INDIAN JOURNAL OF ARID HORTICULTURE
2009, Vol.4 (1): 40-43

Effect of organic and inorganic sources of nitrogen on growth, yield and quality of cabbage (*Brassica oleracea* var. *capitata* L.)

Devendra Kumar Gupta and S. K. Khandelwal
Department of Horticulture, SKN College of Agriculture, Jobner 303329

Abstract

A field experiment to study the Effect of organic and inorganic sources of nitrogen on growth, yield and quality of cabbage was conducted at Horticulture Farm, SKN College of Agriculture, Jobner. Results showed that the plant height, plant spread, number of leaves and leaf area increased significantly with the integrated application of nitrogen as compared to control. The highest values for these parameters were recorded with the application of nitrogen 50% through urea + 50% through vermicompost. The yield increased maximally and significantly when nitrogen was supplied as 50% through urea + 50% through vermicompost. It was also recorded that application of 50% nitrogen through urea + 50% nitrogen through vermicompost registered a significant higher values of growth, yield, nitrogen and protein content in leaves of cabbage. However, 50% nitrogen through urea + 50 % nitrogen through poultry manure was found second most important treatment in increasing the traits under study, which was statistically at par with 50% nitrogen through urea + 50% nitrogen through vermicompos.

Key words: *Brassica Oleracea, vermicompost, yield*

Introduction

Cabbage (*Brassica oleracea* var. *capitata* L.) is one of the most important member of genus *Brassica* grown in world. Golden Acre is very popular variety of cabbage being used by the farmers in the vicinity of big cities owing to its earliness, round and compact head. The productivity of cabbage in India is very low (16.5 tonnes) in comparison to European countries (25.17 tonnes) and it is true with Rajasthan in comparison to other states of India. Available literature reveals that the low soil fertility, nutritional imbalances, adverse climatic conditions, etc. are some of the basic reasons for low productivity of cabbage in Rajasthan.

It is a well known that nitrogen increases the growth and yield of most of the crops, particularly leafy vegetables including the cabbage. Application of nitrogen through inorganic fertilizers can enhance the growth and yield to considerable extent, it adversely affect the fertility and productivity of soil in longer duration. Therefore, it is important to supplement the nitrogen by organic sources like urea. The FYM is rich source of organic matter and able to replenish most of the macronutrients being taken up by crop (Abdel-Nasser and Hussein, 2001). Poultry manure and vermicompost are the concentrated source of nutrients. It is well documented that it is an excellent source of organic matter which increases uptake of several other nutrients (Abusaleha 1992; Jose *et al.*, 1988). Therefore, it is hypothesized that the yield and quality of cabbage can be enhanced to a great extent by application of nitrogen through a combination of urea with different organic sources of nitrogen besides increasing the soil fertility in a sustainable manner. With this background, the present experiment was conducted to evaluate the effect of organic and inorganic sources of nitrogen on growth, yield and quality of cabbage (*Brassica oleracea* var. *capitata* L.).

Material and Methods

The experiment was conducted on Golden Acre variety of cabbage at Horticulture Research Farm, S.K.N. College of Agriculture, Jobner. The climate of this region is semi-arid characterized by aridity of the atmosphere and extremity of temperature both in summer (45.5°C) and winter (-1°C). The average rainfall of this area is 500 mm, most of which occurs during the period of July to mid September. The soil of experimental site was loamy sand (85.2% sand 9.2% silt and 5.4% clay). The soil having pH 8.0, electrical conductivity 1.20 dSm^{-1} in (1:2:5) soil water suspension, organic carbon 0.16% and available N, P_2O_5 and K_2O of 130, 15.20 and 140 kg ha^{-1}, respectively.

The experiment was laid out in a Randomized Block Design (RBD) with three replications. The treatments

were comprised of total 17 combinations of urea, vermicompost, FYM and poultry manure including control (no fertilizer). The seeds were first raised in nursery and then transplanted in field after 6 weeks. The distance between plant to plant as well as row to row was kept at 45 cm. N:P:K was applied at the rate of 150 :80:75 kg ha^{-1} respectively as per zonal recommendation. For treatments, nitrogen was supplied through FYM, vermicompost, poultry manure and urea. Full dose of phosphorus, potash, FYM, vermicompost and poultry manure were applied at the time of transplanting, while urea was applied in two split doses i.e. half at the time of transplanting and remaining half dose at 30 days after transplanting. Standard practices were followed to raise the crop.

Five plants were randomly selected in each plot and tagged for observations on various traits like plant height, plant spread, number of leaves per plant, leaf area and average weight, volume and diameter of head and yield at marketable maturity. Among quality attributes nitrogen content, protein content and vitamin 'C' content were analyzed (A.O.A.C., 1960).

