www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(7): 2988-2992

www.thepharmajournal.com
Received: 06-05-2022
Accepted: 20-06-2022

Rajneesh Tripathi
Department of Soil Science and Agricultural Chemistry, Naini Agricultural University
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Arun Alfred David
Department of Soil Science and Agricultural Chemistry, Naini Agricultural University
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Tarence Thomas
Department of Soil Science and Agricultural Chemistry, Naini Agricultural University
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

I Srinath Reddy
Department of Soil Science and Agricultural Chemistry, Naini Agricultural University
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Rajneesh Tripathi
Department of Soil Science and Agricultural Chemistry, Naini Agricultural University
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Effect of inorganic fertilizers and organic manures on physio-chemical properties of soil in cabbage (*Brassica oleracea* L.) var. pusa drumhead

Rajneesh Tripathi, Arun Alfred David, Tarence Thomas and I Srinath Reddy

Abstract

An experiment was conducted during in *Rabi* season (Nov. 2021-Feb. 2022) to study the "Effect of Inorganic Fertilizers and Organic Manures on Physio-Chemical Properties of Soil in Cabbage (*Brassica oleracea* L.) Var. Pusa Drumhead*".* On central research farm of Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The experiment was laid out in randomized block design with three levels of inorganic fertilizer (0% NPK + 50% NPK + 100% NPK and 0% Zn + 50% Zn + 100% Zn) and three levels of organic manures (0% FYM + 50% FYM + 100% FYM). It was recorded from the application of inorganic fertilizer and organic manures in treatment T_9 (NPK @ 100% + Zn @ 100% + FYM @ 100%) maximum bulk density 1.52 Mg m^{-3}, percent pore space 46.87%, water holding capacity 46.87%, pH 7.38, EC 0.62 dSm^{-1}, organic carbon 0.72%, available Nitrogen 332.45 kg ha^{-1}, available phosphorus 35.75 kg ha^{-1}, available potassium 219.54 kg ha^{-1}, available zinc 0.62 mg kg^{-1} with cost of cultivation 99596.40 ₹ ha^{-1}, gross return 361600.00 ₹ ha^{-1}, net profit 262003.60 ₹ ha^{-1}, and benefit cost ratio 1: 3.63 best from T_1 [Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)].

Keywords: Cabbage, WHC, pH, EC, NPK and Zinc etc.

Introduction

Cabbage (*Brassica oleracea* var capitata) is a small, leafy biennial producing a compact globular mass of smooth or crinkled leaves wrapped over each other known as head. The outer leaves are generally larger than the inner. The stem is short and stout. Plants flower generally after winter. Leaves are low in calories (27 percent), fat (0.1 percent) and carbohydrates (4.6 percent). It is good sources of protein (1.3 percent) which contains all essential amino acids, particularly sulphur containing amino acids. Cabbage is an excellent source of minerals such as calcium (39 mg), iron (0.8 mg), magnesium (10 mg), sodium (14.1 mg), potassium (114 mg) and phosphorus (44 mg). It has substantial amounts of β carotene provitamin A), ascorbic acid, riboflavin, niacin and thiamine. Ascorbic acid content varies from 30-65 mg per 100 g fresh weight MoFA, (2008) [9]. Flavour in cabbage leaves is due to the glycoside sinigrin. Cabbage contains goitrogens which cause enlargement of thyroid glands.

Worldwide 71,803,269 tonnes of Cabbage are produced per year. China is the largest Cabbage producer in the world with 33,881,515 tonnes production volume per year. India comes second with 8,755,000 tonnes yearly production. China and India produce together 59% of World's total. In India West Bengal (2288.50 tonnes) is highest Cabbage producing state followed by Orissa (1058.78 tonnes) and Madhya Pradesh (686.91 tonnes) per year. Uttar Pradesh produces (302.97 tonnes) every year MoFA, (2008) [9].

