The Pharma Innovation Journal 2022; 11(5): 2189-2193

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(5): 2189-2193

www.thepharmajournal.com
Received: 16-03-2022
Accepted: 26-04-2022

Hari Sudheer Reddy YR
M.Sc. Department of Soil Science and Agriculture Chemistry, School of Agriculture, Lovely professional university, Jalandhar, Punjab, India

Pallerla Vishnu
M.Sc. Department of Soil Science and Agriculture Chemistry, School of Agriculture, Lovely professional university, Jalandhar, Punjab, India

Bitra Yasasvi
M.Sc. Department of Soil Science and Agriculture Chemistry, School of Agriculture, Lovely professional university, Jalandhar, Punjab, India

Dr. Nitin Madan Changade
Assistant Professor, Department of Soil Science and Agriculture Chemistry, School of Agriculture, Lovely professional university, Jalandhar, Punjab, India

Corresponding Author:
Dr. Nitin Madan Changade
Assistant Professor, Department of Soil Science and Agriculture Chemistry, School of Agriculture, Lovely professional university, Jalandhar, Punjab, India

Effect on soil fertility under different cropping sequences, irrigation levels and fertilizer doses: A review

Hari Sudheer Reddy YR, Pallerla Vishnu, Bitra Yasasvi and Dr. Nitin Madan Changade

Abstract
Soil fertility plays a leading role in agriculture that can be maintained or impacted by the various sequences of crops, levels of fertilizers and irrigation. The chemical properties of the soil, such as pH, Electrical Conductivity (E.C), Organic carbon, N_2, P_2O_5, K_2O were altered according to the condition of soil quality, which can supply the required dose of fertilizers, suitable cropping patterns and sequences have favourable impact on soil's quality and health, which aids in giving valuable nutrients to crop production. Optimum levels of irrigation with a good water or properly recycled water can be used to maintain the fertility of soil N_2 is subjected to heavy leaching losses over-irrigation levels. Excess doses of fertilizers applied to lead to a negative impact on soil properties, low levels of fertilizer applications lead to a negative impact on crop yields, soil health and crop production. In this review, we have highlighted the impact of various cropping sequences, irrigation levels and fertilizer doses on the fertility status of the soil. The soil pH, EC (Electric Conductivity), OC and NPK show positive and negative impacts on soil which may lead to an increase or decreases the soil fertility.

Keywords: Cropping sequences, soil fertility, irrigation, fertilizer doses, soil, crop production

Introduction
Soil fertility is the capability of soils to support agricultural plant growth and development (IFDC, 2010) [10]. i.e., can provide habitats and result in continuous & increased yield of crops (Sishekanu *et al.*, 2015) [28]. The chemical, physical and biological components of soil interact in complicated and sometimes poorly understood ways to determine a soil's productive capability. Good practices of farm try to control the different components that comprise every one of these attributes to maximize or increases agricultural production and minimize environmental impact.

Importance of soil fertility
The fertile soil is required for the development of plants and produces food that has all the nutrients required for human health. A fertile soil also significantly influences economic activity, growth, and poverty reduction. The lack of intelligence and incorrect method of supplying nutrients, combined with limited use of organic substances, has resulted in soil that is not only insufficient in fertilizers, and bad soil quality, leading to a decrease in agricultural response to suggested fertilizer dosage and favourable remaining impacts on soil fertility maintenance.

It is mostly related to the disposal of agricultural wastes during farming activities, poor fertilizer levels, utilization of waste and plant residues as a resource of fuel and fodder as well as an absence of proper soil conservation methods and cropping patterns (Haileslassie *et al.*,2006) [9]. As a result, reducing soil nutrient loss is today’s key problem and a country's major issue. In the agricultural system, the nutrient status of the soil is severely confined by the limited use of natural and chemical fertilizers, as well as nutrient loss mostly owing to leaching and runoff. (Tulema B. *et al.*, 2007) [32].

