Indian Journal of Ecology (2023) 50(2): 384-387
DOI: https://doi.org/10.55362/IJE/2023/3907

Manuscript Number: 3907
NAAS Rating: 5.79

Evaluation of Integrated Application of Organic and Inorganic Nutrient Sources on Growth and Nutrient Uptake by Cucumber (*Cucumis sativus* L.)

Saurabh Sharma, Jagjeet Chand Sharma, Yog Raj Shukla, Manisha Negi and Kapil Sharma

Department of Soil Science and Water Management
Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan-173 230, India
E-mail: lakhanpal9596@gmail.com

Abstract: The present study was carried out on cucumber cv. K-75 during *kharif* , 2018 and 2019. The experiment comprised of nine treatments of different nutrient sources including organic manures and inorganic fertilizers. The effects of organic manures (farmyard manure, vermicompost and jeevamrut) alone and in conjugation with inorganic fertilizers on growth, nutrient uptake of cucumber were observed. Integrated use of inorganic fertilizers and organic manure significantly influenced plant growth, yield and nutrient uptake by crop. The highest leaf area (394.3 cm^2), vine length (3.1 m), fruit weight (273.5 g) and NPK uptake (143.6, 31.2 and 153.4 kg ha^{-1}, respectively) was in. RDF + FYM @ 100 q ha^{-1}. Increment in NPK uptake under FYM @ 100 q ha^{-1} + Jeevamrut @ 5% was 52.7, 53.2 and 46.7% over control. The current study conclude that the better understanding of importance of integrated nutrient management could be a sustainable module in maintaining soil fertility thus enhancing nutrient uptake and enhanced soil health as evident by soil fertility status of soil after crop harvest.

Keywords: Cucumber, Nutrient sources, FYM, Vermicompost, Jeevamrut, Nutrient uptake

In the world production of cucumber in 2019 was around 87.8 million tonnes and in India was 1.9 lakh tonnes that makes this crop of utmost importance (FAO 2021). Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem, soil health, including biodiversity, biological cycles and soil biological activity. This is achieved by using agronomic, biological and mechanical methods, as opposed to use of synthetic materials to fulfill any specific function within the system (Bokhtiar et al 2008). The organic agriculture is a system that relies on ecosystem management rather than external agricultural inputs (Samman et al 2008). Nurturing effect of native farm produced products like Farm Yard Manure (FYM), Vermicompost (VC) and Jeevamrut supplement soil fertility by enhanced mineralization rate of soil nutrients and meager reports are available on soil microbial quality proving their potential (Amalraj et al 2013). FYM production is easily accessible with straw, cow dung and cow urine and apart from supplying nutrients it supplements the soil with improved physical conditions reveals good potential for its use (Ram et al 2016, Ali et al 2019). Vermicompost application stimulates soil microbial activity and their growth helps in mineralization of plant nutrients, soil aeration, water holding capacity and availability of plant nutrients eventually improves soil fertility (Gill et al 2019). Liquid manures like jeevamrut enhanced microbial activity in soil and ultimately ensure the availability and uptake of nutrients and producing plant growth promoting substances (Palekar 2006, Gore and Sreenivasan 2011, Ukale et al 2016). Integrated nutrient management (INM) refers to use of both the sources *i.e.*, organic and inorganic, for balancing fertility of soil and providing appropriate nutrient level to plants (Negi et al 2021) and helps to restore and sustain soil fertility and crop productivity also helps to check the emerging deficiency of nutrient other than N, P and K (Sachan et al 2017). The main aim of INM is to minimize the use of chemical fertilizers without immolating the yield (Singh et al 2020). Farmers have experienced significant financial losses as a result of the widespread nutrient deficiency that has developed in soil as a result of intense cropping and deterioration of soil health due to excessive use of synthetic fertilizers (Negi et al 2022a). The conjunctive use of different organic sources improve soil health and helps in maximizing production as it involves utilization of local sources and hence, turned to be rational, realistic and economically viable way of supplying nutrients to crop (Singh and Pandey 2010). The purpose of this investigation were to investigate the impact of different nutrient sources on crop growth find out the changes in nutrient uptake by cucumber under the influence of different manures and fertilizers.

