and straw yield (23.83 q/ha) of chickpea than the other treatments. This increase in yield occurred due to an increase in growth and development of chickpea crop with application of vermicompost or it might be due to the better availability of nutrients throughout the crop growth that ultimately improved the growth and yield contributing characters of chickpea and hence resulted in higher seed yield. Organic, integrated and inorganic nutrient management produced 52.5, 42.0 and 27.2% higher seed yield over the farmer's practice which recorded significantly the lowest yield. Singh *et al.* (2004) also reported similar findings that inoculation of chickpea seeds with *Rhizobium* + PSB significantly increased seed yield.

Soil-nutrient status after harvesting

Soil pH remained unaffected with soil moisture regimes and nutrient management sources but numerically higher pH was recorded in irrigated condition and under different nutrient management, inorganic treatment was having less value as compared to other treatments (Table 3). At the same time organic nutrient management significantly increased organic carbon content as compared to other treatments followed by INM and farmer's practice. The least amount of organic carbon content was recorded under inorganic nutrient management. The nutrient status of soil after the end of experiment was influenced by soil moisture regimes and different nutrient management practices. Significantly higher available N in soil was recorded under irrigated condition than *rainfed* condition but there was no significant difference in the status of available P and K in the soil. Dutta and Mondal (2006) reported that supply of irrigation provides adequate moisture in soil which plays an important role in increasing the soil available N. Among nutrient management, application of organic nutrient management significantly influenced the available N, P and K in soil as compared to other treatments. Organic nutrient management resulted in significantly higher available N in soil, whereas other nutrient management practices *i.e.* INM, inorganic and farmer's practice remained statistically at par with each other. Available P and K significantly increased under organic nutrient management practice over other treatments, followed by INM, inorganic and farmer's practice resulted in the least build up of available P and K in soil. Aher *et al.* (2012) reported that organic farming improved

Table 3. Effect of treatments on soil chemical properties

Treatment	pH	OC (g/kg)	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
Soil moisture regime					
Rainfed	5.15	10.6	210.39	25.58	176.70
Irrigated	5.16	12.7	217.39	27.77	177.44
CD (P=0.05)	NS	0.4	5.88	NS	NS
Nutrient Management					
Organic	5.16	14.1	224.20	29.07	184.41
Inorganic	5.14	8.9	208.31	26.33	170.66
Integrated	5.16	12.7	215.77	27.32	177.78
Farmer's practice	5.16	11.0	209.61	23.99	175.44
CD (P=0.05)	NS	0.3	8.30	2.05	2.32
Initial status	5.30	10.3	180.20	18.48	170.33

soil properties and productivity.

Economics

Higher cost of cultivation (Rs. 26025/ha), gross returns (Rs. 68415/ha), net returns (Rs. 42390/ha) and net returns per rupee invested (1.63) were recorded under irrigated condition (Table 4). Among nutrient management, organic nutrient management recorded higher cost of cultivation (Rs. 28654/ha), gross returns (Rs. 87346/ha), net returns (Rs.58692/ha), and net returns per rupee invested (2.05) followed by INM, inorganic and farmer's practice. Singh *et al.* (2004) reported that seed inoculation of chickpea with *Rhizobium* and PSB resulted in the highest gross returns, net returns and net returns per rupee invested over no inoculation.

Irrigated condition and organic nutrient management recorded higher productivity of chickpea in chickpea-okra cropping system under mid-hill region of Himachal Pradesh.

Table 4. Effect of treatments on economics of chickpea

Treatment	Cost of cultivation (?/ha)	Gross returns (?/ha)	Net returns (?/ha)	Net returns per rupee invested
Soil moisture regime				
Rainfed	24449	58612	34163	1.40
Irrigated	26025	68415	42390	1.63
CD (P=0.05)	4657	4657	1358	0.04
Nutrient Management				
Organic	28654	87346	58692	2.05
Inorganic	22630	55771	33141	1.46
Integrated	25810	63551	37741	1.46
Farmer's practice	23855	47384	26529	0.99
CD (P=0.05)	4657	4657	1358	0.12

References

Aher SB, Lakaria BL, Kaleshananda S, Singh AB, Ramana S, Ramesh K and Thakur JK. 2012. Effect of organic farming practices on soil and performance of soybean (*Glycine max*) under semi-arid tropical conditions. Indian Journal of Applied and Natural Sciences **7** (1): 67-71.

Chakarborti M and Singh NP. 2004. Biocompost: a novel input to the organic farming. Agro bios Newsletter **2** (8): 14-15.

Dhima K, Stefanos VS and Eleftherohorinos I. 2015. Effect of cultivar, irrigation and nitrogen fertilization on chickpea productivity. Journal of Scientific Research **6** (2): 1187-1194.

Dutta D and Mondal SS. 2006. Response of summer groundnut (*Arachis hypogaea*) to moisture stress, organic manure and fertilizer with and without gypsum under lateritic soil of West Bengal. Indian Journal of Agronomy **51** (2): 145-148.

Jat RS and Ahlawat IPS. 2004. Effect of vermicompost, biofertilizer and phosphorus on growth, yield and nutrient uptake by gram (*Cicer arietinum*) and their residual effect on fodder maize (*Zea mays*). Indian Journal of Agricultural Sciences **74** (7): 359-361.

Maleki A, Maryam P, Rahim N and Reza R. 2010. Effect of supplemental irrigation, nitrogen chemical fertilizer, and inoculation with rhizobium bacteria on grain yield and its components of chickpea (*Cicer arietinum* L.) under rainfed condition. International Journal of Biological, Bimolecular, Agricultural, Food and Biotechnological Engineering **8** (2): 240-249.