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Research Article

EFFECT OF INM ON YIELD, QUALITY AND ECONOMICS OF CABBAGE (*Brassica oleracea var. capitata* L.) AND ON PHYSICO-CHEMICAL PROPERTIES OF SOIL

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Abstract- A field experiment was carried out at College Agronomy Farm, Anand Agricultural University during *rabi* 2013-14 to study an effect of integrated nutrient management on cabbage (*Brassica oleracea var. capitata* L.) under middle Gujarat. The treatments consisted of 10 treatments, *viz*., 100 % RDN + FYM @ 20 t ha^{-1} (T_1), 100 % RDN + FYM @ 20 t ha^{-1} + Azotobactor + PSB (T_2), 100 % RDN + vermicompost @ 10 t ha^{-1} (T_3), 100 % RDN + vermicompost @ 10 t ha^{-1} + Azotobactor + PSB (T_4), 100 % RDN + FYM @ 10 t ha^{-1} (T_5), 100 % RDN + FYM @ 10 t ha^{-1} + Azotobactor + PSB (T_6), 75 % RDN + FYM @ 10 t ha^{-1} (T_7), 75 % RDN + FYM @ 10 t ha^{-1} + Azotobactor + PSB (T_8), 75 % RDN + vermicompost @ 5 t ha^{-1} (T_9) and 75 % RDN + vermicompost @ 5 t ha^{-1} + Azotobactor + PSB (T_{10}). Application of 100 % RDN + vermicompost @ 10 t ha^{-1} + Azotobactor + PSB (T_4) recorded higher yield (41.5 t ha^{-1}) and net return(244467 ha^{-1}). However, quality parameter *i.e*., head compactness (41.7 %) was recorded higher in treatment T_7 (75 % RDN + FYM @ 10 t ha^{-1}) while moisture content of cabbage head remained non significant. In case of physico-chemical parameter of soil INM treatments did not show their significant influence on EC, pH, available phosphorus and potassium status and bulk density in soil after harvesting of crop but the organic carbon content in soil after harvesting of crop remained high in treatment T4 (0.46) and T3 (0.46).

Keywords- INM, FYM, Vermicompost, Cabbage, Head compactness, Moisture content

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Introduction

Cabbage (*Brasicca oleracea var. capitata* L.) is one of the important leafy vegetable crops. The cabbage belongs to cruciferae family. The "Sauerkraut" is favorite food in Russia, Germany and U.S.A. which is made by fermenting chopped, ground or sliced cabbage in its juice with little salt added to it and from the nutritional point of view, it ranks very high. Its nutritional value per 100 g green leaves contains energy 103 KJ, 5.8 g carbohydrate, 36.6 mg vitamin C and 2.5 mg dietary fibre. Cabbage is a good source of β-carotene and fibre. The particular flavor in the cabbage head is due to the glycoside "sinigrin" which also contains sulphur. Cabbage is originated from the South and Western part of Europe. World vide, it is grown in area of 21.5 million ha with production of 59.55 million tonnes with productivity of 27.7 tones ha^{-1}. In India, it is cultivated in 0.36 million ha area with an annual production of 7.94 million tonnes with productivity of 21.5 tones ha^{-1}. It covers about 4 per cent of the total area under vegetables. In the Gujarat state, It is cultivated in 28.2 thousand ha area with production of 5.53 million tones and productivity of 1.96 million tonnes ha^{-1}. In Gujarat, major cabbage growing districts are Mehsana, Kheda, Vadodara, Gandhinagar and Sabarkantha. Cabbage is one of the most popular vegetable by virtue of its high nutritive and culinary values. It has been shown to reduce the risk of some cancers, especially those in the colorectal group. This is possibly due to the glucosinolates found in cole crops, which serve as metabolic detoxicants or due to the sulphoraphane content, responsible for metabolic anti-carcinogenic activities. Cabbage is a source of indole-3-carbinol, a chemical that boosts DNA repair in cells and appears to block the growth of cancer cells. Research suggests that boiling these vegetables reduces their anti-carcinogenic properties. Cabbage is a geacy feeder and requires adequate manuring for profitable yields, which is a costlier so it is essential to use this input very cautiously and economically.