MATERIAL AND METHODS

Study area: The experiment was conducted at Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan (HP). It is located at 30° 52´ N latitude and 77° 11´ E longitude and at an elevation of 1175 m above mean sea level with an average slope of 7-8 per cent for two consecutive years *i.e.* 2018–19 and 2019–20. Experiment was laid out in a randomized block design with three replications comprising nine treatments (Table 1).

Recommended dose of fertilizers for cucumber is N 100, P 50 and K 60 kg ha^{-1}. Nitrogen, Phosphorus and Potassium were used as inorganic fertilizers in the form of urea, single super phosphate (SSP) and muriate of potash (MOP), respectively. In the inorganic plots, whole quantity of FYM, SSP and MOP fertilizers were applied at the time of field preparation, whereas, urea was applied in three split doses with half as basal dose and remaining quantity of N was applied in two equal splits at monthly interval after transplanting. The whole quantity of FYM (0.54% N, 0.33% P and 0.54% K) and VC (1.38% N, 0.46% P and 0.63% K) was given before transplanting as per the treatment of the experiment in the organic plots. The Jeevamrut (1.41% N, 0.92% P and 0.05% K) was prepared from 10 kg cow dung plus 10 L cow urine added to 100 L of water, mixed and kept for about one week. It was applied to the soil at fortnightly interval along with the irrigation water @ 5% per plot, per application after establishment of the seedling. Five plants were randomly selected and tagged in each treatment to study the plant growth, yield characteristics and nutrient uptake. Leaves, vines and root samples were collected at the time of harvest for chemical analysis. All the samples were washed with distilled water, dried in shade and then the samples were cut into pieces and oven dried at 60°C. Well ground samples of known weight of bulbs and leaves were digested in di-acid mixture prepared by mixing concentrated HNO_3 and $HClO_4$ in the ratio of 4:1 observing all relevant precautions as laid down by Piper (1966) for estimating P and K. Separate digestion was carried out for N estimation using concentrated H_2SO_4 and digestion mixture as suggested by Jackson (1973). In leaves, vines and roots, N was estimated by Microkjeldahl method (Jackson 1973), P using Vando-molybdate phosphoric yellow colour method (Jackson 1973) and K by Flame Photometer method (Jackson 1973). The nutrient uptake by leaves, vines and root was calculated using the following formula:

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%)} \times \text{Dry matter yield (kg/ha)}}{100}$$

The data for two seasons were pooled and subjected to analysis of variance by OPSTAT program and significance of result was verified.

RESULTS AND DISCUSSION

All the treatments of fertilizers and manures recorded significantly higher leaf area as compared to control during both the years of study (Table 2). The significantly higher leaf area (394.3 cm^2) was under RDF + FYM @ 100 q ha^{-1} *i.e.* T_2 which was followed by FYM @ 100 q ha^{-1} + RDF through FYM (on N equivalent basis) *i.e.* T_4. Uniform flow of assimilates to sink was high in T_4 due to the balanced supply and slow release of nutrients *via*. FYM and vermicompost which increased nutritional status of the soil resulting into increased plant growth favorably with the production of more carbohydrates might be the reason of higher leaf area. The results are in conformity with Singh and Walia (2015) and Sharma et al (2017). Vine length differs significantly in most of the treatments. The maximum vine length (3.1 cm) was in T_2 which was followed by T_6. Significantly higher fruit length was in T_2 (16.9 cm) followed by T_6. Amalgamation of organic manures and inorganic fertilizer in T_2 might have maintained the soil nutrient status by supplying the macro nutrients majorly from the inorganic sources and all other important plant micro nutrients *via* organic manure (Shah et al 2020). Fruit weight of cucumber was significantly highest in T_2(273.5