Cabbage is believed to have originated in Western Europe and it was the first Cole crop to be cultivated. Prior to cultivation and use as food, cabbage was mainly used for medicinal purposes Silva, (1986) [14]. It is the most popular vegetable around the world in respect of area, production and availability, almost round the year and occupies the pride place among cole crops due to its delicious taste, flavour and nutritive value. It is grown for heads which are used as vegetable, eaten raw and frequently preserved as sauerkraut or pickle. Cabbage is an excellent source of vitamin C, some B vitamins, potassium and calcium Hasan and Solaiman, (2012) [5].

Nitrogen the key to high cabbage yield. A shortage of nitrogen is the single most common reason for a cabbage crop not reaching its full yield potential. This applies equally to the quantity applied as to how to conserve it and maintain its correct level. Applying sufficient nitrogen will help the lower leaves grow Asati *et al*., (2013) [1].

Phosphorus is a strategic nutrient for cabbage plant management even though only small quantities are absorbed Khan *et al.*, (2002) [8]. The levels of this nutrient in diagnostic leaves for cabbage optimal growth are between 4 and 7 g kg^{-1} Trani *et al.*, (1997) [15] and between 3 and 5 g kg^{-1} for herbaceous plants in general Bansal *et al*., (2020) [3].
Potassium in the cabbage for boosting yield in the district Performance indicators for determining suitability of effect of split dose of Potash on the yield of cabbage Technology option No. of replication Germination % Weight of head (cabbage) in Kg Yield (q) Cost of cultivation Gross return (Rs. ha^{-1}) Net return (Rs. ha^{-1}) B:C Ratio Farmers practice 10 Asati *et al*., (2013) [1].

Materials and Methods

The present study entitled "Effect of Inorganic Fertilizers and Organic Manures on Physio-Chemical Properties of Soil in Cabbage (*Brassica Oleracea* L.) Var. Pusa Drumhead" comprise of a field experiment which was carried out at the Soil Science & Agricultural Chemistry Research Farm, Sam Higginbottom University of Agriculture Technology and Sciences Prayagraj during *Rabi* season Nov. 2021-Feb. 2022, which is located at 25˚24'30'' N latitude, 81˚51'10" E longitude and 98 m above the mean sea level. The detail of the experimental site, soil and climate is described in this chapter together with the experimental design, layout plan, cultural practice and techniques employed for the parameters. The area of Prayagraj district comes under subtropical belt in the South East Uttar Pradesh, which experience extremely hot summer and fairly winter. The maximum temperature of the location reaches up to 46 ˚C-48 ˚C and seldom falls as 4 ˚C-5 ˚C. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually. It comes under subtropical climate receiving the mean annual rainfall of about 1100 mm, major rainfall from July to end of September. However, occasional precipitation was also not uncommon during winter. The winter months were cold while summer months were very hot and dry. The minimum temperature during the crop season was to be 27.1 ˚C and the maximum is to be 39.94 ˚C. The minimum humidity was 57.70% and maximum was to be 75.37%.
Experiment will be laid out in randomized block design with three levels of NPK, Zinc and FYM. Plot size was 2 x 2 m^2 for crop seed rate is 650 g ha^{-1} in cabbage (*Brassica Oleracea* L.) Var. Pusa Drumhead. Basal dose of fertilizer was applied in respective plots according to treatment allocation uniform furrows opened by about 5 cm. All the agronomic practices were carried out uniformly to raise the crop. The crop was harvested on February.

Table 1: Treatment combination for cabbage crop.

Treatment	Treatment combination
T_1	Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)
T_2	NPK @ 0% + Zn @ 50% + FYM @ 50%
T_3	NPK @ 0% + Zn @ 100% + FYM @ 100%
T_4	NPK @ 50% + Zn @ 0% + FYM @ 0%
T_5	NPK @ 50% + Zn @ 50% + FYM @ 50%
T_6	NPK @ 50% + Zn @ 100% + FYM @ 100%
T_7	NPK @ 100% + Zn @ 0% + FYM @ 0%
T_8	NPK @ 100% + Zn @ 50% + FYM @ 50%
T_9	NPK @ 100% + Zn @ 100% + FYM @ 100%

