International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(4): 2196-2200

Received: 25-05-2018
Accepted: 27-06-2018

Dakge Riba
Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh, India

Amreen Hasan
Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh, India

Narendra Swaroop
Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh, India

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

Arun A David
Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh, India

Smriti Rao
Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh, India

Correspondence
Dakge Riba
Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, Uttar Pradesh, India

Effects of organic and inorganic source of nutrients on Physio-chemical properties of soil and yield of cabbage (*Brassica oleracea* L.)

Dakge Riba, Amreen Hasan, Narendra Swaroop, Tarence Thomas, Arun A David and Smriti Rao

Abstract
The field experiment was conducted on effects of organic and inorganic fertilizers on soil health, growth and yield of Cabbage (*Brassica oleracea* L.) Cv. Magic ball at the Soil Science Research Farm, Sam Higginbottom University of Agriculture & Technology Sciences during Rabi season 2017-2018. The maximum plant height (24.45 cm), maximum head diameter (21.56 cm) and maximum yield (24.12 tonnes/ha^{-1}) was obtained in treatment T_8 (@40kg ha^{-1} N_{40} + @10 t ha^{-1} FYM)). Growth parameters, soil properties, increased significantly with the application of FYM and inorganic fertilizers with recommended dose of P&K i.e. maximum pH, EC (dSm^{-1}) and pore space(%) was obtained in T_8 [@40kg ha^{-1} N_{40} + @10 t ha^{-1} FYM] were increase with increase in fertilizer levels. The lowest values related to all parameters were obtained in control treatment. Cost benefit ratio (C: B) 1: 3.56 was highest in T_6 (@40kg ha^{-1} N_{40} + @0 t ha^{-1} FYM) and T_8 (@40kg ha^{-1} N_{40} + @10 t ha^{-1} FYM) was more profitable Rs 84934.40 ha^{-1} than any other treatments and recommendations.

Keywords: NPK, FYM (farm yard manure), urea, cost benefit ratio, cabbage

Introduction
Cabbage (*Brassica oleracea*) is a green leafy biennial plant, belonging to the Brassicaceae family originating from California. It is grown as an annual vegetable crop for its dense leaved heads. It is descended of the wild cabbage, *Brassica oleracea* var.oleraceae and is closely related to broccoli and cauliflower. Cabbage (*Brassica oleracea*L. var. *capitata*L.) is the most widely cultivated cole crop in the world and can beused as fresh (salad) or cooked vegetable products. The head is an excellent source of vitamins, minerals and dietary fibers. It is a good source of vitamin A, B, & C, contains minerals like P, K, Na, Fe, fats and protein. It has cooling effect and helps to prevent diabetic problems. The Food and Agriculture Organization of United Nations (FAO) 2012 reports that world production of cabbage and other brassicas for 2011 was almost 69 million metric tons (68 million long tons; 75 million short tons).
The root system of cabbage is fibrous and shallow, about 90 percent root mass is the upper 20-30 cm (8-12 in) tall, with flowers that are yellow or white. The initials leaves form a rosette shape compromising 7-15 leaves, each measuring 25-30 cm (10-14 in) by 20-30 cm (8-12 in) leaves.
Cabbage grows best in a relatively cool and humid climate. Leaves are more distinctly petioled and the quality of the head is impaired in drier atmospheres. The optimum temperatures for growth and development are from 18 °C to 20 °C. It is fairly resistant to frost and can survive temperatures as low as - 3 °C without damage. Cabbage is also adapted to a wide variety of climatic conditions and can such be grown throughout the year in most regions. Cabbage can be grown on a wide range of soils but it thrives on well-drained, moisture-retentive loamy soils well supplied with organic matter. It does not grow well on highly acidic soil. The ideal soil pH ranges from 5.5 to 6.5 and it should not be allowed to fall below 4.5. In soils with pH above 6.5 the leaves become dark but leaf margins die back. Plants in saline soils are also highly susceptible to blackleg.
The crop demands higher amount of plant nutrients particularly nitrogen for head production. However, excess supply of nitrogen through inorganic fertilizers although increases the total dry weight but adversely affects the head quality by producing coarse and loose head, reducing keeping quality and enhancing the nitrate nitrogen content of head (Ojetayo *et al*., 2011) [32].

Some study suggests that application of higher amount of organic manure along with reduced levels of inorganic nitrogen fertilizer can improve the nutritional and keeping quality of cabbage head (Londhe 2002; Yadav *et al*., 2001) [57]. Therefore, integrated nutrient management practices will be beneficial for improvement of overall quality of head.