According to Seyoum B., (2016) [24] the change of ecological systems into cultivation land ecosystems has led to soil resource scarcity. Most of the physicochemical characteristics of soil inside the research area are significantly altered by the various land uses. Especially, the level of soil pollution was high over agricultural land, leads to low cultivable level to avoid it, proper planning should take to control or restore the soil quality.”

Influence on traditional as well as new farming techniques in agro-systems upon soil properties, development of such combination like microbes – plant - soil as well as biosynthetic processes are essential to crop production for agricultural demand, and the important aspects presently used for analyzing of soil, & concerns in ecosystems that also have the high impact on soil fertility, especially affected response to human activities on cropping systems. This information, together with the essential regulations, can aid in the preservation of good soil (Tony Yang *et al*., 2020) [31].

The main aim of this review paper is to observe the impact on soil fertility under different cropping sequences, irrigation levels, and fertilizer doses.

Impact on soil fertility under different cropping sequences: Rotation of crops is developed to increase production from agriculture, however intensive farming had grown worried with farming techniques' ecological responsibility (Fargione *et al.*, 2018) [6]. Crop production systems, involving conservation agriculture, mixed cropping, and strip cropping, as well as allied agricultural activities, get influence the fertility of the soil (Vukicevich *et al*., 2016) [35].

S. Porpavai *et al.*, 2011 [19] investigated cropping sequences of rice, black gram, green gram, sesamum, onion, okra, groundnut, and radish from 2002 to 2006 under Kharif, rabi and summer seasons to know the impact of soil properties. Evaluated the cropping system through productivity, OC and NPK availability and stated a positive significance on soil organic carbon, available N_2 through legume crops, which increases the yield of rice with improved soil fertility gradually increased.

The current study looked at the impact of crop patterns on land nutrient content, agricultural production, water usage, and economic benefits. Cropping sequences had a good influence on the soil's fertility value. The soil accessible N_2 level was observed to exhibit a growing tendency over the soil surface quantity, however, the variance among growing sequences was statistically negligible because of changes inside the successive plants' deleting patterns of available N (Tamilezhai *et al*, 2018) [30]. Along with the significant improvement seen in P and K.

Chary G R *et al.*, 2016 [3] experimented with the impact of various cropping sequences and different nutrient management on the soil quality indices. They revealed the results as the cropping sequences with cotton-cotton showed the higher performance with 1.06 and lower in sesamum-cotton & sesamum-groundnut with 0.89. Available Nitrogen is maximum in sole organic sources with 197.9 kg N ha^{-1}, Cotton-groundnut cropping sequence provided the highest available phosphorus at the rate of 24.72 kg P ha^{-1} and maximum available potassium is found in the cotton-cotton cropping sequence with 449.1 kg K ha^{-1} in comparison to control, INM, RDF and sole organic nutrients.

Gobinder Singh *et al.*, 2016 [8] stated that physiochemical qualities of soil influence the cropping pattern of the region, as well as the elemental composition of the soil, alter when the cropping sequence shifts. Soil properties testing criteria revealed just the amount of nutrients available in the soil. As a result, plant analysis & practical experiments on crop nutrient requirements must be conducted to provide exact recommendations on soil management for supporting various cropping sequences in the research region.

Soil quality control is critical to the sustainability of agricultural systems. The current study aims to determine adequate nutrient levels in farmed soil within maize + wheat and paddy + wheat farming sequence in the outer Himalayas in HP. Based on conventional Navigation soil sampling, composite surface soil samples were from thirty-eight and fifteen typical locations, accordingly, representing soil during maize-wheat & paddy-wheat farming cycles. In 2016-2017, 6 to 8 topsoil samples were taken on farmland to create a homogenous mixture (Gazala Nazir *et al*, 2020) [17].

Table 2: Impact of the fertility of the soil by cropping sequence and fertilizer dose showing values of soil parameters.

