www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(8): 2209-2213

www.thepharmajournal.com
Received: 07-04-2022
Accepted: 06-05-2022

Archana Sharma
Department of Soil Science and Water Mangement, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

JC Sharma
Department of Soil Science and Water Mangement, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Ritika Gautam
Department of Soil Science and Water Mangement, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Krishan Lal Gautam
Department of Silviculture and Agroforestry, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Deeksha Sharma
Department of Entomology, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Corresponding Author
Deeksha Sharma
Department of Entomology, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Effect of organic and inorganic fertilization on NPK contents, their uptake and economics of cauliflower

Archana Sharma, JC Sharma, Ritika Gautam, Krishan Lal Gautam and Deeksha Sharma

Abstract
In wake of high input cost of chemical fertilizer there is need to judiciously use the fertilizers along with organic manure to sustain yield level. Although, use of chemical fertilizers is the fastest way of replenishing the nutrient depletion, yet limited input availability and rising fertilizer prices deter the farmers from using these inputs to required level. Therefore two year field experiment was conducted during 2019-20 and 2020-21 by using Randomized block design. The results revealed that application of 150% NPK + FYM recorded with highest leaf (3.36, 0.63 and 2.01%), curd (4.18, 0.76 and 3.95%) and root (1.34, 0.45 and 3.68%) NPK contents and their uptake (207.2, 37.6 and 163.6 kg ha^{-1}), respectively. But highest net returns were recorded under 100% NPK + FYM i.e. Rs 371581.6 per hectare with 2.82 B: C ratio. Hence study suggests that cauliflower production could be beneficial on the application 100% NPK + FYM and improves crop productivity and profitability.

Keywords: NPK contents, *Brassica oleracea, Cauliflower*

Introduction

Cauliflower (*Brassica oleracea* var. botrytis L.) is one of the most important vegetable crop of Cole group grown extensively all over India under temperate to tropical climatic condition belonging to the genus Brassica of the family Brassicaceae. Cauliflower is a rich source of vitamin C (Keck, 2004) [1] which is about 48.2 mg $100g^{-1}$, besides minerals such as P, K, Ca, Na and Mg. A high intake of cauliflower has been associated with reduced risk of aggressive prostate cancer (Kushwaha *et al.* 2013) [2] as it contains potent anti-cancer compounds such as diindolylmethane, sulforaphane and selenium. India is the second major cauliflower producing country after China in the world and contributes 32 percent in area *i.e.* 4.60 lakh ha and 36 percent in production *i.e.,* 9.17 million metric tonnes. In Himachal Pradesh, it is grown in an area of 5,917 ha with a production of 1.30 million metric tonnes and productivity of 22.54 metric tons ha^{-1} (Anonymous, 2020) [3]. In the state, it is grown commercially as an off-season crop during summer-rainy (March to November) season in Shimla, Mandi, Solan, Kullu and Kangra districts, bringing lucrative returns to the farmers. Utilization of indigenous sources of organics acts alternatives and supplements to chemical fertilizers and even help in increasing the productivity. The balanced supply of nutrients and scientific management practices has potential to increase the productivity of these vegetable crops. The crop yield and quality can be improved by combined application of inorganic and organic nutrient sources. Low and imbalanced use of chemical fertilizers is one of the major reasons for the low productivity of cauliflower. The farmers indiscriminately use N fertilizer while the application of P and K fertilizers is very limited and that of secondary and micronutrients is almost negligible. Thus, an imbalanced fertilizer use has led to multi nutrient deficiencies resulting in yield stagnation and deteriorated soil health. Farm yard manure has been used for centuries as a fertilizer farming as it supplies all major nutrients (N, P, K, Ca, Mg, S) necessary for plant growth, as well as micronutrients (Fe, Mn, Cu and Zn). Hence, it acts as a mixed fertilizer (Dejene and Lamlam, 2012) [4]. Farm yard manure improves soil physical, chemical and biological properties. Improvement in the soil structure due to application of Farm yard manure leads to a better environment for root development (Prasad and Sinha, 2000) [5]. Therefore, reducing the use of synthetic fertilizers and to conserve the natural resources while sustaining crop production are major issues in present scenario, which is only possible through adoption of nutrient supply system that involves integrated use of nutrient sources (Merentola *et al.*, 2012) [6].

Material and Methods

The field experiment with cauliflower (*Brassica oleracea*var botrytis) variety PSBK-1 was conducted during 2019-20 and 2020-21 at Dr. YS Parmar University of Horticulture and Forestry, Solan (Latitude 30° 52' N and longitude 77° 11' E, 1175 m above MSL) having average slope of 7-8 percent. The site receives a mean annual rainfall of 1100 mm of which 75% is received during monsoon period (Mid June–Mid September). According to Soil Taxonomy of USDA, Soils of the study area belongs to typic eutrochrept and sandy loam in texture.