Organic and inorganic fertilizers use is primarily based on providing nutrients to plants, sustaining plant growth and development and increasing yield. Inorganic fertilizers are cheaper and thus more affordable, resulting in the use of more mineral and less organic fertilizers (OF), increasing thus incidents of unbalanced fertilization, soil physical structure deterioration and degradation, salt accumulation, secondary salinization etc. Organic matter increases the content of organic carbon, microbial biomass and cation exchange capacity. Organic inputs alone will not meet the nutritional needs of crops because they contain a comparatively less quantity of nutrients compared to inorganic fertilizers, the need to integrate the two forms in order to achieve better crop yields. The interaction between organic matter and inorganic fertilizers may lead to either an increase or decrease in nutrients in soil depending on the nutrient and plant material.

Materials and Methods

The field experiment on effect of organic and inorganic source of nutrients on the physio-chemical properties of soil and yield of cabbage (*brassica oleracea l.*) Cv. Magic ball was conducted during the Rabi season of the year 2017-2018 at the Research Farm of Department of Soil Science, Sam Higginbottom university of Agriculture, Technology and Sciences. Allahabad (UP), located at 25'N latitude 81.50'E longitude and 98m above the mean sea level. Agroclimatically, Allahabad district represents the subtropical belt of the South East of Uttar Pradesh, and is endowed with extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46℃- 48℃ and seldom falls as low as 4℃ -5℃. The relative humidity ranged between 20 to 94 percent. The average rainfall of this area is around 1100mm annually. It comes under subtropical climate receiving the mean annual rainfall of about 1100mm, 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 5.9 0c and the maximum is to be 29.04 0C. The minimum humidity was to be 42.72.0% and maximum was to be 93.28%.

Table 1: The nine treatments combinations of organic and inorganic fertilizer.

Treatment	Treatment Combinations
T_0	control
T_1	@$0N_0$ + @5 t ha^{-1} FYM
T_2	@$0N_0$ + @10 t ha^{-1} FYM
T_3	@20kg ha^{-1} N_{20} + @0 t ha^{-1} FYM
T_4	@20kg ha^{-1} N_{20} + @5 t ha^{-1} FYM
T_5	@20kg ha^{-1} N_{20} + @10 t ha^{-1} FYM
T_6	@40kg ha^{-1} N_{40} + @0 t ha^{-1} FYM
T_7	@40kg ha^{-1} N_{40} + @5 t ha^{-1} FYM
T_8	@40kg ha^{-1} N_{40} + @10 t ha^{-1} FYM

Result and Discussion

Experiment will be laid out in 2x2 randomized block design (RBD) with different doses of organic and inorganic fertilizer, plot size was 2x2 m^2. Cabbage grows on 29th November 2017 and the source of nutrients were FYM, Urea, SSP and MOP respectively. Basal dose of fertilizer was applied in respective plots according to treatment allocation. All the agronomic practices were carried out uniformly to raise the crop. The crop was harvested on 27th Jan 2018 first cutting and 30th Jan 2018 second cutting. Soil samples were collected from the soil 0-15 cm depth, air dried kept in an oven at 105^0C for 48 hrs for drying, pass through 2 mm sieve, soils were analysis by using standard procedures as described for pH 1:2 (w/v) (Jakson 1958), EC (dSm^{-1}) (Wilcox 1950), Organic Carbon (%) (Walkley and Black 1947), available Nitrogen kg ha^{-1} (Subbiah and Asija 1956), Phosphorus kg ha^{-1} (Olsen *et al.*, 1954) and Potassium kg ha^{-1} (Toth and Price 1949), Boron kg ha^{-1} (Wilcox 1950), Sulfur kg ha^{-1} (Bardsley and Lancaster 1960), Magnesium Meq/100g (Bower *et al.* 1952), Calcium Meq/100g (Bower *et al.* 1952). The plant parameter, physical and chemical properties during the experiment are presented in Tables 2, 3, and 4 respectively.