Results and discussion

Growth attributes

Plant height, plant spread, number of leaves and leaf area increases significantly in most of the treatments with the application of nitrogen either alone or in combination of organic and inorganic sources. Application of nitrogen 50% through urea + 50% through vermicompost (T_8) recorded the maximum plant height (21.55 cm), plant spread (42.74 cm), number of leaves per plant (22.34) and leaf area (2010.6 cm^2). These values were followed by application of nitrogen 50% through urea + 50% through poultry manure (T_{12}). Statistically treatments T_8 and T_{12} were non significant in most of the growth traits (Table 1). Increase in yield and other attributes to the involvement of nitrogen in chlorophyll synthesis, protein synthesis and assimilation of various other organic compounds of physiological significance in the plant system. The organic manures not only provide the plant nutrients, but also improve the physical properties of the soil such as porosity, CEC and WHC, etc. Gopal and Lal (1996) reported that number of leaves and plant height of cabbage cv. Golden Acre increased with increasing levels of nitrogen.

The increase in plant growth with the application of urea in combination with vermicompost might be due to the fact that the urea readily supplied nitrogen in early crop growth stages whereas vermicompost prolonged the supply of nutrients to crop during the entire growing season. Vermicompost might have also improved the physical and biological properties of soil. The physiological parameters pertaining to photosynthesis, stomatal conductance and transpiration also exhibited significant increment with nitrogen supplied through urea in combination with vermicompost. It indicates that the increase in these physiological parameters might be attributed via increased ion absorption from soil, enhanced carbohydrate assimilation and production of new tissues which have ultimately increased vegetative growth. The other sources of nitrogen i.e. FYM & poultry manure in combination of urea found effective in increasing growth of cabbage because of similar properties of soil. Tomar *et al.* (1998) also reported that with the application of vermicompost leaf area of carrot was significantly increased. Similarly, the plant height, root and shoot biomass in tomato were significantly increased when 20% commercial horticulture medium was replaced by vermicompost. These results are in close agreement with Thanunathan *et al.* (1997) in onion and Reddy *et al.* (1998) in garden pea who observed significantly increased values of growth parameters due to application of vermicompost.

Replacement of vermicompost with poultry manure also enhanced the vegetative growth of cabbage. It might be due to the fact that poultry manure contains uric acid having 60 percent nitrogen. The uric acid rapidly changes to ammonia form causing its immediate and efficient utilization for better plant growth and development. Enhanced vegetative growth with the application of urea in combination with poultry manure has also been reported by Jose *et al* (1988) in brinjal and Wang *et al.* (1996) in cabbage, cucumber and white guard. Jose *et al.* (1988) obtained highest plant height and early flowering in brinjal with the application of nitrogen 50% through urea and 50% through poultry manure. Yadav (2002) also reported the maximum increase in growth and yield attributes in okra with the application of poultry manure added urea. Awodun (2007) also reported that application of poultry manure @6 t/ha increase the growth and yield parameters such as number of leaves, stem girth and length of internodes of fluted pumpkin relative to control.

Yield attributes and yield

Among all the treatment combinations, treatment T_8 (50% N through urea and 50% N through vermicompost) produced the maximum weight, highest diameter and maximum volume of head. These parameters were significantly higher over other treatments except T_{12} (50% N through urea + 50% N through poultry manure). The yield was recorded maximum with application of nitrogen 50% through urea and 50% through vermicompost (T_8) which was higher than other treatments, but statistically at par with the application of nitrogen 50% through urea +50% through poultry manure (T_{12}). The treatments T_8 and T_{12} registered an increase in yield in the order of 39.52 and 22.33 percent, respectively over control (Table 2).

The significant improvement in yield and yield attributes on account of vermicompost application along with urea might have attributed to the translocation of nutrients from soil, particularly at later stages of crop growth when sink was able to synthesize the enhanced amount of

Table 1. Effect of organic and inorganic sources of nitrogen on plant height, plant spread, number of leaves and leaf area per plant in cabbage.