Results and Discussion

Bulk density (Mg m^{-3})

The result of data depicted Table 2 and Fig. 1 clearly shows the response of bulk density of soil was recorded as influenced by different levels of inorganic fertilizer, and organic manure. The maximum bulk density of soil was recorded 1.52 Mg m^{-3} in T_9 (NPK @ 100% + Zn @ 100% + FYM @ 100%) followed by 1.45 Mg m^{-3} in T_8 (NPK @ 100% + Zn @ 50% + FYM @ 50%) and 1.42 Mg m^{-3} in T_6 (NPK @ 50% + Zn @ 100% + FYM @ 100%) and the minimum bulk density of soil was recorded 1.20 Mg m^{-3} in T_1 [Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)] respectively. Similar result has been recorded by Asomah *et al*., (2021) [2] and Ray *et al*., (2018) [11].

Particle density (Mg m^{-3})

The result of data depicted Table 2 and Fig. 1 clearly shows the response of bulk density of soil was recorded as influenced by different levels of inorganic fertilizer, and organic manure. The maximum particle density of soil was recorded 2.67 Mg m^{-3} in T_1 [Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)] followed by 2.61 Mg m^{-3} in T_2 (NPK @ 0% + Zn @ 50% + FYM @ 50%) and 2.58 Mg m^{-3} in T_4 (NPK @ 50% + Zn @ 0% + FYM @ 0%) and the minimum particle density of soil was recorded 2.50 Mg m^{-3} in T_9 (NPK @ 100% + Zn @ 100% + FYM @ 100%) respectively. Similar result has been recorded by Asomah *et al*., (2021) [2] and Ray *et al*., (2018) [11].

% Pore space

The result of data depicted Table 2 and Fig. 1 clearly shows the response of (%) pore space of soil was recorded as influenced by different levels of inorganic fertilizer, and organic manure. The maximum (%) pore space of soil was recorded 46.87% in T_9 [NPK @10 0% + Zn @ 100% + FYM @ 100%)] followed by 45.49% in T_8 (NPK @ 100% + Zn @ 50% + FYM @ 50%) and 44.56% in T_6 (NPK @ 50% + Zn @100% + FYM @ 100%) and the minimum (%) pore space of soil was recorded 38.32% in T_1 [Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)] respectively. Similar result has been recorded by Asomah *et al*., (2021) [2] and Ray *et al*., (2018) [11].

Water holding capacity (%)

The result of data depicted Table 2 and Fig. 1 clearly shows the response of water holding capacity (%) of soil was recorded as influenced by different levels of inorganic fertilizer, and organic manure. The maximum water holding capacity (%) of soil was recorded 46.87% in T_9 [NPK @100% + Zn @ 100% + FYM @ 100%)] followed by

45.49% in T_8 (NPK @ 100% + Zn @ 50% + FYM @ 50%) and 44.56% in T_6 (NPK @ 50% + Zn @100% + FYM @ 100%) and the minimum water holding capacity (%) of soil was recorded 38.32% in T_1 [Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)] respectively. Similar result has been recorded by Asomah *et al*., (2021) [2] and Ray *et al*., (2018) [11].

Table 2: Response of inorganic fertilizer and organic manure on bulk density (Mg m^{-3}), particle density (Mg m^{-3}), % pore space and water holding capacity (%) of soil.

Treatments		Bulk density (Mg m^{-3})	Particle density (Mg m^{-3})	% Pore space	Water holding capacity (%)
T_1	Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)	1.20	2.67	38.32	30.57
T_2	NPK @ 0% + Zn @ 50% + FYM @ 50%	1.26	2.61	40.62	32.18
T_3	NPK @ 0% + Zn @ 100% + FYM @ 100%	1.32	2.57	41.85	33.42
T_4	NPK @ 50% + Zn @ 0% + FYM @ 0%	1.28	2.58	39.44	31.89
T_5	NPK @ 50% + Zn @ 50% + FYM @ 50%	1.36	2.57	42.50	35.72
T_6	NPK @ 50% + Zn @ 100% + FYM @ 100%	1.42	2.61	44.56	37.29
T_7	NPK @ 100% + Zn @ 0% + FYM @ 0%	1.39	2.54	43.28	36.82
T_8	NPK @ 100% + Zn @ 50% + FYM @ 50%	1.45	2.51	45.49	38.42
T_9	NPK @ 100% + Zn @ 100% + FYM @ 100%	1.52	2.50	46.87	39.62