S. No	Crop sequence	Fertilizer doses	Soil parameters						Soil type	References
			pH	EC	OC	N	P	K		
01	Rice - wheat	100% NPK + 5t FYM	7.9	0.32	0.56	132	26.7	269	Silty loam	Mahajan, A., & Gupta, R. D. 2009 [16].
02.	Rice - wheat	100% NPK + 5t FYM	7.7	0.27	0.82	140	27	178	Silty clay	Saha, S., *et al*.,2019 [21]
03.	Rice - wheat	100% NPK + 5t FYM	7.3	0.26	0.46	173	16.8	164	Alluvial soil	Kakraliya, S. K *et al.* 2017 [13]
04.	Rice - wheat	100% NPK + 5t FYM	8.1	0.32	3.1	230	43.3	160	Sand loamy	Sandhu, P., *et al.*,2020 [22]

The application of mixed fertilizer also showed significant effect on soil properties. The researcher applied 100% RDF along with 5 t FYM and observed the variation in soil chemical properties, it could be due to the several types of soil (as shown in table 2). Mahajan and Gupta (2009) [16] observed the neutral soil pH, safe electrical conductivity and higher potassium content when followed the crops sequences (Rice-wheat) and grown in silty loam soil.

Impact on soil fertility under different irrigation levels

Over-irrigation of soil might occur because of poor dispersal uniformity or control, which polluted water, and chemicals and might even result in water contamination. more irrigation might lead to extensive draining by an increase in water levels, which could bring to irrigated saline issues which necessitate process is as follows management a by a certain type of surface drainage. Singh *et al.*, 2018 [27] studied the responses of various irrigations and dosages of fertilizers to the growth and yield parameters of wheat. Investigator noticed that maximum plant height, a greater number of tillers per plant, highest dry matter accumulation, leaf area index, maximum grain and straw yield were obtained significantly highest with four irrigations and fertilizers applied at the rate of 125% RDF compared with 1, 2 irrigations and 75%, 100% RDF.

Related the physical qualities following irrigated agriculture were a little more varied in moderate and sub-humid settings. Few research found that water supply flow improved, whereas others found minor differences. The impacts of water expansion upon physical traits on soil in current agroecosystems to increase operational, administration, geographical, & time - series are examples of knowledge gaps (John J. Drewry *et al*., 2021) [11].

Kadasiddappa *et al*., 2018 [12] Reduce the problem of water scarcity in agricultural production, wastewater reuse is among the greatest alternatives to uncontrolled do with important commodities. The use of such technological advancements supported by scientific understanding would undoubtedly increase agricultural yield, and irrigation management, and contribute to the preservation of soil properties in suitable conditions.

Xiukang Wang *et al.*, 2016 [36] stated that irrigation level @ 75% ET_0 is suitable for tomato crops along with nitrogen use efficiency which is better than @ 100% ET_0. Avoid leaching of N_2 from soil and increase the yield and comparing with other irrigation levels. Drip irrigation and fertilizer treatment have also been observed to improve nutrient levels both in soil and plants compare to surface irrigation, implying that balanced fertilization is essential for optimal stevia plant growth, production, & nutrition (Behera, M.S *et al*., 2013) [1].

Kumar *et al.*, (2013) [15] experimented in rabi season at Raipur with twenty-five treatments including five irrigation levels and five nitrogen levels through fertigation. Maximum plant height and a maximum number of leaves per plant ware noted at 150% RDF and drip at 100% PE. Maximum yield (30.60 t ha^{-1}) was recorded at 150% RDN (Recommended Dose of Nitrogen) @ 29.71 t ha^{-1} and drip at 100% PE. The maximum uptake of Nitrogen, Phosphorus and potassium are 296.22 kg ha^{-1}, 26.90 kg ha^{-1} & 309.74 kg ha^{-1} were observed at fertigation with 150 percent of the recommended dose of nitrogen. Highest water use efficiency (WUE) was recorded with application of drip irrigation @ 40% PE (9.80 q ha^{-1} cm^{-1}) over furrow irrigation @ 1.2 Iw/CPE (8.08 q ha^{-1} cm^{-1}).