Treatment		Plant height (cm)	Plant spread (cm)	No of leaves (Per plant)	Leaf area (cm^2)
T_1	Control	15.20	33.13	17.10	1453.5
T_2	100% N (urea)	18.65	38.06	20.61	1749.1
T_3	75% N (urea) + 25% N (FYM)	18.55	36.43	19.65	1719.7
T_4	50% N (urea) +50 % N (FYM)	18.35	36.23	19.81	1735.4
T_5	25% N (urea) +75% N (FYM)	18.15	34.79	18.53	1649.2
T_6	100% N (FYM)	17.20	34.42	17.41	1566.9
T_7	75% N (urea) + 25% N (VC)	18.45	38.36	20.09	1796.9
T_8	50% N (urea) +50 % N (VC)	21.55	42.74	22.34	2010.6
T_9	25% N (urea) +75% N) (VC)	19.20	37.11	19.82	1744.2
T_{10}	100% N (VC)	18.10	35.56	18.85	1658.8
T_{11}	75% N (urea) + 25% N (PM)	19.05	35.16	18.38	1619.3
T_{12}	50% N (urea) +50 % N (PM)	19.70	40.38	20.85	1876.5
T_{13}	25% N (urea) +75% N (PM)	18.15	36.12	19.49	1715.1
T_{14}	100% N (PM)	17.65	34.27	18.21	1607.9
T_{15}	50% N (urea) + 25% N (FYM) + 25% N (VC)	19.10	35.85	19.18	1695.9
T_{16}	50% N (urea) +25 % N (FYM) + 25% N (PM)	18.70	34.72	19.68	1733.8
T_{17}	50% N (urea) + 25% N (VC)+ 25% N (PM)	19.35	38.60	20.32	1828.6
	SEm±	0.67	1.18	0.65	51.22
	CD (P=0.05)	1.93	3.39	1.85	147.19

VC= Vermicompost, PM= Poultry manure

Table 2. Effect of organic and inorganic sources of nitrogen on weight, diameter and volume of head and yield in cabbage.

	Treatment	Average head weight (kg)	Average head diameter (cm)	volume (cc)	Yield (q ha^{-1})
T_1	Control	0.616	11.14	0.762	252.16
T_2	100% N (urea)	0.700	13.03	0.866	276.52
T_3	75% N (urea) + 25% N (FYM)	0.673	12.79	0.835	273.60
T_4	50% N (urea) +50 % N (FYM)	0.662	12.66	0.824	269.84
T_5	25% N (urea) +75% N (FYM)	0.649	12.05	0.802	263.50
T_6	100% N (FYM)	0.631	11.68	0.783	256.45
T_7	75% N (urea) + 25% N (VC)	0.705	12.92	0.875	292.76
T_8	50% N (urea) +50 % N (VC)	0.808	14.76	1.003	351.82
T_9	25% N (urea) +75% N) (VC)	0.678	12.85	0.847	283.15
T_{10}	100% N (VC)	0.638	12.17	0.792	265.77
T_{11}	75% N (urea) + 25% N (PM)	0.693	12.66	0.860	286.91
T_{12}	50% N (urea) +50 % N (PM)	0.787	13.46	0.976	308.48
T_{13}	25% N (urea) +75% N (PM)	0.659	12.54	0.823	280.09
T_{14}	100% N (PM)	0.641	11.80	0.791	261.22
T_{15}	50% N (urea) + 25% N (FYM) + 25% N (VC)	0.661	12.45	0.820	282.88
T_{16}	50% N (urea) +25 % N (FYM) + 25% N (PM)	0.642	11.79	0.796	272.35
T_{17}	50% N (urea) + 25% N (VC) + 25% N (PM)	0.703	12.78	0.871	302.12
	SEm±	0.026	0.527	0.036	15.94
	CD (P=0.05)	0.076	1.514	0.104	45.81

VC= Vermicompost, PM= Poultry manure

carbohydrate assimilated by the enhanced rate of photosynthesis. Further, increased vegetative growth might have provided more sites for translocation of photosynthates, which ultimately resulted in increased yield. Higher rates of photosynthesis, transpiration and stomatal conductance due to application of vermicompost in present investigation also strengthen these findings. These results were in accordance with the findings of Reddy *et al.* (1998) in garden pea, Tomar *et al.* (1998) in brinjal and Oliveira *et al.* (2001) in cabbage. Reddy *et al.* (1998) reported that maximum number of pods per plant, seeds per pod and yield of garden pea cv. FC-1 can be obtained by application of 10 t vermicompost ha^{-1} along with recommended doses of NPK (27.5:60:50 kg ha^{-1}). Likewise, Oliveira *et al.* (2001) reported that highest head weight (700 g) and yield (38 t ha^{-1}) of cabbage cv Mastukaze was obtained with the application of earthworm compost @ 27 and 29 t ha^{-1}, respectively. Azarmi *et al* (2008) concluded that addition of vermicompost @ 15t/ha significantly increase the growth and yield of tomato. Premsekhar and Rajashree (2009) also reported that FYM @20 t/ha recorded the highest yield of okra (10.39 t/ha) with the B:C ratio of 3.56.

