Int.J.Curr.Microbiol.App.Sci (2020) *9*(10): 591-597

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 9 Number 10 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.910.070

Effect of Different Levels of NPK and Zinc on Soil Health Growth and Yield of Chickpea (*Cicer arietinum* L.) var. PUSA 362

Ankur Sahu*, Narendra Swaroop, Arun Alfred David and Tarence Thomas

Department of Soil Science and Agricultural Chemistry, Naini Agricultural institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj 211007 U.P. India

**Corresponding author*

Keywords

Chickpea, NPK, Zinc, EC, pH, Yield

Article Info

Accepted:
07 September 2020
Available Online:
10 October 2020

A B S T R A C T

The study entitled The Effect of different level of NPK and Zinc on soil health, growth and yield of Chickpea (*Cicer arietinum* L.). Cv-Pusa-362 was carried out at the research farm of Soil science and agriculture chemistry, Sam Higginbottom University of Agriculture, Technology and Science, Prayagraj during the season of Rabi 2019-20. The soil of the experimental area was sandy loam in texture. The experiment was laid out in randomized block design with three levels of N P & K (0%, 50% and 100%) and three levels of Zinc (0%, 50% and 100%). The experimental results revealed that significantly maximum growth parameters like plant height(42.9cm), number of branches (19.6) and yield attributes like number of pods (63.1), number of seeds pods^{-1} (1.6), test weight (28.38g), total grain yield (25.13q ha^{-1}) were noticed under T_9 (@100 % NPK + 100 % Zn) as compared to rest of the treatments and lowest under T_1 (Control). And the result shows that pH, EC (dSm^{-1}), Bulk density (Mg m^{-3}), Particle density(Mg m^{-3}), Pore space (%), Organic carbon (%), available Nitrogen (306.24kg ha^{-1}), phosphorus (28.96kg ha^{-1}), potassium (210.23kg ha^{-1}) and Zinc (0.89kg ha^{-1}) on the soil showed significant effect with T_9 (@100 % NPK + 100 % Zn). Maximum gross return, net return (Rs.124849) and B:C ratio (1:4.24) were also recorded with the treatment T_9 (@100 % NPK + 100 % Zn).

Introduction

Pulses are a major source of proteins among the vegetarians in India, and complement the staple cereals in the diets with proteins, essential amino acids, vitamins and minerals (Pingoliya *et al.,* 2013). They contain 22 to 24% protein, which are almost twice the protein in wheat and thrice that of rice (Shukla *et al.,* 2013). It is an easily available source of protein in the rural heart of India that is village. According to the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) chickpea seeds contain on average- 21.1% protein, 64% total carbohydrates (47% starch, 6% soluble sugar), 5% fat, 6% crude fiber and 3% ash. High mineral content has been reported for phosphorus (340 mg per 100 g), calcium (190 mg per 100 g) and magnesium (140 mg per 100 g), iron (7 mg per 100 g) and zinc (3 mg per 100 g). Balanced fertilizer application in a

cropping system is very necessary for a sustainable production system as well as appropriate soil nutrient flexibility. Increasing the level of NPK up to 100% RDF significantly improved growth parameters, yield attributes, grain and straw yield (Verma *et al.,* 2018). The effect of N fertilizer application on soil organic matter status and soil physical properties is important to agricultural sustainability and to increase crop yield (Zhong *et al.,* 2014). Under dry land conditions nitrogen increases the growth and development, dry matter production and yield of crops (Dinesh, 2014). Beside this phosphorus is also an important fertilizer in chickpea production, it is a very important chemical fertilizer (Dotaniya *et al.,* 2013) that can raise the water holding capacity of soil. Potassium is very effective in the nodulation of pulse crops thus increases the seed yield through better fixation of nitrogen (Rajput 2018). It also increases the pH of soil and plays a major role in the regulation of water. Late application of Zn especially at the seed filling period increased the ability of chickpea plants to use nitrogen effectively (Mohamed *et al.,* 2016).