Sturm *et al.*, (2010) experimented on the white cabbage crop by broadcast application and fertigation with tank sprinkler and drip irrigation on uptake of nitrogen, nitrate content and yield in sandy loam soil. The maximum yield (93 t ha^{-1}), plant nitrogen uptake (246 kg ha^{-1}), and fertilizer use efficiency (42%) were observed in the combination with broadcast fertilization and tank sprinkler irrigation. After harvest, the N reserve was 41 kg ha^{-1}, revealing the least probability for Nitrogen removal. Although fertigation and drip irrigation providing 100% of the crop's water requirements did not achieve the greatest yield (72 t ha^{-1}), the N surplus post-harvest was approximately +38 kg ha^{-1}. The treatment with broadcast fertilization and drip irrigation meeting 50% of the crop's water demand had the minimum yield (58 t ha^{-1}), fertilizer use efficiency (30%), and thus the maximum possibility for N losses (N surplus post-harvest +68 kg ha^{-1}).

Pooja rani *et al.*, (2021) [18] experimented on onion crops for two years on sandy loam soil to know the uptake of nutrients can be increased by the drip fertigation at Hisar. The treatment with drip irrigation at 100% CPE along with RDN (Recommended dose of Nitrogen) 125 kg ha^{-1} increased the uptake of nitrogen, phosphorus and potassium @ 187.44 & 196.48 kg N $ha^{-1,}$ 44.30 & 61.86 kg P ha^{-1} and 211.83 & 226.68 kg P ha^{-1}. The drip N fertigation did not affect the nutrient availability after harvest of onion crop in soil when compared to respective drip irrigation and N fertigation application.

Impact on soil fertility under different fertilizer doses

An investigation of the availability of soil nutrients and crop yield on acid alfisol under regular application of chemical fertilizers and amendments after 36 years in Palampur, Himachal Pradesh, results show that a negative impact on pH (5.8 to 4.58) and decline in nitrogen and a positive impact on soil organic carbon, available P_2O_5 and potassium. More use of chemical fertilizers has a long-term negative impact on soil physicochemical properties, which may damage soil health. The combination of amendments with fertilizers will minimize the usage of inorganic inputs and gives an increase in crop yields (Shambhavi *et al*., 2017) [25].

Essential nutrients are provided through fertilizers improving crops quicker and producing additional grain. on the other side, excess fertilizers may be a concern as it causes emissions of greenhouse gases like N_2O and leads to the loss of aquatic species due to the o growth of toxic algal blooms (which releases harmful chemical). Researchers are now working to develop ways to minimize the quantity of fertilizer required without compromising agricultural production (Sedlacek *et al*., 2020) [23].

M Rao *et al.*, 2017 experimented on rice crops by supplying a combination of organic and chemical fertilizers to know the NPK nutrient uptake by rice plants. 100% RDF + 10 t ha^{-1} FYM (farmyard manure) shows an increase significantly followed by green manuring, vermicompost and control in NPK uptake.

On a long-term premise, the use of chemical fertilizers in combining with organic manures can increase soil health & increasing agricultural output (Baradhan and Suresh Kumar, 2018) [27]. The distribution of varied dosages of organic wastes or fertilizers was not shown to be advantageous in the yield characteristics or soil qualities. As a result, optimal dosages of fertilizers are necessary for long-term soil promoting health when using endowed with rich natural resources of fertilizer (Devkota, S *et al.*, 2021) [4].

There is still concern that its usage of inorganic fertilizers so over decades may have harmed soil nutrients. In continuous cultivation, the use of unbalance supplements via synthetic fertilizers could not only maintain the optimum amount of agricultural production; therefore, integrating chemical fertilizer with green manure not only endure crop yields but is also successful in developing soil quality & strengthening nutrient uptake (Dubey *et al*., 2012) [5].