Table 1. Treatment details

Treatment codes	Treatment details
T_1	Control (No application of manures and fertilizers)
T_2	RDF + FYM @ 100 q ha^{-1}
T_3	Jeevamrut @ 5%
T_4	FYM @ 100 q ha^{-1} + RDF through FYM (on N equivalent basis)
T_5	FYM @ 100 q ha^{-1} + Jeevamrut @ 5%
T_6	VC (on N equivalent basis of FYM) + RDF through FYM (on N equivalent basis)
T_7	VC (on N equivalent basis of FYM) + Jeevamrut @ 5%
T_8	FYM @ 100 q ha^{-1} (50%) + VC (on N equivalent basis of 50% FYM) + RDF through FYM (on N equivalent basis)
T_9	FYM @ 100 q ha^{-1} (50%) + VC (on N equivalent basis of 50% FYM) + Jeevamrut @ 5%

g) which was statistically at par with T_6 and T_8. The increase in fruit weight might be due to the incorporation of FYM in integrated nutrient module would have improved the supply of N to plant leading to better vegetative growth and fruit weight. Moreover, microorganisms present in FYM might have efficiently dissolved nutrients making them available to plants which would have promoted the nutrient uptake and increase in fruit weight (Pandey and Chandra 2013). Pooled analysis of data revealed that all the treatments of fertilizers and manures had significant effect on fruit diameter and significantly highest fruit diameter was observed in T_2. Among the pure organic treatments, highest fruit diameter was in T_8. Microorganisms present in organic manures along with inorganic fertilizers would have assisted the root growth and enhanced nutrient absorption might have boosted the production of hormones amplifying the production of carbohydrates and their accumulation in fruits *i.e.* increasing fruit diameter. These results were in line with the findings of Laxminarayana and Patiram (2006) in rice and Negi et al (2021) in onion.

All the integrated treatments with the organic and inorganic amendments influenced the uptake of nutrients and highest N uptake (122.5 kg ha^{-1}) by cucumber crop (leaves, fruits, vines and roots) was in RDF + FYM @ 100 q ha^{-1} *i.e.* T_2 (Table 3) which produced significant difference among all other treatments. It was followed by VC (on N equivalent basis of FYM) + RDF through FYM (on N equivalent basis). The percentage increase in N uptake by cucumber under RDF + FYM @ 100 q ha^{-1} was 3.3 per cent over VC. This increase in RDF + FYM @ 100 q ha^{-1} can be attributed to the conjoint use of inorganic manures accompanied with organic manures resulting in solubilization of nutrients and reduced leaching leading to accumulation of different nutrients in plants.

The highest P uptake (31.2 kg ha^{-1}) was observed in RDF + FYM @ 100 q ha^{-1} as compared to VC (on N equivalent basis of FYM) + RDF through FYM (on N equivalent basis) resulted in 10.57 per cent higher P uptake (Table 3). This surge in P uptake may be the result of remodeling FYM with NPK, increasing the P in soil solution through mineralization of organic P compounds due to solubilizing action of organic acids produced by prolonged decomposition of FYM. Pandey et al (2009) also reported same trend in wheat. The significantly higher K uptake (153.4 kg ha^{-1}) was in RDF + FYM @ 100 q ha^{-1} *i.e* T_2 which was significantly at par with VC (on N equivalent basis of FYM) + RDF through FYM (on N equivalent basis). The higher K uptake might be due to the release of K from K bearing minerals during decomposition of organic amendments *i.e.* vermicompost and FYM. Similar results were observed by Mitra et al (2010) in jute, Diksha and Rajpaul (2020) in wheat and Negi et al (2022b) in onion.