Nitrogen supply resulted in more chlorophyll content, which is together accelerated the photosynthetic rate and there by increased the supply of carbohydrates. The better availability of nitrogen also favoured the metabolic and auxin activities and also the vegetative growth, head weight, TSS, dry matter per cent and head diameter. The increased TSS and dry matter per cent in head might be due to the fact of plant protein, amino acid, as result of increased uptake of nitrogen. The role of organic manure in vegetable production is much more realized than in other cereal crops. Farm yard manure is commonly used as organic manure. The consistent and indiscriminate use of chemical fertilizers has caused serious damage to the soil health and ecology. Also, high yield of vegetable cannot be realized only with the use of organic and biological origin products. The application of organic manure might have significantly enhanced the availability of native and applied macro and micronutrients in the soil as a consequence of which the net weight of heads would have increased. Biofertilizers are cost effective and renewable source of plant nutrients to supplement the parts of chemical fertilizers. Biofertilizers are agriculturally important and beneficial microorganisms, which have the ability to mobilize the nutritionally important elements from non-usable to usable form through biological processes. Biofertilizers having a capacity provide soil nutrients to plant in available form and vary slowly so essential nutrients available throughout growing season. Keeping this in view, the present study was made to assess effect of integrated nutrient management on cabbage (*Brassica oleracea var. capitata* L.)

Materials and Methods

A field experiment was carried out in loamy sand soil, alluvial in origin, light brown in colour, well drained, fairly retentive of moisture, low in organic matter and

Table-1 *Effect of integrated nutrient management on yield, quality parameter and economics of cabbage (Brassica oleracea ver. Capitata L.)*

Treatments		Yield of head (t ha^{-1})	Head compactness (%)	Moisture content (%)	Net return (` ha^{-1})	B:C Ratio
T_1	100% RDN + FYM @ 20 t ha^{-1}	35.6	29.8	89.8	227057	3.92
T_2	100% RDN + FYM @ 20 t ha^{-1}+ *Azotobactor* + *PSB*	37.3	31.0	90.2	239947	4.13
T_3	100% RDN + vermicompost @ 10 t ha^{-1}	40.1	29.8	90.1	233777	2.68
T_4	100% RDN + vermicompost @ 10 t ha^{-1} + *Azotobactor* + *PSB*	41.5	27.5	90.9	244467	2.80
T_5	100% RDN + FYM @ 10 t ha^{-1}	33.8	34.4	89.8	222977	4.72
T_6	100% RDN + FYM @ 10 t ha^{-1} + *Azotobactor* + *PSB*	36.3	34.5	90.0	243267	5.14
T_7	75% RDN + FYM @ 10 t ha^{-1}	26.1	41.7	90.3	161840	3.48
T_8	75% RDN + FYM @ 10 t ha^{-1} + *Azotobactor* + *PSB*	26.7	39.8	90.2	166530	3.57
T_9	75% RDN + vermicompost @ 5 t ha^{-1}	33.4	36.6	90.3	205720	3.37
T_{10}	75% RDN + vermicompost @ 5 t ha^{-1} + *Azotobactor* + *PSB*	33.5	32.8	89.9	206810	3.38
S.Em. ±		1.8	2.4	1.06	-	-
C.D. (P=0.05)		5.3	7.0	NS	-	-
C.V. %		10.6	14.4	2.35	-	-

Table-2 *Effect of integrated nutrient management on physico-chemical properties of soil*

Treatments		EC (dS m^{-1})	pH	Bulk density (Mg cc^{-1})	Organic carbon(%)	Av. P_2O_5 (Kg ha^{-1})	Av. K_2O (Kg ha^{-1})
T_1	100% RDN + FYM @ 20 t ha^{-1}	0.248	7.53	1.36	0.44	46.5	244
T_2	100% RDN + FYM @ 20 t ha^{-1}+ *Azotobactor* + *PSB*	0.253	7.56	1.35	0.43	46.4	242
T_3	100% RDN + vermicompost @ 10 t ha^{-1}	0.267	7.66	1.35	0.46	48.0	229
T_4	100% RDN + vermicompost @ 10 t ha^{-1} + *Azotobactor* + *PSB*	0.266	7.61	1.34	0.46	48.7	224
T_5	100% RDN + FYM @ 10 t ha^{-1}	0.293	7.75	1.36	0.40	45.7	239
T_6	100% RDN + FYM @ 10 t ha^{-1} + *Azotobactor* + *PSB*	0.286	7.80	1.37	0.42	45.5	239
T_7	75% RDN + FYM @ 10 t ha^{-1}	0.230	7.63	1.37	0.41	45.4	231
T_8	75% RDN + FYM @ 10 t ha^{-1} + *Azotobactor* + *PSB*	0.240	7.55	1.36	0.39	43.9	231
T_9	75% RDN + vermicompost @ 5 t ha^{-1}	0.230	7.58	1.35	0.41	46.7	230
T_{10}	75% RDN + vermicompost @ 5 t ha^{-1} + *Azotobactor* + *PSB*	0.231	7.55	1.36	0.42	47.2	228
S.Em. ±		0.02	0.14	0.01	0.01	1.6	8.2
C.D. (P=0.05)		NS	NS	NS	0.03	NS	NS
C.V. %		12.1	3.61	2.0	4.48	7.0	7.0