Upinder Sharma *et al.*, (2014) [33] experimented on the maize-wheat system to reveal the impacts of using incessant chemical fertilizers and manures on soil fertility and productivity at CCHSAU, Hisar. The plots applied with FYM declined the bulk density (BD) and reduction in pH after 16 cropping cycles in all treatments. Apart from 100% nitrogen, all treatments enhanced the soil's organic carbon content (OC). Cation exchange capacity (CEC) improved in all treatments as compared to the soil's initial state. In most of the treatments, there was an increase in available N over the initial condition. In treatments where just Nitrogen was supplied alone or with FYM, available phosphorus (P) decreased from its original state. Except for 100 percent NPK, all treatments resulted in a decline in available potassium (K) status. In comparison to asymmetrical fertilizer application, regular application of FYM with symmetrical usage of inorganic fertilizers enhanced exchangeable calcium (Ca) and magnesium (Mg) levels over the initial state.

Table 1: Status of chemical properties under different fertilizers doses in carrot crop.

S. No	Crop	Fertilizer Doses	Soil parameters						Soil type	Reference
			pH	EC	OC	N	P	K		
01.	Carrot	50:40:50 NPK	6.5	-	0.27	206	26	220	Sandy loam	V. Shanu *et al.*, 2019 [26]
02.	Carrot	80:40:40 NPK	4.4	-	1.6	305	17	225	Sandy loam	S.P. Kanaujia 2019 [14]
03.	Carrot	50N+ 6 t vermicompost	6.28	0.307	2.4	135	24	79	Clay loam	Tadila Getaneh & Amare Mezgebu., 2019 [7]
04.	Carrot	50% NPK+ 50% Vermicompost	5.85	0.44	-	182	17.1	172	red lateritic	P. Biswas. *et al*., 2020 [2]

The various researcher studied the soil's chemical properties by growing carrots as shown in above table 1. The above table 01 shows that soil parameters are different for each soil, based on soil pH ranging from 4.4 to 6.5 indicates the acidic soil, OC from 0.27 to 2.4, nitrogen and potassium availability is high in 80:40:40, phosphorous shows more in 50:40:50. among all, carrot with 50 N + 6t vermicompost shows a good yield.

Conclusion:

The effect of soil fertility through cropping sequences helps to increase the soil nutrients availability to crops and provide sufficient nutrients and helps in the growth and development of crops with a positive impact. Providing excess amount of irrigation leads to negative impacts like loss of few nutrients due to leaching causes deficiency and less growth. The utilization of organic sources as fertilizers has a good impact on soil health and it also helps to avoid the loss of nutrients.