Quality attributes

Nitrogen content in leaves, protein content in head and vitamin C content were increased with the application of organic sources of nitrogen along with urea as compared to control (Table 3). However, there was no significant effect of organic manures or urea on vitamin C content of the head. Application of nitrogen 50% through urea + 50% through vermicompost exhibited maximum nitrogen content of 3.57% in leaves and protein content of 14.61% in head of cabbage. It might be due to improved nutritional environment in the rhizosphere as well as its utilization in the plant system, leading to enhanced translocation of nutrients, vitamins and proteins in heads. Another reason might be the increased activity of nitrate reductase which helped in synthesis of certain amino acids and proteins as reported by Lopes *et al.* (1996) in cowpea and Rajkhowa *et al.* (2000) in green gram. Yadav (2002) also reported that organic manures in combination with inorganic form of nitrogen increased the protein content in okra. Mukesh Kumar *et al* showed that total chlorophyll content was increase with the application of poultry manure and vermicompost as compared to urea. Premsekhar and Rajashree (2009) also reported that chlorophyll content in the leaves of okra have been significantly improved with the application of organic sources of nutrients.

References

Abdel-Nasser, G. and Hussein, A.H.A. 2001. Effect of different manure sources on some soil properties an sunflower plants growth. I. soil physical and chemical properties. *Alexendria Journal of Agricultural Research*. 46: 227-251.

Abusaleha, H. 1992. Effect of different sources and forms of nitrogen on the uptake of major nutrients in okra. *Indian Journal of Horticulture*. 49: 192-196.

A.O.A.C. 1960. Official method of analysis, (18th Ed). Association of Official Agricultural Chemist, Washington.

Awodun, M.A. 2007. Effect of poultry manure on growth, yield and nutrient content of Fluted Pumpkin (Telfaria occidentalis Hook F). *Asian J. Agric. Res.*1(2): 67-73

Azarmi, R, Ziveh, P.S. and Satari, M.R. 2008. Effect of vermicompost on growth, yield and nutrition status of tomato (*Lycopersicum esculentum*). *Pak J Biol Sci.* 11(14): 1797-1802.

Gopal, L. and Lal, G. 1996. Effect of nitrogen and spacing on yield and quality of cabbage (*Brassica oleraces* var. capitata). *Annals of Bilogy* (*Ludhiana*). 12:242-244.

Jose, D., Shanmufavelu, K.G. and Thamburaj, S. 1988. Studies on efficacy of organic vs inorganic form of nitrogen in brinjal. *Indian Journal of Horticulture*. 45: 100-103.

Lopes, A. J., Stanford, N. P., Figueiredo, M.V.B., Burity, N. A. and Ferraz, E. B. 1996. Effect of vermicompost mineral nitrogen and mineralization agent on N-fixation and yield of cowpea. *Revista Braxsileira de cinica do solo*. 20 : 55-62.

Mukesh Kumar, Sultan Singh, Sharma, S.K. and Devi Singh 2007. Effect of different N sources on yield, nutrients and chlorophyll content of marigold cv Pus Narangi. *Environ. and Eco.*25S

Oliveira, A.P., Ferreira, D.S., Costa, C.C., Silva, A.F. and Alves, E.V. 2001. Utilization of cattle manure an dearth worm compost in hybrid cabbage production. *Horticulture Brasileira* 13;70-73

Premsekhar, M. and Rajashree, V. 2009. Influence of organic manures on growth, yield and quality of Okra. Am-Eurasian J. Sustain. Agric.,3(1): 6-8.

Rajkhowa, D.J., Gogoi, A.K., Khandali, R. and Rajkhowa, K.M. 2000. Effect of vermicompost on green gram nutrition. *Journal of Indian Society of Sol Science*. 48: 207-208.

Reddy, R., Reddy, M.A.N., Reddy, Y.T.N., Reddy, N.S. and Anjanappa 1988. Effect of organic and inorganic sources of NPK on growth and yield of pea (*Pisum sativum*). *Legume Research*. 21:57-60

Thanunathan, K., Natarajn, S., Sentikumar, R. and Asulmurugan. 1997. Effect of different sources of organic amendments ongrowth and yield of onion in mine spoil. *Madras Agric. J.* 84:382-384.

Tomar, V.K., Bhatnagar, R.K. and Palta, R. K. 1998. Effect of vermicompost on production of brinjal and carrot. Krishi Anusandhan Patrika. 13: 153-156.

Wang, X.D., Wang, F.T., Liao, Z. Z., Lin, Z. and Mao, P. 1996. Study of formula selection and rational application amont of organic and inorganic granular fertilizer for some vegetable crops. *Acta Agric. Shanghai*. 12: 61-65.

Yadav, P. 2002. Effect of organic manures and nitrogen levels on growth, yield and quality of okra (*Abelmoschus esculentus* L.) M.Sc. Thesis, Rajasthan Agricultural University, Bikaner.