Table 2: Plant growth parameter

Treatment	Plant height(cm)	Head diameter(cm)	Head yield
T_0	18.21	11.08	10.21
T_1	21.00	14.33	11.25
T_2	21.04	15.31	11.00
T_3	21.24	16.27	16.55
T_4	22.95	18.26	20.15
T_5	22.14	20.31	23.90
T_6	22.31	17.15	18.32
T_7	23.27	19.48	21.41
T_8	24.45	21.56	24.12
F-Test	S	S	S
C.D	2.082	1.38	2.527

Table 3: Physical & chemical properties of soil (pre- sowing)

Particulars	Results	Methods
Sand (%)	45.5%	Bouyoucos Hydrometer method (1952)
Silt (%)	37.0%	Bouyoucos Hydrometer method (1952)
Clay (%)	17.5%	Bouyoucos Hydrometer method (1952)
Soil Color	-	Munshell Color Chart (1915)
Dry Soil	10YR 6/4 light yellowish brown	
Wet Soil		10YR 4/3 brown
pH	7.07	Jackson, 1958
EC (dSm^{-1})	0.5	Wilcox, 1950
Available nitrogen (N) kg ha^{-1}	210 kg ha^{-1}	Subbaih and Asija, 1956
Available phosphorus (P) kg ha^{-1}	13.01 kg ha^{-1}	Olsen *et al*., 1954
Available potassium (K) kg ha^{-1}	210 kg ha^{-1}	Toth and Prince, 1949

Table 4: Effect of different levels of organic and inorganic on Physio-Chemical properties of soil after harvest of cabbage.

Treatment	Bd,(Mg m^{-3})	Pd (Mgm^{-3})	Pore space (%)	pH 1:2 (w/v)	EC (dSm^{-1})	Organic Carbon (%)	N (kg ha^{-1})	P2O5 (kg ha^{-1})	K2O (kg ha^{-1})
T_0	1.17	2.54	51.52	7.16	0.78	0.36	82.41	13.5	250.13
T_1	1.19	2.57	52.52	7.23	0.82	0.41	84.75	16.5	257.6
T_2	1.19	2.67	53.64	7.2	0.82	0.40	90.75	19.5	257.6
T_3	1.17	2.65	54.20	7.26	0.81	0.40	90.75	16.5	268.8
T_4	1.19	2.62	54.71	7.26	0.85	0.40	91.5	16.5	265.8
T_5	1.17	2.57	53.67	7.2	0.85	0.42	91.5	18.0	257.6
T_6	1.21	2.63	53.22	7.23	0.83	0.37	93.11	19.5	261.33
T_7	1.20	2.66	55.98	7.26`	0.89	0.42	94.5	21.0	272.5
T_8	1.21	2.68	56.36	7.30	0.91	0.41	95.25	19.5	272.53
F-Test	NS	NS	NS	NS	NS	S	S	S	S
C.D	1.756	0.082	1.806	1.791	1.238	0.011	2.884	0.974	2.884

Physical properties of soil (post-harvest)

The results given in Tables 4 indicates some of the important parameter of physical and chemical properties for Cabbage. NPK and FYM fertilizers conjunction on pH, EC, bulk density, particle density and pore space to be non-significant. The pH, EC (dsm^{-1}), bulk density (Mgm^{-3}), particle density (Mgm^{-3}) and pore space (%) of post-harvest soil was recorded 7.30, 0.91, 1.21, 2.68 and 56.36 respectively in the treatment T_8 that was significantly higher as compared to other treatment combination. The slight decreased in bulk density, particle density and pore space may be due to tillage operation and increase in plant growth.

Chemical properties of soil (post-harvest)

Table 4 indicates some of the important parameter on physical properties on Cabbage. NPK and FYM fertilizers in conjunction on pH, EC (dsm^{-1}), BD, PD, and pore space was found non-significant and Organic carbon (%), available nitrogen (kg ha-1), available phosphorus (kg ha-1), available potassium (kg ha-1). Organic carbon (%), available nitrogen (kg ha-1), available phosphorus (kg ha-1), available potassium (kg ha-1), was recorded (0.41, 95.25, 19.5, 272.53) respectively in the treatment T_8 that was significantly higher as compared to other treatment combination.

The slight increase in soil pH, soil EC (dSm-1), phosphorus (kg ha-1), Organic carbon (%),available potassium (kg ha-1) and decrease in available nitrogen (kg ha-1) may be due to increase in levels of inorganic fertilizer and FYM fertilizer, similar observation was found by Everaarts A.P and R. Booi (2000) [3]. It may be concluded from trial that the various level of inorganic fertilizer and FYM fertilizer used from different sources in the experiment, the treatment combination T_8 (@40kg ha^{-1} N_{40} + @10 t ha^{-1} FYM) was found to be the best, for improvement in physical and chemical properties of soil.