References

1. Behera MS, Verma Om, Mahapatra PK, Singandhupe Ramlal, Kumar Ashwani. Effect of irrigation and fertility levels on yield, quality, and economics of Japanese mint (*Mentha arvensis*) under drip irrigation system. Indian Journal of Agronomy. 2013;58:109-113.
2. Biswas P, Mahato B, Mahato DC, Rahman FH, Ghosh C. Effect of Vermicompost and Biochar on Growth and Yield of Carrot in Red Lateritic Soils of Purulia District of West Bengal. 2020.
3. Chary GR, Sharma KL, Reddy KS, Hirpara DS, Akbari KN, Lal M. Effect of Cropping Sequences and Nutrient Management Practices on Soil Quality under Rainfed Semiarid (Hot dry) Vertisol Soils of Western India. Indian Journal of Dryland Agricultural Research and Development. 2019;34(1):27-37.
4. Devkota S, Rayamajhi K, Yadav DR, Shrestha J. Effects of different doses of organic and inorganic fertilizers on cauliflower yield and soil properties. Journal of Agriculture and Natural Resources. 2021;4(2):11-20.
5. Dubey V, Patel AK, Shukla A, Shukla S, Singh S. Impact of continuous use of chemical fertilizer. International Journal of Engineering Research and Development. 2012;3(11):13-16.
6. Fargione JE, Bassett S, Boucher T, Bridgham SD, Conant RT, Cook-Patton SC. Natural climate solutions for the United States. Science Advances. 2018;4(11):eaat1869.
7. Getaneh T, Mezgebu A. Integrated effect of nitrogen and vermicompost levels on yield and yield components of carrot (*Daucus carota* L.) at Woreta, Northwestern Ethiopia. Journal of Horticulture and Forestry. 2019;11(6):97-103.
8. Gobinder Singh, Sharma M, Manan J, Singh G. Assessment of soil fertility status under different cropping sequences in District Kapurthala. Journal of Krishi Vigyan. 2016;5(1):1-9.
9. Haileslassie A, Priess JA, Veldkamp E, Lesschen JP. Smallholders' soil fertility management in the Central Highlands of Ethiopia: implications for nutrient stocks, balances, and sustainability of agroecosystems. Nutrient Cycling in Agroecosystems. 2006;75(1):135-146.
10. International Fertilizer Development Centre (IFDC). Integrated nutrient management. 2010.
11. John Drewry J, Sam Carrick, Nicole L, Mesman Peter. Almond, Karin Müller, Fiona L. Shanhun, Henry Chau. The effect of irrigated land-use intensification on the topsoil physical properties of pastoral silt loam. New Zealand Journal of Agricultural Research 0:0, 2021, 1-12.
12. Kadasiddappa MM, Rao VP. Irrigation scheduling through drip and surface methods-A critical review on growth, yield, nutrient uptake, and water use studies of rabi maize. Agricultural Reviews. 2018, 39(4).
13. Kakraliya SK, Jat RD, Kumar S, Choudhary KK, Prakash J, Singh LK. Integrated nutrient management for improving, fertilizer use efficiency, soil biodiversity and productivity of wheat in irrigated rice-wheat cropping system in Indo-Gangetic plains of India. International Journal of Current Microbiology and Applied Sciences. 2017;6(3):152-163.
14. Kanaujia SP. Integrated nutrient management on productivity of carrot and fertility of the soil. SAARC Journal of Agriculture. 2013;11(2):173-181.
15. Kumar P, Sahu RL. Effect of irrigation and fertigation levels on cabbage (*Brassica oleracea* var. *capitata* L.). Progressive Horticulture. 2013;45(2):366-372.
16. Mahajan A, Gupta RD. Integrated nutrient management (INM) in a sustainable rice-wheat cropping system. Dordrecht: Springer Netherlands. 2009.
17. Nazir G, Sharma VK, Suri D. Appraisal of soil fertility status in vegetable growing soils of the outer Himalayan region of Himachal Pradesh. Indian Journal of Ecology. 2020;47(4):989-991.
18. Pooja Rani, Batra VK, Bhatia AK, Sain V. Effect of water deficit and fertigation on nutrients uptake and soil fertility of drip-irrigated onion (*Allium cepa* L.) in the semi-arid region of India. Journal of Plant Nutrition. 2020;44(6):765-772.
19. Porpavai S, Devasenapathy P, Siddeswaran K, Jayaraj T. Impact of various rice-based cropping systems on soil fertility. Journal of cereals and oilseeds. 2011;2(3):43-46.
20. Rao Puli MR, Prasad PRK, Jayalakshmi M, Rao BS. Effect of organic and inorganic sources of nutrients on NPK uptake by rice crop at various growth periods. Research Journal of Agricultural Sciences. 2017;8(1):64-69.
21. Saha S, Saha B, Seth T, Dasgupta S, Ray M, Pal B. Micronutrients availability in the soil-plant system in response to long-term integrated nutrient management under the rice-wheat cropping system. Journal of Soil