Experimental design and treatments

The experiment was conducted with 9 treatments *viz*., T_1-control, T_2-100% FYM (N equivalent basis), T_3-100% N, T_4-NP, T_5-NK, T_6-PK, T_7-NPK, T_8-100% NPK + FYM (recommended Practice) and T_9- 150% NPK + FYM replicated thrice in randomized block design in plot size of 3 m × 2.7 m. A recommended fertilizer dose of 150: 100: 54 kg of N, P_2O_5 and K_2O ha^{-1} represented NPK in cauliflower.

Crop management and digestion of samples

The field was prepared during 2019 by ploughing and then in subsequent trials manual tilling operation was done to avoid the mixing of soils of different plots. The nine treatments *viz*. were laid in randomized block design with three replications. Well decomposed FYM (250 q ha^{-1} recommended) was used and had a C:N ratio of 58. Chemical fertilizers containing N, P, K were applied as urea, SSP and muriate of potash, respectively. The fertilizer was broadcast and mixed in soil before transplanting. Manual weeding was done as an intercultural operation. Well ground samples of known weight of plant (leaf, curd and root) were digested separately 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) [7] for estimating P and K. Separate digestion was carried out for N estimation using concentrated H_2SO_4 and digestion mixture (Potassium sulphate 400 parts, copper sulphate 20 parts, mercuric oxide 3 parts, selenium powder 1 part) as suggested by Jackson (1973) [8].

The nutrient uptake by plants was calculated by using the following formula:

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content (\%)} \times \text{dry matter yield (kg/ha)}}{100}$$

The nutrient uptake in leaves, curd and roots was added to calculate total uptake by whole plant.

Statistical analysis: The data recorded was analyzed by using MS-Excel and OPSTAT. The mean values of data were subjected to Analysis of Variance as described by Panse and Sukhatme (2000) [9] for using Randomized Block Design.

Results and Discussion

NPK content in cauliflower

Inquisition of the data in Table 1 showed that treatments under study had a significant effect on leaf NPK contents during both the years of study. On pooling of the data, it was revealed that highest leaf N (3.36%) was reported in T_8 and T_9 which was statistically at par with T_7 (3.13%), while lowest was reported from T_1 (2.27%).

Table 1: Effect of nutrient management on leaf NPK (%) content in cauliflower

Treatments	N			P			K		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1 (Control)	2.13	2.40	2.27	0.47	0.48	0.47	1.65	1.79	1.72
T_2 (100% FYM N equivalent basis)	2.53	2.80	2.67	0.54	0.55	0.55	1.82	1.83	1.83
T_3 (100% N)	2.87	2.87	2.87	0.48	0.51	0.50	1.33	1.33	1.33
T_4 (100% NP)	2.73	3.00	2.87	0.54	0.55	0.55	1.13	1.27	1.20
T_5 (100% NK)	2.89	2.95	2.92	0.53	0.54	0.54	1.24	1.25	1.25
T_6 (100% PK)	2.83	2.86	2.84	0.59	0.60	0.60	1.70	1.72	1.71
T_7 (100% NPK)	3.10	3.16	3.13	0.62	0.63	0.63	1.70	1.71	1.71
T_8 (100% NPK + FYM)	3.33	3.39	3.36	0.61	0.62	0.62	1.81	1.90	1.86
T_9 150% NPK + FYM)	3.23	3.50	3.36	0.62	0.63	0.63	1.96	2.05	2.01
Mean	2.85	2.99		0.56	0.57		1.59	1.65	
$CD_{0.05}$	0.27	0.39		0.05	0.07		0.36	0.32	
T	0.23			0.04			0.23		
Y	0.11			NS			NS		
T × Y	NS			NS			NS		

Highest leaf P (0.63%) was recorded in T_7 and T_9 which was statistically at pat with T_6 and T_8. Lowest leaf P was recorded under control (0.47%) which was statistically at par with T_3 (0.50%). Maximum value for leaf K was recorded in T_9 (2.01%) which was statistically at par with T_2 (1.83%) and T_8 (1.86%), while lowest leaf K was observed in T_4 (1.20%) which was statistically at par with T_5 (1.25%) and T_3 (1.33%). Year had a significant effect on leaf N content, whereas, had a non-significant effect on Leaf P and K contents. Interaction effect on leaf NPK was also found to be non-significant.