Conclusion

On the basis of present investigation it is concluded that the treatment T_8 (N_{40}40kg ha^{-1}+ 10 t ha^{-1} FYM) was found to be the best treatment combination in respect to plant growth and head yield parameter. T_6 (40kg ha^{-1} N_{40} + 0 t ha^{-1} FYM) and T_7 (40kg ha^{-1} N_{40} + 5 t ha^{-1} FYM) was found to be the best treatment combination in respect to net return and gross return of Cabbage grown under Allahabad Agro-climatic conditions. This treatments showed maximum gross return, net return and benefit: cost ratio i.e. (3.56) respectively. These findings are based on one year research trial, to sustain more work to be needed for the same.

Acknowledgements

The authors are grateful to the department of Soil Science and Agricultural Chemistry, Naini Agriculture Institute, for taking their keep interest and encouragement to carry out the research work at Sam Higginbottom University of Agriculture**,** Technology & Sciences, Allahabad 211007.

Reference

1. Alok KM. Integration of different sources of nitrogen for yield maximum of cabbage. M.Sc. Thesis B.C.K.V. Kalyani, 2001.
2. Akhter S, Sen Akter RS, Silva JAT, da Haque A, Noor S. Efficacy of vermicompost to improve soil health, yield and nutrient uptake of cauliflower in grey terrace soil of Bangladesh. (Special Issue: Vermitechnology III.). Dynamic Soil, Dynamic Plant. 2013; 6(1):103-109.
3. Everaarts AP, R Booi. The effect of nitrogen application on nitrogen utilization by white cabbage (*Brassica oleracea* var.capitata) and on nitrogen in the soil at harvest. 2000; 75(6):705-712.
4. Azarmi R, Giglou MT, Taleshmikail RD. Influence of vermicompost on soil chemicsl and physical properties in tomato (*Lycopersicum esculentum*) field. African Journal of Biotechnology. 2008; 7(14):2397-2401.
5. Bharadwaj ML, Harender Raj, Koul BL, Raj H. Yield response and economics of organic sources of nutrients as substitutestoxy inorganic. Sources in tomato, okra, cabbage and cauliflower. Indian J agric. Sci. 2002; 70(10):653-656.
6. Bergamin LG, Cruz MCP, da Ferreira ME, Barbosa JC. Cabbage yield in relation to boron fertilization associated with organic manure [Portuguese]. Horticultura Brasileira. 2005; 23(2):311-315.
7. Chan KY, Dorahy C, Wells T, Fahey D, Donovan N, Saleh F *et al.* Use of garden organic compost in vegetable production under contrasting soil P status. Australian Journal of Agricultural Research. 2008; 59(4):374-382.
8. Dalal VV, Bharadiya PS, Aghav VD. Effect of organic and inorganic sources of nitrogen on growth and yield of cabbage (*Brassica oleracea* var. capitata). Asian J Hort. 2010; 5(2):291-293.
9. Dhama AK. Organic farming for sustainable agriculture, Agrobios, 2003.
10. Dixit SP. Effect of nitrogen and FYM on the productivity of cabbage in dry temperate hill zone of Himachal Pradesh. Ann. agric. Res. 1997; 18(2):258-261.
11. Dubey NK, Pyare APR, Mishra A. Integrated nutrient management in broccoli (*Brassica oleracea* L. italica Plenck). Plant Archives. 2009; 9(1):423-425.
12. Eimhoit S, Schjonning P, Munkholm LJ. Soil aggregation a matter of proper management. Danish Research centre for organic farming, 2005.
13. FAO. Food and Agricultural Organisation, 2012.