Table 3. Effect of different nutrient sources on NPK uptake by cucumber (Pooled for 2 years)

Treatment code	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
T_1	67.9	14.6	81.7
T_2	143.6	31.2	153.4
T_3	80.0	16.3	94.4
T_4	120.7	25.1	132.2
T_5	104.7	20.0	113.3
T_6	138.8	27.9	147.6
T_7	99.9	18.9	111.8
T_8	128.6	25.5	138.2
T_9	96.9	21.5	113.5
CD (P=0.05)	7.5	1.4	6.7
Y × T	10.6	1.9	9.4

Table 2. Effect of different nutrient sources on growth parameters of cucumber (Pooled for 2 years)

Treatment code	Leaf area (cm^2)	Vine length (m)	Fruit length (cm)	Fruit weight (g)	Fruit diameter (cm)
T_1	329.3	2.1	14.7	246.7	4.48
T_2	394.3	3.1	16.9	273.5	4.94
T_3	327.8	2.4	15.6	255.2	4.56
T_4	387.4	2.9	16.7	269.6	4.84
T_5	342.0	2.6	16.1	267.6	4.75
T_6	369.7	3.0	16.8	272.0	4.86
T_7	365.6	2.7	16.4	257.6	4.78
T_8	368.4	2.9	16.6	271.1	4.85
T_9	336.6	2.8	16.3	269.0	4.68
CD (p=0.05)	6.5	0.1	0.4	3.1	0.2
Y × T	NS	NS	NS	NS	NS

CONCLUSION

The application of RDF (N 100, P 50 and K 60 kg ha^{-1}) + FYM @ 100 q ha^{-1} significantly enhanced the growth and nutrient uptake by cucumber. Nutrient supplied through pure organic sources was not as effective as from inorganic fertilizers + FYM. Therefore, combined use of inorganic fertilizers and organic manures can be suggested for sustainable production of cucumber.

REFERENCES

Ali W, Ali M, Iqbal J, Khalil MK and Ahmad Z 2019. Impact of zinc and organic manure on wheat productivity and soil fertility. *Advances in Crop Science and Technology* **7**: 414.

Amalraj ELD, Kumar GP, Ahmed SKMH, Abdul R and Kishore N 2013. Microbiological analysis of Panchgavya, vermicompost and FYM and their effect on plant growth promotion of pigeon pea (*Cajanus cajan* L.) in India. *Organic Agriculture* **3**: 23-29.

Bokhtiar SM, Paul GC and Alam KM 2008. Effects of organic and inorganic fertilizer on growth, yield *Lagenaria siceraria* and juice quality and residual effects on ratoon crops of sugarcane. *Journal of Plant Nutrition* **31**: 1832-1843.

Diksha D and Rajpaul S 2020. Impact of integrated nutrient management on growth, yield and nutrient uptake by wheat (*Triticum aestivum*). *Indian Journal of Ecology* **47**: 324-329.

FAOSTAT (2021) Food and Agriculture Organization of the United Nations. Rome Italy. https://www.fao.org/faostat/en/

Gill P, Singh D, Gupta RK and Urmila LH 2019. Comparative chemical evaluation of vermicompost produced by using different organic wastes. In: Ghosh S (ed) *Waste valorisation and recycling.* Springer, Singapore.

Gore N and Sreenivasan MN 2011. Influence of liquid organic manures on growth, nutrient content and yield of tomato (*Lycopersicon esculentum* Mill.) in the sterilized soil. *Karnataka Journal of Agricultural Sciences* **24**: 153-157.

Jackson ML 1973. *Soil chemical analysis*. New Delhi: Prentice Hall of India Pvt. Ltd. 498p.

Laxminarayana K and Patiram 2006. Effect of integrated use of inorganic, biological and organic manures on rice productivity and soil fertility in ultisol of Mizoram. *Journal of the Indian Society of Soil Science* **54**: 213-220.

Mitra S, Roy A, Saha AR, Maitra DN, Sinha MK, Mahapatra BS and Saha S 2010. Effect of integrated nutrient management on fibre yield, nutrient uptake and soil fertility in jute (*Corchorus olitorius*). *Indian Journal of Agricultural Sciences* **9**: 801:804.