pH (1:2.5) w/v

The result of data depicted Table 3 and Fig. 2 clearly shows the response of pH of soil was recorded as influenced by different levels of inorganic fertilizer, and organic manure. The maximum pH of soil was recorded 7.38 in T_9 [NPK @10 0% + Zn @ 100% + FYM @ 100%)] followed by 7.29 in T_8 (NPK @ 100% + Zn @ 50% + FYM @ 50%) and 7.16 in T_7 (NPK @ 100% + Zn @ 0% + FYM @ 0%) and the minimum pH of soil was recorded 6.50 in T_1 [Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)] respectively. The mean value of soil pH was found non-significant Sarma *et al*., (2011) [13], Kedino *et al*., (2009) [7] and Narsimha *et al.*, (2013) [10].

Electrical conductivity (dSm^{-1})

The result of data depicted Table 3 and Fig. 2 clearly shows the response of electrical conductivity (dSm^{-1}) of soil was recorded as influenced by different levels of inorganic fertilizer, and organic manure. The maximum electrical conductivity (dSm^{-1}) of soil was recorded 0.62 dSm^{-1} in T_9 [NPK @10 0% + Zn @ 100% + FYM @ 100%)] followed by 0.58 dSm^{-1} in T_8 (NPK @ 100% + Zn @ 50% + FYM @ 50%) and 0.52 dSm^{-1} in T_7 (NPK @ 100% + Zn @ 0% + FYM @ 0%) and the minimum electrical conductivity (dSm^{-1}) of soil was recorded 0.32 dSm^{-1} in T_1 [Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)] respectively. The mean value of soil electrical conductivity (dSm^{-1}) was found significant Sarma *et al*., (2011) [13], Kedino *et al*., (2009) [7] and Narsimha *et al*., (2013) [10].

Organic Carbon (%)

The result of data depicted Table 3 and Fig. 2 clearly shows the response of organic carbon (%) of soil was recorded as influenced by different levels of inorganic fertilizer, and organic manure. The maximum organic carbon (%) of soil was recorded 0.72% in T_9 [NPK @10 0% + Zn @ 100% + FYM @ 100%)] followed by 0.68% in T_8 (NPK @ 100% + Zn @ 50% + FYM @ 50%) and 0.66% in T_6 (NPK @ 50% + Zn @ 100% + FYM @ 100%) and the minimum organic carbon (%) of soil was recorded 0.55% in T_1 [Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)] respectively. The mean value of soil organic carbon (%) was found significant Sarma *et al*., (2011) [13], Kedino *et al*., (2009) [7] and Narsimha *et al.*, (2013) [10].

Table 3: Response of inorganic fertilizer and organic manure on pH (1:2.5) w/v, EC (dSm^{-1}) and organic carbon (%) of soil.

Treatments		pH (1:2.5) w/v	EC (dSm^{-1})	Organic carbon (%)
T_1	Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)	6.50	0.32	0.55
T_2	NPK @ 0% + Zn @ 50% + FYM @ 50%	6.56	0.38	0.58
T_3	NPK @ 0% + Zn @ 100% + FYM @ 100%	6.62	0.42	0.60
T_4	NPK @ 50% + Zn @ 0% + FYM @ 0%	6.58	0.36	0.56
T_5	NPK @ 50% + Zn @ 50% + FYM @ 50%	6.88	0.45	0.64
T_6	NPK @ 50% + Zn @ 100% + FYM @ 100%	7.02	0.47	0.66
T_7	NPK @ 100% + Zn @ 0% + FYM @ 0%	7.16	0.52	0.65
T_8	NPK @ 100% + Zn @ 50% + FYM @ 50%	7.29	0.58	0.68
T_9	NPK @ 100% + Zn @ 100% + FYM @ 100%	7.38	0.62	0.72