Materials and Methods

Experimental site

The study was carried out at the research farm of Soil science and agriculture chemistry Prayagraj, during the season of Rabi 2019-2020. The farm is located at 25 0 24 30" North latitude 810 51'10" East longitude and 98 m above mean sea level.

The complete detail of the treatment combination is given in table 1.

Treatment combinations

Laboratory analysis- the bulk and particle density of soil was determined by graduate measuring cylinder and pH and EC by Glass electrode pH meter and Digital Conductivity meter. Organic carbon was determined by rapid titration method given by Walkley and Black (1934). Available N was determined by alkaline permanganate method (Subbiah and Asija 1956), available P by Olsen *et al.,* (1954), available K by Flame photometric method (Toth and Prince, 1949) and available Zn by Shaw and Dean1952 (Table 2 and 3).

Economic parameters in treatment

Treatment-wise the input and output cost was calculated with the help of different economic parameters like, Net profit and B:C ratio etc.

Results and Discussion

In table 4 and 5 we can see the significant and non significant effect of different level of NPK and Zinc on yield, physical and chemical properties of soil.

Plant height (cm)- the effect of treatment on plant height ware significant in 30, 60, 90 and 120 days. At 30, 60, 90 and 120 days maximum plant height (11.4 cm), (20.8cm), (32.8cm) and (42.9cm) ware recorded at T_9 (NPK 100%, Zn 100% 20:40:20Kg NPK+20 Kg Zn ha^{-1}) respectively. The minimum plant height (9.7 cm), (18.7 cm), (30 cm) and (39.7 cm) ware recorded in 30, 60, 90 and 120 days respectively with T_1 (Control). Similar result was obtained by Darvhankar *et al.,* (2019). The effect of NPK and Zinc on number of branches was also significant. At 30, 60, 90 and 120 days maximum number of branches (10.4), (14.1), (17.5) and (19.6) was recorded at T_9 (NPK 100%, Zn 100% 20:40:20Kg NPK+20 Kg Zn ha^{-1}) respectively. The minimum number of branches (8.3), (12.3), (15) and (16.8) was recorded respectively with T_1 (Control). Similar result was obtained by Darvhankar *et al.,* (2019). There is significant effect of treatment on the number

of pods plant^{-1}, number of seeds pod^{-1}, seed weight and total grain yield Verma *et al.*, (2018). The maximum number of pods plant^{-1} (63.1), maximum number of seeds (1.6), maximum seed weight (28.38 g) and higher grain yield (25.13 q) recorded at T_9 (NPK @100%, Zn @100% 20:40:20Kg NPK+20 Kg Zn ha^{-1}) and minimum number of pods plant^{-1} (54.6), number of seeds (1.06), seed weight (24.35g) and grain yield (20.25 q) recorded at T_1 (control). Similar result reported by Rajput (2018) (Fig. 1–3).

Table.1 Treatment combination of chickpea

TREATMENT	TREATMENT COMBINATION	SYMBOL
T_1	Control (Absolute control)	L_1F_1
T_2	@NPK 0%,@Zn 50% 10kg Zn ha^{-1}	L_1F_2
T_3	@NPK 0%,@Zn 100% 20 kg Zn ha^{-1}	L_1F_3
T_4	@NPK 50%,@Zn 0% 10:20:10 Kg NPK ha^{-1}	L_2F_1
T_5	@NPK 50%,@Zn 50% 10:20:10 Kg NPK+10Kg Zn ha^{-1}	L_2F_2
T_6	@NPK 50%,@Zn 100% 10:20:10Kg NPK+20Kg Zn ha^{-1}	L_2F_3
T_7	@NPK 100%,@Zn 0% 20:40:20 Kg NPK ha^{-1}	L_3F_1
T_8	@NPK 100%,@Zn 50% 20:40:20Kg NPK+10 Kg Zn ha^{-1}	L_3F_2
T_9	@NPK 100%,@Zn 100% 20:40:20Kg NPK+20 Kg Zn ha^{-1}	L_3F_3