14. Fortuna A, Harwood RR, Paul EA. The effect of compost and crop rotation on carbon turnover and the particulate organic matter fraction.Soil Science. 2003; 168(66):434-440.
15. Gadge PM. Effect of organic and inorganic fertilizers on the growth, yield and quality of cabbage *Brassica oleracea* var. capitata. M.Sc (Agri) Thesis., MKV, Parbhani, 2003.
16. Gh Peyvast, JA Olfati, S Madeni, A Forghani. Effect of vermicompost on the growth and yield of spinach (*Spinaciaoleracea* L.) Journal of Food, Agriculture & Environment. 2008, 6(1).
17. Ghuge TD, Gore AK, Jadhav SB. Effect of organic and inorganic nutrient sources on growth, yield and quality of cabbage. J. Soil Crops. 2007; 17(1):89-92.
18. Ghosh BC, BeraN, Das D, Swain DK. Effect of Varying soil and vermicompost mixtures on Growing Media and yield and Quality of Sweet corn. International Conference on Food and Agricultural Sciences. 2013; 55:8.
19. H Biswas, Dev Narayan, Brij Lal Lakaria. Effect of integrated nutrient management on soil properties and performance of aonla (*Emlica officinalis*) based agri-horti system in Bundelkhand region. Indian Journal of Soil Conservation. 2012; 40(2):141-146.
20. Kanwar K, Paliyal SS, Nandal TR. Integrated nutrient management in cauliflower (Pusa Snowball K-1).Research on Crops. 2002; 3(3):579-589.
21. Kumar M, Kumari P, Ojha RK, Kumar Anil, Prasad K K. Effect of temperature on growth and yield of broccoli under integrated nutrient management. Progressive Horticulture. 2012; 44(2):307-312.
22. Kumazr Sajib, Prosanta Kumar Dash, Bipradas Adhikary, Md, Abul Mannan, Yield Performance of Cabbage under different combinations of manures and fertilizers. World Journal of Agricultural Sciences. 2015; 11(6):411-422.
23. Londe DS. Studies on integrated nutrient management in cabbage (*Brassica oleracea* varcapitata L). M.Sc Agri)Thesis. MPKV, Rahuri. 2002.
24. Mohd Rafi, Narwadkar PR, Prabu T, Sajindranath AK. Effect of organic and inorganic fertilization on yield and quality of tomato.Soils and Crops. 2002; 12(2):167-169.
25. Mohapatra SK, Munsi PS, Mahapatra. Effect of integrated nutrient management on growth, yield and economics of broocoli (*Brassica Oleracea* L Var. italicaplenck.) vegetable science. 2013; 40(1):69-72.
26. Mishra US, Pandey RC, Sharma PK. Effect of integrated use of organic manure and fertilizers on the growth, yield and quality of cabbage (*Brassica oleracea*var. capitata L.) cultivars Golden acre. New Agriculturist. 2012; 23(1):99-102.
27. Moradi Hossein, Fahramand Mohammad, Alirezasobhkhizi Mohammad, Adibian, Mohen Noori, Shilaabdollahi, Khashay Rigi. Effect of vermicompost on plant growth and its relationship with soil properties. Intl. J. Farm &Alli. Sci. 2014; 3(3):333-338.
28. Nagavellamma KP, Wani SP, Stephane Lacroix, Padmaja VV, Vineela C, BabuRao M. et al. Vermicomposting: Recycling wastes into valuable organic fertilizer Global Theme an Agroecosystems Report no.8. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi – Arid Tropiocs, 2001, 20.
29. Nanthakumar S, Veeraragavathatham D. Changing scenario in the production system of horticultural crops.Proceedings of the National seminar. South Indian Hort. 2001; 49:195-198.
30. Nitin Gudadhe, MB Dhonde, NA Hirwe. Effect of integrated nutrient management on soil properties under cotton chickpea cropping sequence in versitols of Deccan plateau of India. Agricultural research communication centre Indian J. Agric. Res. 2015; 49(3):207-214.
31. Oelhaf RC. Organic agriculture:Economicand ecological comparisions with conventional methods. http://ideas.repec.org/a/eee/jfpoli/v6y1981i3p207-208.html (accessed February 2011), 1978.
32. Ojetayo AE, Olaniyi JO, Akanbi WB, Olabiyi TI. Effectof fertilizer types on nutritional quality of two cabbage varietiesbefore and after storage. Journal of Applied Bioscience. 2011; 48:3322-30.
33. Pandey AK, Mishra RK, Rai Mathura. Infiuence of soil amendments and azotobacter on growth and yield of Broccoli (*Brassica oleraceavar.* Italica L) veg. sci. 2008; 35(2):165-168.
34. Parmar DK, Vinod Sharma. Integrated nutrient management in cauliflower under mid-hills of Western Himalayas. Annals-of-Agricultural- Research. 2001; 22(3):432-433.
35. Padamwar SB, Dakore HG. Role of vermicompost in enhancing nutritional value of some cole crops. International Journal of plant sciences. 2010; 5(1):397-398.
36. PeerzadaIshfaq Akbar, Vijay Kumar, M Faeem Malik. Effect of bio-organic fertilizers on the performance of cabbage under western U.P conditions. Annals of Horticulture. HI- Tech Horticultural Society, 2009; 2(2):204-206.
37. Prabhakaran C, James GP. Effect of different organic Nitrogen sources on Ph, Total soluble solids, Titrable acidity.Reducing and Non 62 reducing sugars, Crude protein and Ascorbic acid content of tomato fruits. J. Soils and Crops. 2002; 12(2):160-166.
38. Prassana KP, Rajan S. Effect of organic farming on storage life of brinjal fruits. Changing scenario in the production systems of horticultural crops. South Indian Hort., 49 (special), 2001, 255-256.
39. Premuzic Z, Garate A, Bonilla I, Booij R, Neeteson J. Towards an ecologically Sound fertilization in field vegetable production.Acta Hort. 2002; 571:65-72.
40. Rao TSS, Sankar CR. Changing scenario in the production systems in horticultural crops. Proceedings of a national seminar. South Indian Hort. 2001; 4:288-291.
41. Rai R, Thapa U, Mandal AR, Roy B. Growth, yield and quality of cabbage (*Brassica oleracea* var. capitata L.)as influenced by vermicompost.Environment and Ecology. 2013; 31(1):314-317.
42. Romaniuk R, Giuffre L, Romero R. A soil quality Index to evaluate the vermicompost Amendments effects on soil properties. Journal of Environmental Protection. 2011; 2:502-510.
43. Renuka B, Ravishankar C. Effect of organic manures on growth an yield of tomato. South Ind. Hort. 49 (special) 2002, 216-219.
44. Sarkar AK, Singh RP. Importance of long term fertilizer use for sustainable agriculture in Jharkhand. Fert. News. 2002; 47(11):107-111.
45. Scholl LV, Nieuwenhuis R. Soil fertility management, 4thedn. *Agromisa Foundation*, Wageningen Publisher, Netherlands, 2004.