Available Nitrogen (kg ha^{-1})

The result of data depicted Table 4 and Fig. 3 clearly shows the response of available Nitrogen (kg ha^{-1}) of soil was recorded as influenced by different levels of inorganic fertilizer, and organic manure. The maximum available Nitrogen (kg ha^{-1}) of soil was recorded 332.45 kg ha^{-1} in T_9 [NPK @100% + Zn @ 100% + FYM @ 100%)] followed by 328.29 kg ha^{-1} in T_8 (NPK @ 100% + Zn @ 50% + FYM @ 50%) and 325.88 kg ha^{-1} in T_6 (NPK @ 50% + Zn @ 100% + FYM @ 100%) and the minimum available Nitrogen (kg ha^{-1}) of soil was recorded 310.18 kg ha^{-1} in T_1 [Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)] respectively. The mean value of soil available Nitrogen (kg ha^{-1}) was found significant Ghuge *et al*., (2007) [4], Herencia *et al*., (2011) [6] and Sable *et al*., (2007) [12].

Available Phosphorus (kg ha^{-1})

The result of data depicted Table 4 and Fig. 3 clearly shows the response of available phosphorus (kg ha^{-1}) of soil was recorded as influenced by different levels of inorganic fertilizer, and organic manure. The maximum available phosphorus (kg ha^{-1}) of soil was recorded 35.75 kg ha^{-1} in T_9

[NPK @100% + Zn @ 100% + FYM @ 100%)] followed by 32.16 kg ha^{-1} in T_8 (NPK @ 100% + Zn @ 50% + FYM @ 50%) and 31.29 kg ha^{-1} in T_7 (NPK @ 100% + Zn @ 0% + FYM @ 0%) and the minimum available phosphorus (kg ha^{-1}) of soil was recorded 310.18 kg ha^{-1} in T_1 [Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)] respectively. The mean value of soil available phosphorus (kg ha^{-1}) was found significant Ghuge *et al*., (2007) [4], Herencia *et al*., (2011) [6] and Sable *et al*., (2007) [12].

Available Potassium (kg ha^{-1})

The result of data depicted Table 4 and Fig. 3 clearly shows the response of available potassium (kg ha^{-1}) of soil was recorded as influenced by different levels of inorganic fertilizer, and organic manure. The maximum available potassium (kg ha^{-1}) of soil was recorded 219.54 kg ha^{-1} in T_9 [NPK @100% + Zn @ 100% + FYM @ 100%)] followed by 215.78 kg ha^{-1} in T_8 (NPK @ 100% + Zn @ 50% + FYM @ 50%) and 210.86 kg ha^{-1} in T_7 (NPK @ 100% + Zn @ 0% + FYM @ 0%) and the minimum available potassium (kg ha^{-1}) of soil was recorded 195.42 kg ha^{-1} in T_1 [Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)] respectively. The mean value of soil available potassium (kg ha^{-1}) was found significant Ghuge *et al*., (2007) [4], Herencia *et al*., (2011) [6] and Sable *et al*., (2007) [12].

Available Zinc (mg kg^{-1})

The result of data depicted Table 4.1.11 and Fig. 4.1.11 clearly shows the response of available zinc (mg kg^{-1}) of soil was recorded as influenced by different levels of inorganic fertilizer, and organic manure. The maximum available zinc (mg kg^{-1}) of soil was recorded 0.62 mg kg^{-1} in T_9 [NPK @100% + Zn @ 100% + FYM @ 100%)] followed by 0.60 mg kg^{-1} in T_8 (NPK @ 100% + Zn @ 50% + FYM @ 50%) and 0.59 mg kg^{-1} in T_6 (NPK @ 50% + Zn @ 100% + FYM @ 100%) and the minimum available zinc (mg kg^{-1}) of soil was recorded 0.52 mg kg^{-1} in T_1 [Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)] respectively. The mean value of soil available zinc (mg kg^{-1}) was found significant Ghuge *et al*., (2007) [4], Herencia *et al*., (2011) [6] and Sable *et al*., (2007) [12].