Table 2 revealed that different treatments tried had significant effect on curd NPK contents during both the years of study. On assessment of pooled data, highest curd N content was recorded in T_9 (4.18%) which was statistically at par with T_7 (3.91%) and T_8 (4.10%), while treatment T_1 recorded the minimum value for curd N (3.03%). Treatment T_9 was recorded with maximum curd P (0.76%) content which was statistically at par with T_7 (0.73%) and T_8 (0.74%) and minimum was under T_4 (0.59%) which was statistically at par with T_1 and T_5. Treatment T_8 was recorded with highest curd K content (3.97%) and treatments T_6, T_7 and T_9 were equally effective for leaf K content, while minimum curd K was observed in T_1 (3.09%). Year had a significant effect on curd N and K contents and non-significant effect on curd P content. Interaction effect between treatment and year was found non-significant with respect to curd NPK content.

Table 2: Effect of nutrient management on curd NPK (%) content in cauliflower

Treatments	N			P			K		
	2019-20	**2020-21**	**Pooled**	**2019-20**	**2020-21**	**Pooled**	**2019-20**	**2020-21**	**Pooled**
T_1 (control)	2.97	3.10	3.03	0.60	0.62	0.61	3.05	3.13	3.09
T_2 (100% FYM N equivalent basis)	3.33	3.50	3.42	0.68	0.70	0.69	3.34	3.48	3.41
T_3 (100% N)	3.37	3.57	3.47	0.63	0.68	0.66	3.09	3.19	3.14
T_4 (100% NP)	3.20	3.33	3.27	0.58	0.59	0.59	3.61	3.66	3.64
T_5 (100% NK)	3.39	3.43	3.41	0.57	0.65	0.61	3.34	3.52	3.43
T_6 (100% PK)	3.60	3.77	3.68	0.61	0.72	0.67	3.64	3.83	3.74
T_7 (100% NPK)	3.66	4.17	3.91	0.68	0.78	0.73	3.57	4.06	3.81
T_8 (100% NPK + FYM)	3.90	4.30	4.10	0.71	0.77	0.74	3.73	4.20	3.97
T_9 150% NPK + FYM)	3.93	4.43	4.18	0.74	0.78	0.76	3.76	4.14	3.95
Mean	3.48	3.73		0.64	0.70		3.46	3.69	
$CD_{0.05}$	0.54	0.38		0.05	0.05		0.44	0.38	
T	0.32			0.04			0.29		
Y	0.15			NS			0.13		
T × Y	NS			NS			NS		

Perusal of data presented in Table 3 depicted that different treatments had significant effect on root NP contents during both the years of investigation, while on root K content significant effect was recorded only in 2nd year. Pooled analysis of the data showed highest root N (1.34%) was recorded under T_9 which was statistically at par with T_8 (1.23%), whereas, lowest root N was recorded under control which was statistically at par with T_3, T_4, T_5 and T_6. Treatment T_9 was recorded with maximum root P (0.45%) and treatments T_7 and T_8 was equally effective root N content, while minimum was recorded under control (0.27%). Year effect was significant on root N and P contents. Highest root K content was observed in treatment T_9 (3.68%) which was statistically at par with T_2 (3.33%) and T_8 (3.44%). Lowest value of root K content was recorded under control (2.26%). Year and interaction effect (T × Y) was found non-significant.

Table 3: Effect of nutrient management on root NPK (%) content in cauliflower

Treatments	N			P			K		
	2019-20	**2020-21**	**Pooled**	**2019-20**	**2020-21**	**Pooled**	**2019-20**	**2020-21**	**Pooled**
T_1 (Control)	0.77	0.87	0.82	0.26	0.28	0.27	2.29	2.23	2.26
T_2 (100% FYM N equivalent basis)	1.04	1.11	1.07	0.30	0.32	0.31	3.30	3.36	3.33
T_3 (100% N)	1.00	1.04	1.02	0.33	0.34	0.34	3.02	3.28	3.15
T_4 (100% NP)	0.85	1.06	0.95	0.32	0.34	0.33	3.08	3.18	3.13
T_5 (100% NK)	0.93	1.03	0.98	0.33	0.38	0.36	2.99	3.10	3.05
T_6 (100% PK)	0.99	0.99	0.99	0.36	0.40	0.38	2.75	2.89	2.82
T_7 (100% NPK)	1.07	1.12	1.10	0.38	0.42	0.40	2.50	3.06	2.78
T_8 (100% NPK + FYM)	1.20	1.26	1.23	0.42	0.45	0.43	3.47	3.42	3.44
T_9 150% NPK + FYM)	1.31	1.37	1.34	0.44	0.46	0.45	3.67	3.70	3.68
Mean	1.02	1.09		0.35	0.38		3.01	3.13	
$CD_{0.05}$	0.28	0.24		0.06	0.05		NS	0.50	
T	0.22			0.04			0.54		
Y	0.10			0.02			NS		
T × Y	NS			NS			NS		