Table.2 Physical analysis of pre sowing soil sample of chickpea

PARTICULARS	RESULT	METHOD EMPLOYED
Textural class	Sandy loam	Bouyoucous hydrometer method(1952)
Sand (%)	68.25	
Silt (%)	19.45	
Clay (%)	13.30	
Soil colour		Munshell colour chart(1954)
Dry soil	10YR 6/4 Light Yellowish Brown	
Wet soil	10YR 4/3 Brown	
Bulk density (Mg m^{-3})	1.29	Graduated Measuring Cylinder (Muthuaval et.al.,1992)
Particle density (Mg m^{-3})	2.29	
Pore space (%)	44%	

Table.3 Chemical analysis of pre sowing soil sample of chickpea

PARTICULARS	RESULT	METHOD EMPLOYED
Soil pH	7.5	Glass electrode, pH meter (Jackson 1958)
EC(dSm^{-1})	0.17	Digital Conductivity meter (Wilcox 1950)
Organic carbon (%)	0.65	(Walkley and Black's 1947) Wet Oxidation Method
Available nitrogen (kg ha^{-1})	285	(Subbaih and Asija, 1956) Kjeldahl Method
Available phosphorus (kg ha^{-1})	23.40	(Olsen et al. 1954) Colorimetric method
Available potassium (kg ha^{-1})	118.55	(Toth and Prince, 1949) Flame photometric method
Available zinc (kg ha^{-1})	0.60	(Shaw and Dean1952)

Table.4 Effect of different levels of NPK and Zinc on growth and yield parameters of chickpea

Treatment	Plant height(cm)	No. of branches	No. of pods plant^{-1}	No. of seeds pod^{-1}	Seed weight(g)	Total grain yield (q ha^{-1})
T_1	39.7	16.8	54.6	1.06	24.35	20.25
T_2	40.6	17.2	55.76	1.13	25.20	20.86
T_3	40.9	17.6	56.26	1.2	26.56	21.73
T_4	40.9	17.8	58.66	1.13	25.45	21.22
T_5	41.5	18.0	57.53	1.26	26.68	22.50
T_6	42.0	18.0	60.46	1.23	27.72	23.15
T_7	42.0	18.4	59.26	1.23	27.18	22.95
T_8	42.2	19.0	61.6	1.46	28.18	23.43
T_9	42.9	19.6	63.1	1.6	28.38	25.13
F-test	S	S	S	S	S	S
S. Em. (±)	0.18	0.20	0.68	0.06	0.42	0.49
C.D at 5%	0.55	0.59	2.04	0.17	1.27	1.47

Table.5 Effect of NPK and Zinc on physical and chemical properties of soil after harvest of chickpea

Treatment	Bulk Density (Mg m^{-3})	Particle density (Mg m^{-3})	Pore Space (%)	Solid Space (%)	Soil pH	EC (dSm^{-1})	Organic Carbon (%)	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	Zn (kg ha^{-1})
T_1	1.28	2.39	46.44	53.55	7.8	0.18	0.54	281.50	26.38	145.71	0.63
T_2	1.25	2.40	47.91	52.08	7.5	0.17	0.58	285.35	26.75	149.35	0.85
T_3	1.27	2.41	47.30	52.69	7.4	0.16	0.62	287.72	26.43	156.25	0.69
T_4	1.22	2.42	49.58	50.41	7.0	0.13	0.63	291.30	27.85	173.15	0.72
T_5	1.26	2.42	47.93	52.06	7.2	0.15	0.66	292.47	27.45	178.25	0.77
T_6	1.24	2.47	49.79	50.20	7.3	0.14	0.69	294.63	28.15	176.78	0.83
T_7	1.23	2.45	49.79	50.20	7.0	0.14	0.72	298.85	28.32	203.62	0.81
T_8	1.21	2.46	50.81	49.18	7.1	0.15	0.73	304.15	28.64	209.81	0.85
T_9	1.22	2.48	50.80	49.19	7.2	0.16	0.76	306.24	28.96	210.23	0.89
F-test	NS	S	S	S	S	S	S	S	S	S	S
S. Em. (±)	0.02	0.01	0.33	0.15	0.10	0.01	0.01	1.77	0.68	1..36	0.01
C.D at 5%	0.07	0.04	0.99	0.45	0.31	0.02	0.04	5.31	2.02	4.08	0.03