Table 2: Response of inorganic fertilizer and organic manure on available nitrogen (kg ha^{-1}), available phosphorus (kg ha^{-1}), available potassium (kg ha^{-1}) and available zinc (mg kg^{-1}) of soil.

Treatments		Available Nitrogen (kg ha^{-1})	Available Phosphorus (kg ha^{-1})	Available Potassium (kg ha^{-1})	Available Zinc (mg kg^{-1})
T_1	Control (NPK @ 0% + Zn @ 0% + FYM @ 0%)	310.18	25.62	195.42	0.52
T_2	NPK @ 0% + Zn @ 50% + FYM @ 50%	315.2	27.18	198.72	0.54
T_3	NPK @ 0% + Zn @ 100% + FYM @ 100%	318.51	29.52	201.62	0.56
T_4	NPK @ 50% + Zn @ 0% + FYM @ 0%	316.72	26.61	197.75	0.55
T_5	NPK @ 50% + Zn @ 50% + FYM @ 50%	320.54	28.72	203.28	0.57
T_6	NPK @ 50% + Zn @ 100% + FYM @ 100%	325.88	30.54	208.45	0.59
T_7	NPK @ 100% + Zn @ 0% + FYM @ 0%	323.72	31.29	210.86	0.58
T_8	NPK @ 100% + Zn @ 50% + FYM @ 50%	328.29	32.16	215.78	0.60
T_9	NPK @ 100% + Zn @ 100% + FYM @ 100%	332.45	35.75	219.54	0.62

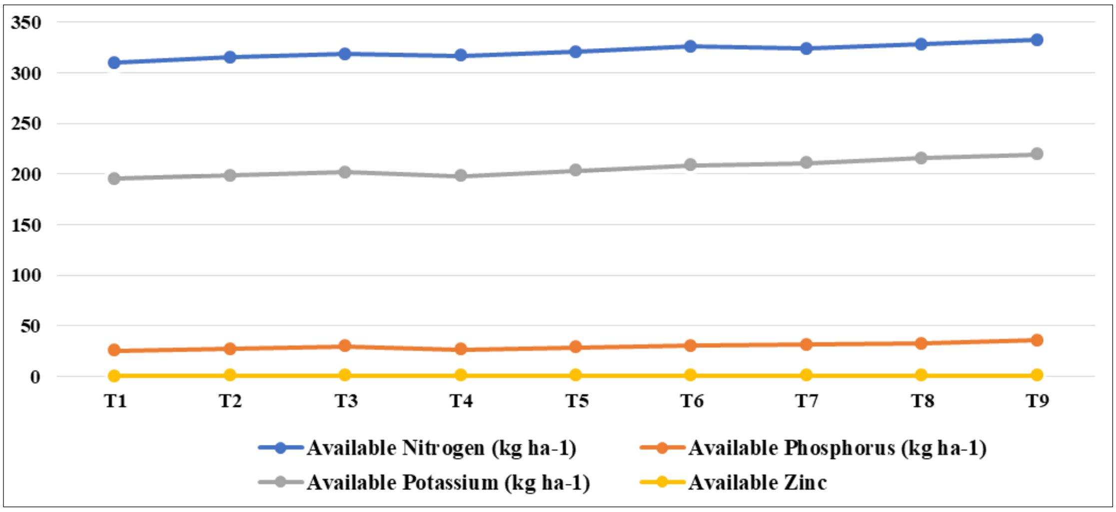

Fig 3: Response of inorganic fertilizer and organic manure on available nitrogen (kg ha^{-1}), available phosphorus (kg ha^{-1}), available potassium (kg ha^{-1}) and available zinc (mg kg^{-1}) of soil.