NPK uptake in cauliflower

A glance of data given in Table 4 depicts that NP uptake in cauliflower was significantly influenced by different treatment during both the years of study, but K uptake was significantly varied only during 2nd year of study. Pooled data analysis showed significantly highest N uptake under T_9 (207.2 kg ha^{-1}) which was statistically at par with T_8 (207.1 kg ha^{-1}), whereas the lowest was recorded under T_1 (115.1 kg ha^{-1}). Significantly highest P uptake (37.55 kg ha^{-1}) was noticed under T_9 which was statistically at par with T_8 (36.7 kg ha^{-1}) and lowest P uptake (19.7 kg ha^{-1}) was observed under control. As far as K uptake is concerned, it was significantly highest under T_9 (163.6 kg ha^{-1}) which was statistically at par with T_8 (158.0 kg ha^{-1}) and the minimum value (80.8 kg ha^{-1}) for K uptake was noticed under control (T_1). Year had significant effect on NPK uptake, whereas, Interaction effect between year and treatment had non-significant effect.

Table 4: Effect of nutrient management on NPK (kg ha^{-1}) uptake in cauliflower

Treatments	N			P			K		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1 (Control)	108.8	121.5	115.1	18.8	20.6	19.7	78.9	82.6	80.8
T_2 (100% FYM N equivalent basis)	161.6	182.7	172.1	30.2	33.2	31.7	124.1	138.9	131.5
T_3 (100% N)	157.3	154.0	155.7	23.9	25.8	24.8	98.5	104.1	101.3
T_4 (100% NP)	158.9	167.3	163.1	25.1	26.0	25.5	112.1	116.9	114.5
T_5 (100% NK)	153.8	171.5	162.7	22.7	27.6	25.2	97.4	112.6	105.0
T_6 (100% PK)	138.5	130.7	134.6	24.9	30.5	27.7	107.8	122.0	114.9
T_7 (100% NPK)	163.7	170.8	167.2	27.3	32.7	30.0	111.1	127.7	119.4
T_8 (100% NPK + FYM)	198.5	209.7	204.1	33.8	39.5	36.7	151.7	164.3	158.0
T_9 150% NPK + FYM)	201.4	213.1	207.2	35.0	40.1	37.6	158.4	168.8	163.6
Mean	160.3	169.0		26.9	30.7		115.5	126.5	
$CD_{0.05}$	15.7	21.8		5.1	4.8		25.0	NS	
T	12.6			3.4			15.9		
Y	5.9			1.6			7.5		
T × Y	NS			NS			NS		

Increased yield due to increased level of nutrition led to increase in uptake of N in different fertilized treatments over control. The use of FYM with NPK improved crop growth and increased yield that resulted in higher uptake of NPK. The increase in NPK uptake in balanced fertilization plots compared to the control might be due to supply of NPK through external inputs and better root proliferation. The higher P uptake values in FYM treated plots might be due to the fact that organic materials form chelates with Al^{3+} and Fe^{3+} resulting in reduction in P fixation. In control, lower values of NPK uptake were recorded which may be due to continuous removal of nutrients and no addition nutrients externally (Gourav *et al.*, 2019) [10]. Combined application of organic and inorganic source of nutrients modified the soil environment, besides providing the physical properties of soil and also the slow microbial decomposition of humus gradually increases that nutrient availability during cropping period, which was manifested in higher nutrient uptake (Shah and Wani, 2017) [11]. The results obtained are in agreement with the findings of Patel *et al*. (2011) [12] and Batabyal *et al.* (2016) [13] in cauliflower.

Economics of cauliflower

Data on cost of production and net returns from the produce as well as B:C ratio for the cauliflower as influenced by various treatments under study is presented in Table 5. Highest average net returns of 503439.5 Rs ha^{-1} was obtained in treatment T_8 (100% NPK + FYM) with B:C ratio of 2.82 in cauliflower However, maximum B:C ratio was recorded in treatment T_5 (3.73) in cauliflower, but the net returns under this treatments are less than that in case of T_8 and T_9. Highest net returns under conjoint use of NPK and FYM as compared to sole application of FYM indicated that organic sources of nutrients of least profitable this is due to higher input cost and lower economic yield in the organically grown crops. Despite of higher cost of cultivation under integrated use of NPK and FYM, these treatments are still profitable due higher crop yield depending on the responsiveness of the soil. The results are in line with the findings of Tekesangla *et al.* (2015) [14] and Batabyal *et al*. (2016) [13].