Fig.1 Effect of NPK and Zinc on availability of nitrogen, phosphorus and potassium in soil after harvest of chickpea

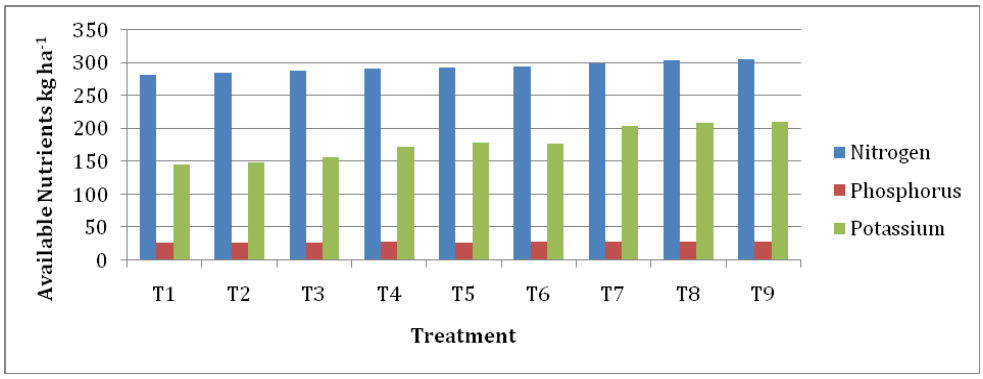


Fig.2 Effect of NPK and Zinc on availability of Zinc on soil after harvest of chickpea

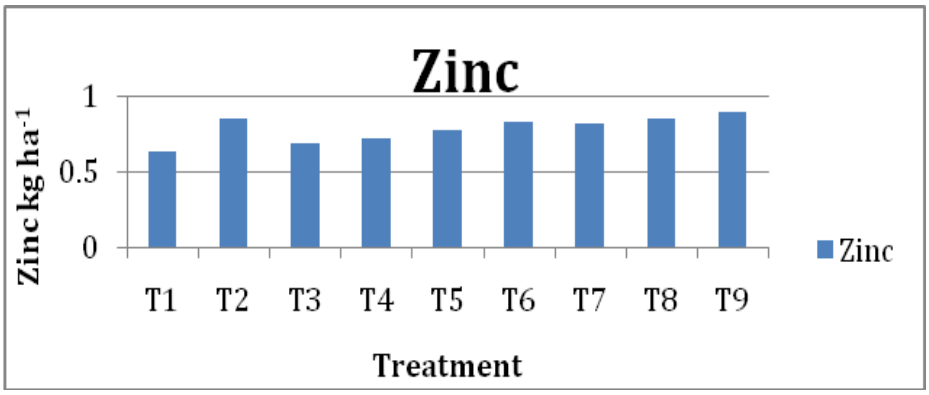
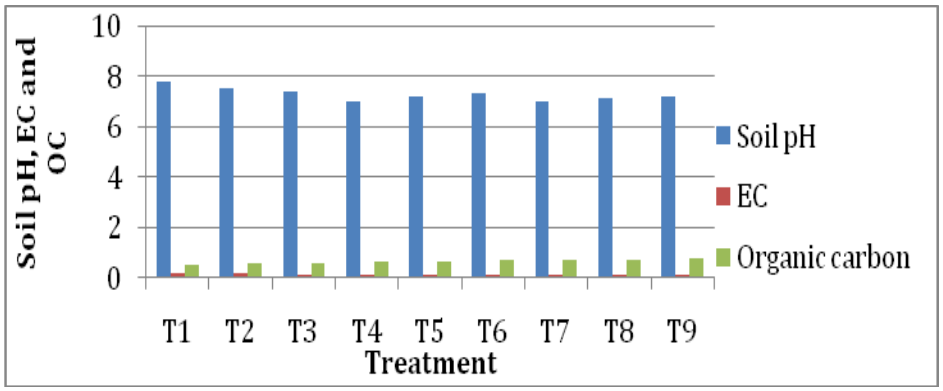