Science and Plant Nutrition. 2019;19(4):712-724.
22. Sandhu PS, Walia SS, Gill RS, Dheri GS. Thirty-one years study of integrated nutrient management on Physico-chemical properties of soil under rice-wheat cropping system. Communications in Soil Science and Plant Analysis. 2020;51(12):1641-1657.
23. Sedlacek CJ, Giguere AT, Pjevac P. Is too much fertilizer a problem? Front Young Minds. 2020;8(63):1-5.
24. Seyoum B. Assessment of soil fertility status of Vertisols under selected three land uses in Girar Jarso District of North Shoa zone, Oromia national regional state, Ethiopia. Environmental Systems Research. 2016;5(1):1-16.
25. Shambhavi S, Kumar R, Sharma SP, Verma G, Sharma RP, Sharma SK. Long-term effect of inorganic fertilizers and amendments on productivity and root dynamics under maize-wheat intensive cropping in an acid Alfisol. Journal of Applied and Natural Science. 2017;9(4):2004-2012.
26. Shanu V, Lakshminarayana D, Prasanth P, Naik DS. Studies on the Influence of Integrated Nutrient Management (INM) on Quality Parameters and Economics of Carrot (*Daucus carota* L.) cv. Kuroda Improved under Southern Telangana Conditions. Int. J Curr. Microbiol. App. Sci. 2019;8(4):2792-2796
27. Singh Tejbal, Singh N, Kumar Pramod, Singh Sanjeev, Correspondence Tejbal Singh. Effect of different irrigation and fertility levels on dynamic growth and yield of late sown wheat (*Triticum aestivum* L.). IJCS. 2018;6(1):1523-1528.
28. Sishekanu M, Mabengwa M, Makungwe M, Gondwe B, Banda F, Siulemba G. Integrated Soil Fertility Management Training Manual for Zambian Agricultural Extension Workers. The Zambian Soil Health Consortium. 2015.
29. Šturm M, Kacjan-Maršić N, Zupanc V, Bračič-Železnik B, Lojen S. Effect of different fertilization and irrigation practices on yield, nitrogen uptake and fertilizer use efficiency of white cabbage (*Brassica oleracea* var. *capitata* L.). Scientia Horticulturae. 2010;125(2):103-109.
30. Tamilezhai A, Sekaran NC, Sudhalakshmi C. Effect of Different Cropping Sequences on Soil Nutrients Status, Nutrients Uptake and Crop Yield in PAP Command Area of Tamil Nadu. Madras Agricultural Journal. 2018, 105.
31. Tony Yang, Kadambot HM, Siddique Kui Liu. Cropping systems in agriculture and their impact on soil health-A review, Global Ecology and Conservation, 2020, 23.
32. Tulema B, Aune JB, Breland TA. Availability of organic nutrient sources and their effects on yield and nutrient recovery of tef [*Eragrostis tef (Zucc.) Trotter*] and soil properties. Journal of Plant Nutrition and Soil Science. 2007;170(4):543-550.
33. Upinder Sharma SS, Paliyal SP, Sharma Sharma GD. Effects of Continuous Use of Chemical Fertilizers and Manure on Soil Fertility and Productivity of Maize–Wheat under Rainfed Conditions of the Western Himalayas, Communications in Soil Science and Plant Analysis. 2014;45:20.
34. Verma R, Maurya BR, Meena VS, Dotaniya ML, Deewan P, Jajoria M. Enhancing Production Potential of Cabbage and Improves Soil Fertility Status of Indo-Gangetic Plain through Application of Bio-organics and Mineral Fertilizer. Int. J Curr. Microbiol. App. Sci. 2017;6(3):301-309.
35. Vukicevich E, Lowery T, Bowen P, Úrbez-Torres JR, Hart M. Cover crops to increase soil microbial diversity and mitigate the decline in perennial agriculture. A review. Agronomy for Sustainable Development. 2016;36(3):1-14.
36. Xiukang W, Yingying X. Evaluation of the effect of irrigation and fertilization by drip fertigation on tomato yield and water use efficiency in the greenhouse. International Journal of Agronomy, 2016.