Table 5: Effect of nutrient management on cost economics of cauliflower and capsicum

Treatments	Cauliflower			
	Total cost (Rs ha^{-1})	Gross Return (Rs ha^{-1})	Net Return (Rs ha^{-1})	B:C
T_1 (Control)	84300.0	356203.7	271903.7	3.23
T_2 (100% FYM N equivalent basis)	129300.0	449271.6	319971.6	2.47
T_3 (100% N)	86230.4	362570.8	276340.3	3.20
T_4 (100% NP)	92417.9	412991.4	320573.4	3.47
T_5 (100% NK)	87670.4	415049.4	327378.9	3.73
T_6 (100% PK)	91927.5	388102.1	296174.6	3.22
T_7 (100% NPK)	93867.9	411165.4	317297.5	3.38
T_8 (100% NPK + FYM)	131857.9	503439.5	371581.6	2.82
T_9 150% NPK + FYM)	155636.9	493181.5	337544.6	2.17

Conclusion

Based on two year field experimentation it could be inferred that cauliflower nutrient contents i.e. NPK was significantly improved by conjoint application of inorganic and organic nutrients. Application of 150% NPK + FYM was recorded with highest NPK contents in leaf, curd and root of cauliflower and their uptake also. Maximum net returns was recorded under 100% NPK + FYM with B:C ratio 2.82. Therefore this treatment combination suggested best for the cauliflower production.

References

1. Keck AS. Cruciferous vegetables: cancer protective mechanisms of glucosinolate hydrolysis products and selenium. Integrative Cancer Therapies. 2004;3(1):5-12.
2. Kushwaha A, Baily SB, Maxton A and Ram Baily GD. Isolation and characterization of PGPR associated with cauliflower roots and its effect on plant growth. The Bioscan. 2013;8(1):95-99.
3. Anonymous. Horticulture statistics at a glance. Ministry of Agriculture and Farmer Welfare, GOI. 2020.
4. Dejene M, Lemlem M. Integrated agronomic crop managements to improve Tef productivity under terminal drought, In: Rahman I Md M. and Hasegawa H, Eds., Water Stress, In Tech Open Science, 2012, 235-254.

5. Prasad B, Sinha SK. Long-term effects of fertilizers and organic manures on crop yields, nutrient balance, and soil properties in rice-wheat cropping system in Bihar," In: Abrol IP, Bronson KF, Duxbury JM, Gupta RK. Eds., Long-term soil fertility experiments in rice-wheat cropping systems. Rice- wheat consortium paper series 6, Rice-Wheat Consortium for the Indo-Gangetic Plains, New Delhi. 2000;6:105-119.
6. Merentola Konaujia SP, Singh VB. Effect of integrated nutrient management on growth, yield and quality of cabbage (*Brassica oleracea*var. capitata). Journal of Soils and Crops. 2012;22(2):233-239.
7. Piper CS. Soil and Plant Analysis. Hans publication, Bombey, India. 1966, 368.
8. Jackson ML. Soil Chemical Analysis. Printice Hall of India Pvt. Ltd., New Delhi, 1973, 111-26.
9. Panse VG, Sukhatme PV. Statistical Methods for Africultural Workers. Indian Council of Agricultural Research, New Delhi. 2000, 381.
10. Gourav, Sankhyan NK, Sharma RP, Sharma GD. Long term effect of fertilizers and amendments on the properties of an acid Alfisol and uptake of primary nutrients and sulfur in maize-wheat rotation in North Western Himalayas. Journal of Plant Nutrition. 2019, 1-19.
11. Shah RA, Wani BA. Yield, nutrient uptake and soil fertility of maize (*Zea mays* L.) as influenced by varying nutrient management practice under temperate condition of Kashmir valley India. Plant Archives. 2017;17(1):75-78.
12. Patel KK, Patel BA, Jadav NJ, Patel JC, Panchal DB. Influence of integrated nutrient management on curd yield, quality and nutrient uptake and economics of cauliflower (*Brassica oleracea* var botrytis L.) under middle Gujarat. Advance Research Journal of Crop Improvement. 2011;2(2):193-196.
13. Batabyal K, Mandal B, Sarkar D, Murmu S, Tamang A, Das I, *et al*. Comprehensive assessment of nutrient management technologies for cauliflower production under subtropical condition. European Journal of Agronomy. 2016 Sep 1;79:1-13.
14. Tekasangla Kanaujia P, Singh PK. Integrated nutrient management for quality production of cauliflower in acid alfisol of Nagland. Karnataka Journal of Agricultural Sciences. 2015;28(2):244-247.