Fig.3 Effect of NPK and Zinc on Soil pH, electrical conductivity and organic carbon of soil after harvest of chickpea



Physical and Chemical Properties of soil

There is non significant effect of treatment combination on bulk density. The maximum bulk density (1.28) was recorded at T_1 (Control) and minimum value (1.21) recorded at T_8 (NPK 100%, Zn 50% 20:40:20Kg NPK+10 Kg Zn ha^{-1}). Treatments shows the significant effect on particle density, the maximum value of particle density (2.48)

recorded at T_9 (NPK 100%, Zn 100% 20:40:20Kg NPK+20 Kg Zn ha^{-1}) and minimum value (2.39) recorded at T_1 (Control).Treatments show the significant effect on pore space. The value of pore space was maximum (50.81%) at T_8 (NPK @100%, Zn@ 50% 20:40:20Kg NPK+10Kg Zn ha^{-1}) and minimum pore space (46.44%) at T_1 (Control).The higher value of pH (7.8) recorded at T_1 (Control) followed by 7.5 at T_2 (NPK 0%, Zn 50% 10kg Zn ha^{-1}). The lower pH (7) at T_7 (NPK 100%, Zn 0% 20:40:20 Kg NPK ha^{-1}) Similar result reported by Zhong *et al.,* (2014). The maximum value of electrical conductivity (0.18) of the soil was recorded at T_1 (Control) and minimum value (0.13) recorded at T_4 (NPK 50%, Zn 0% 10:20:10 Kg NPK ha^{-1}). Treatments show the significant effect. The maximum value of organic carbon (0.76) was recorded at T_9 (NPK 100%, Zn 100% 20:40:20Kg NPK+20 Kg Zn ha^{-1}) and minimum value of organic carbon (0.54) was recorded at T_1 (Control). There is significant effect of treatments on availability of nitrogen. The maximum amount of nitrogen (306.24 kg ha^{-1}) recorded at T_9 (NPK 100%, Zn 100% 20:40:20Kg NPK+20 Kg Zn ha^{-1}) and minimum nitrogen (281.5 kg ha^{-1}) recorded at T_1 (control). There is significant effect of treatments on availability of phosphorus. The higher amount of phosphorus (28.96 kg ha^{-1}) recorded at T_9 (NPK 100%, Zn 100% 20:40:20Kg NPK+20 Kg Zn ha^{-1}) and minimum (26.38 kg ha^{-1}) recorded at T_1 (control). Similar result obtained by Kuldeep *et al.,* (2016). The amount of potassium was maximum (210.23 kg ha^{-1}) at T_9 (NPK 100%, Zn 100% 20:40:20Kg NPK+20 Kg Zn ha^{-1}) and minimum (145.71 kg ha^{-1}) recorded at T_1 (Control). It shows significant effect of treatment combination. The maximum amount of Zinc (0.89 kg ha^{-1}) recorded at T_9 (NPK 100%, Zn 100% 20:40:20Kg NPK+20 Kg Zn ha^{-1} which shows the significant effect of treatment combination

It was concluded that the post harvest soil properties such as EC(dSm^{-1}), available Nitrogen, Phosphorus, Potassium and Zinc were found to be significant with increasing level of NPK and zinc. The treatment combination T_9 (NPK@ 100%, Zn @100% 20:40:20 Kg NPK+20 Kg Zn ha^{-1}) was found to best in term of particle density, pore space(%), organic carbon(%), available nitrogen, phosphorus, potassium and zinc as 2.48, 50.80, 0.76, 306.24, 28.96, 210.23 and 0.89 respectively. Its found to be the best treatment for maximum growth and yield parameter and gave highest net profit of (Rs.124849) ha^{-1} and recorded highest Benefit Cost ratio (1:4.24). It could be recommended for profitable cultivation of chick pea and maintain the soil health.