Negi M, Sharma S, Sharma U, Kumar P, Sharma U and Sharma K 2022a. Aspects of the current and prospective sustainable usage of nanofertilizers in agriculture and their effects on health of the soil: an updated review. *Journal of Soil Science and Plant Nutrition* 1-18.

Negi M, Sharma JC and Shukla YR 2022b. Effect of organic manures and inorganic fertilizers on dry matter yield, soil and plant nutrient content in onion (*Allium cepa*). *Indian Journal of Agricultural Sciences* **92**: 680-683.

Negi M, Sharma JC, Shukla YR, Chauhan A, Sharma S and Sharma K 2021. Comparative assessment of different nutrient sources on growth, yield and nutrient uptake by onion (*Allium cepa* L.). *Journal of Plant Nutrition* **45**: 1516-1522.

Palekar S 2006. *Text book on Shoonya Bandovalada Naisargika Krushi*, Published by Swamy Anand, Agri Prakashana, Bangalore, pp.210-214.

Pandey I B, Dwivedi DK and Pandey RK 2009. Integrated nutrient management for sustaining wheat (*Triticum aestivum*) production under late sown condition. *Indian Journal of Agronomy* **54**: 306-309.

Pandey SK and Chandra KK 2013. Impact of integrated nutrient management on tomato yield under farmers field condition. *Journal of Environmental Biology* **34**: 1047-1051.

Piper CS 1966. *Soil Chemical Analysis*. Asia Publishing House, Bombay, India.

Ram S, Singh V and Sirari P 2016. Effects of 41 years of application of inorganic fertilizers and farm yard manure on crop yields, soil quality, and sustainable yield index under a rice-wheat cropping system on mollisols of North India. *Communication in Soil Science and Plant Analysis* **47**: 179-193.

Sachan S, Singh D, Kasera S, Mishra SK, Tripathi Y, Mishra V and Singh RK 2017. Integrated nutrient management (INM) in okra (*Abelmoschus esculentus* (L.) Moench) for better growth and higher yield. *Journal of Pharmacognosy and Phytochemistry* **5**: 1854-1856.

Samman S, Chow JW, Foster MJ, Ahmad ZI, Phuyal JL and Petocz P 2008. Fatty acid composition of edible oils derived from certified organic and conventional agricultural methods. *Food Chemistry* **109**: 670-674.

Shah PS, Nabi G, Khan M, Saddam H and Jan AJ 2020. Long-term integrated nutrient management for rice-based cropping pattern: effect on growth, yield, nutrient uptake. Nutrient balance sheet, and soil fertility. *Sarhad Journal of Agriculture* **36**: 478-488.

Sharma A, Panja P and Mandal J 2017. Effect of intregated nutrient management on onion (*Allium cepa* L.) yield, quality attributes, soil properties and production economics under field condition. *Indian Journal of Ecology* **44**: 355-359.

Singh J, Singh MK, Kumar M, Gupta A and Singh KP 2020. Growth, yield and quality parameters of cucumber (*Cucumis sativus* L.) as influenced by integrated nutrient management application. *International Journal of Current Microbiology and Applied Sciences* **10**: 1445-14462.

Singh G and Walia SS 2015. Influence of integrated nutrient management on growth and yield of babycorn (*Zea mays* L.). *Indian Journal of Ecology* **42**: 346-348.

Singh PK and Pandey M 2010. Study the effect of integrated nutrient management on yield and nutrient uptake in cabbage. *Indian Journal of Hill Farming* **2**: 39-41.

Ukale DU, Bhagwat RV, Upadhyay SK, Cukkemane N and Cukkemane AA 2016. Metabolic analysis of liquid formulations of organic manures and its influence on growth and yield of *Solanum lycopersicum* L. (tomato) crop in field. *Biocatalysts and Agricultural Biotechnology* **8**: 50-54

Received 12 November, 2022; Accepted 18 February, 2023