Conclusion

From trial it was concluded that the various level of inorganic fertilizer and organic manures used from different sources fertilizers [*i.e.* Urea (N 46%), + SSP (16 P_2O_5) + MOP 60% K_2O)] in the experiment gave the best result in the treatment T_9 (NPK @ 100% + Zn @ 100% + FYM @ 100%) followed by treatment T_8, in T_9 the soil health parameters retained the suitable soil properties, yield attributes and yield of Cabbage and gave highest net profit of 262003.60 ₹ ha^{-1} with highest cost benefit ratio is 1:3.63. Therefore, it can be recommended for farmers to obtain best combination Treatment (T_9) for higher farm income and sustainable agriculture.

Acknowledgements

The authors are grateful to the Hon'ble Vice chancellor SHUATS, Department of Soil Science and Agricultural Chemistry, Naini Agriculture Institute, for taking their keen interest and encouragement to carry out the research work.

References

1. Asati KP, Badaya AK, Gathiye GS. Adoption behaviour of vegetable growers towards improved technologies in Madhya Pradesh. Progressive Research. 2013;8:455-457.
2. Asomah S, Anankware JP, Adjei RR. Impact of organic and inorganic fertilizers on the growth and yield of cabbage in Ghana. International Journal of Horticultural Science. 2021;27:46-49.
3. Bansal SK, Imas P, Nachmansohn J. Response of Cabbage to Potash Fertilization in Field Plot Trials Conducted in Jammu & Kashmir, West Bengal and Maharashtra. Indian Journal of Fertilisers. 2020;16(7):708-716.
4. Ghuge TD, Jadhav SB, Gore AK. Effect of organic and inorganic sources of nutrients on uptake and nutrient availability of soil after harvesting of cabbage. Journal of Soils and Crops. 2007;17:294-298.
5. Hasan MR, Solaiman AHM. Efficacy of organic and organic fertilizer on the growth of cabbage (*Brassica oleracea* L.). International Journal of Agriculture and Crop Sciences. 2012;4(3):128-138.
6. Herencia JF, Pedro AG, Jose ARD, Maqueda C. Comparison of nutritional quality of the crops grown in an organic and conventional fertilized soil. *Scientia Horticulturea*. 2011;30:1-7.
7. Kedino Z, Kanaujia SP, Singh VB, Singh PK. Effect of organic manures and biofertilizers on growth, yield, quality of cabbage (*Brassica oleracea* var. *capitata*) under foot hill condition of Nagaland. Environment and Ecology. 2009;27(3):1127-1129.
8. Khan RS, Ahmed S, Khan F, Ahmed M, Zaman, Khan AB. Effect of different levels of nitrogen, phosphorus and potassium on the growth and yield of cabbage. Asian Journal of Plant Sciences. 2002;1:548-549.
9. MoFA. Ministry of Food and Agriculture, 2008. https//www.mofa.gov.gh
10. Narsimha A, Singh P, Singh RS. Reported the apparent electrical conductivity of the soil and water profile. Der chemical sinica. 2013;4(2):25-31.
11. Ray PK, Adarsh A, Chaudhary A. Effect of organic and inorganic fertilizers on yield and economics of cabbage (*Brassica oleracea* var. *capitata*). Journal of Pharmacognosy and Phytochemistry. 2018;7(5):1967-1970.
12. Sable PB, Bhamare VK. Effect of biofertilizers (AZB and *Azospirillum*) alone and in combination reduces levels of nitrogen and quality of cauliflower cv. Snowball-16. Asian Journal of Horticulture. 2007;2:215-217.
13. Sarma I, Phookan DB, Boruah S. Effect of organic manures and bio-fertilizer on yield and economics of Cabbage (*Brassica oleracea* var. *capitata*.). Journal of Eco-friendly Agriculture. 2011;6(1):6-9.
14. Silva AA. Jr. Mineral and organic fertilizing in cabbage. Commercial quality and the occurrence of Xanthomonas campestris cv. Campestris. Hort. Bras. 1986;4(2):10-12.
15. Trani R, Power JF. Soil Fertility Management for Sustainable Agriculture. Lewis Publishers in an Imprint of CRC Press, 1997.