46. Shelke SR, Adsule RN, Amrutsagar VM. Nitrogen management through organics and inorganics in brinjal. J. Maharashtra agric. Univ. 1999; 24(3):297-298.
47. Sreenivas Muralidhar S, Rao MS. Vermicompost A viable component of IPNSS in nitrogen nutrition of ridge gourd. Ann. agric.Res. 2002; 21(1):108-113.
48. Shalini SB, Channal HT, Hebsur NS, Dharmatti PR, Sanrangamath. Effect of integrated nitrogen management on yield of knol-khol and population of Azospirillum in Vertisol. 2002; 15(1):151-152.
49. Sharma KC. Influence of integrated nutrient management on yield and economics in broccoli (*Brassica oleracea* L. var. italica) plant under cold temperate conditions. Veg. Sci. 2000: 27:62-63.
50. Singh DK, Singh IP, Singh B, Pal MK. Effect of integrated nutrient management on growth attributing parameters in cabbage (*Brassica oleracea* var. capitala L.). Progressive Agriculture. 2008; 8(2):243-246.
51. Supe VS, Marbhal SK. Effect of organic manure with graded levels of nitrogen on growth and yield of cabbage (*Brassica oleraceae* var. capitata L.). Asian Journal of Horticulture. 2008; 3(1):48-50.
52. Subba Rao TSS, Ravishankar C. Effect of organic and inorganic manures on growth and yield of brinjal. South Indian Hort., 2000; 49(special):288-291.
53. Veerabhadraiah TN, Hamegowda TCB. Consequences of organic and inorganic sources of nutrition on physio-chemical properties of soil under French bean land use cover. 18th World Congress of Soil Science. Philadelphia, Pennsylvania, USA, 2006.
54. Vimala P, Illias MK, Salbiah H. Effect of rates of organic fertilizer on growth, yield and nutrient content of cabbage (*Brassica oleraceae* var. capitata) grown under shlter. Acta- Horticulturae. 2006; 7(10):391-397.
55. Wang Yuan, Yuan Shei, Fei Liu, Rong Hou, Wu Li Juan. Effect of anaerobic fermentation residue of biogas production on yield and quality of Chinese cabbage and nutrient accumulations in soil. International Journal of Global Energy Issues. 2008; 29(3):284-293.
56. Weber J, Karezewska A, Drozd J, Licznar M, Lieznar S, Jamroz E *et al*. Agricultural and ecological aspects of a sandy soil as affected by the application of municipal solid waste composts. Soil Biology and Biochemistry. 2007; 39:1294-1302.
57. Yadav VS, Yadav BD, Sharma YK. Effect of NICAST (*Organic manure*) in comparison to recommended doses ofmanure and fertilizers in cabbage. South Indian Horticulture. 2001; 49:157-9.