Acknowledgement

I am grateful for constant inspiration and encouragement, valuable help and advice throughout the study period and investigation from the head of the department and staff, Department of Soil Science and Agricultural Chemistry, SHUATS Prayagraj, Uttar Pradesh.

References

Devi, P., S. Darvhankar, A. Prakash and Diptanu Banik,(2019) Effect of different doses of nitrogen on growth and yield of chickpea *(cicer arietinum* L.), *Plant Archives Vol. 19, Supplement 1, pp. 458-460.*

Dotaniya ML, Datta SC, Biswas DR, Kumar K. (2014), Effect of organic sources on P_2O_5 fraction and available P_2O_5 in typical Haplustept *J. Indian Soc. Soil Sci. 62(1):80-83.*

El Habbasha, S.F., Magda H. Mohamed, 11 E.M. Abd El-Lateef, B.B. Mekki and M.E. Ibrahim, (2016) Effect of Combined Zinc and Nitrogen on Yield,

Chemical Constituents and Nitrogen Use Efficiency of Some Chickpea Cultivars under Sandy Soil Conditions, *World Journal of Agricultural Sciences 9 (4): 354-360.*

Kuldeep Balai, M Jajoria, R Verma, P Deewan and SK Bairwa,(2017) Nutrient content, uptake, quality of chickpea and fertility status of soil as influenced by fertilization of Phosphorus and Zinc, *Journal of Pharmacognosy and Phytochemistry, 6(1): 392-398.*

Kumar, D., Arvadiya LK, Kumawat AK, Desai, Patel TU(*2014)*, Yield, Protein Content, Nutrient Content and their Uptake in Chickpea (*Cicer arietinum* L.) as Influenced by Graded Levels of Fertilizers and Bio Fertilizers. *Trends in Biosciences. 7(24):42294233.*

Pingoliya, K.K., A.K. Mathure, M.L. Dotaniya, D.K. Jajoria and G.P. Narolia (2013) Effect of phosphorus and iron level on growth and yield attributes of chickpea (*Cicer arietinum* L.), *Legume Res.,37 (5): 537-541.*

Rajput, A. (2018) Potassium Application on Chickpea Crop under Irrigated Area. *Sarhad Journal of Agriculture, 34(4): 941-947*

Shukla, A.K., *et al.*, (2019) "Yield gap analysis in kabuli chickpea through front line demonstration." *International journal of Agriculture Sciences 11, (2), 7770-7772.*

Sudhanshu Verma, A. Singh, Swati S. Pradhan, JP Singh and SK Verma (*2018*), effects of organic formulations and synthetic fertilizer on the performance of pigeonpea in eastern region of Uttar Pradesh, *Bangladesh J. Bot. 47(3): 467-471.*

Zhong, H., et al., (2014). Effect of different nitrogen application on soil physical, chemical properties and yield in maize (*Zea mays* L.), *Agricultural Sciences, 5, 1440-1447.*

How to cite this article:

Ankur Sahu, Narendra Swaroop, Arun Alfred David and Tarence Thomas. 2020. Effect of Different Levels of NPK and Zinc on Soil Health Growth and Yield of Chickpea (*Cicer arietinum* L.) var. PUSA 362. *Int.J.Curr.Microbiol.App.Sci.* 9(10): 591-597.
doi: https://doi.org/10.20546/ijcmas.2020.910.070