medium in available phosphorus (43.0 kg ha^{-1}) and available potassium (228.0 kg ha^{-1}) at 0-15 cm soil depth during the *rabi* season of 2013-14 at College Agronomy Farm, B. A. college of Agriculture, Anand Agricultural University, Anand. The climate of this region is semi-arid and sub-tropical with fairly dry and hot summer. Winter is fairly cold and sets in, in the month of November and continues till the middle of February. The lower temperatures are usually recorded in the months of December and January. Summer is hot and dry which commences from mid of February and ends by the month of June. May is the hottest month with mean maximum temperature around 40ºC. The nutrient management treatments were *viz*., 100 % RDN + FYM @ 20 t ha^{-1} (T_1), 100 % RDN + FYM @ 20 t ha^{-1} + Azotobactor + PSB (T_2), 100 % RDN + vermicompost @ 10 t ha^{-1} (T_3), 100 % RDN + vermicompost @ 10 t ha^{-1} + Azotobactor + PSB (T_4), 100 % RDN + FYM @ 10 t ha^{-1} (T_5), 100 % RDN + FYM @ 10 t ha^{-1} + Azotobactor + PSB (T_6), 75 % RDN + FYM @ 10 t ha^{-1} (T_7), 75 % RDN + FYM @ 10 t ha^{-1} + Azotobactor + PSB (T_8), 75 % RDN + vermicompost @ 5 t ha^{-1} (T_9) and 75 % RDN + vermicompost @ 5 t ha^{-1} + Azotobactor + PSB (T_{10}). The experiment was laid out in randomized block design and replicated four times. The size of the unit plot was3.60m x 5.40m and each accommodates 6 rows of plant. The seedlings were transplanted at 60 x 45 cm spacing. Entire quantity of phosphorus (75 kg ha^{-1}) and potash (75 kg ha^{-1}) were applied as a common basal dose in furrow to all the plots in form of single super phosphate and muriate of potash, respectively. One half quantity of nitrogen was given as a basal dose at the time of preparation of land and remaining quantities was applied as top dressing at around 30 days after sowing. Need based plant protection measures were given whenever required. Head compactness was calculated by using following formula which was suggested by Pearson, (1931) Z=(C/W3) × 100 (Where, Z= an index of compactness, C= the average weight of cabbage head (g), W= the diameter of cabbage head). Economics was calculated based on the input and output prices. The statistical analysis of the data generated during the course of investigation was carried out on computerized system as per the procedure described by Cochran and Cox, (1967) [1].

Result and discussion

Yield of cabbage were significantly affected by INM treatments. Application of nitrogen @ 200 kg ha^{-1} along with 10 t vermicompost and Azotobactor + PSB (T_4) noted higher head yield of cabbage (41.5 t ha^{-1}) and it was at par with T_3 (100 % RDN + vermicompost @ 10 t ha^{-1}) followed by treatment T_2 (100 % RDN + FYM @ 20 t ha^{-1}+ Azotobactor + PSB) and treatment T_6 (100 % RDN + FYM @ 10 t ha^{-1} + Azotobactor + PSB). This might be due to INM enhanced growth attributes and yield attributes that increased in yield in this treatment. Superiority of vermicompost over farm yard manure was due to its nutritional richness, quick mineralization and more availability of nitrogen and other plant nutrients and also by biofertilizers which stimulated the root growth and induced changes in root morphology, which in turn affected the assimilation of nutrients. The increase in production can be explained as fixing of atmospheric nitrogen and make it available to plant through biofertilizers.

As nitrogen is constituent of protein and chlorophyll and it play a vital role in photosynthesis process. This enhanced accumulation of food materials, which in turn increased growth and yield attributes and ultimately yield of cabbage. The similar results were obtained by Choudhary, *et.al*., (2012) and Kumar, *et.al*., (2013) [2,3]. Asokan, *et a*l., and Goutham Kishore, (2018) [4,5) reported that phosphate solubilizing bacteria secretes some organic acids such as lactic, glycolic, fumaric & succinic acids which convert insoluble phosphates into soluble forms Data presented in [Table-1] revealed that maximum moisture content of cabbage head (90.9 %) was found in treatment T_4 (100 % RDN + vermicompost @ 10 t ha^{-1} + Azotobactor + PSB) over the rest of the treatments but it did not reach up to the level of significant.

Quality parameter

A perusal of data summarized in [Table-1] revealed that head compactness of cabbage was significantly influenced due to different treatments of INM. The higher head compactness of cabbage (41.7 %) was noted with the treatment T_7 (75 % RDN + FYM @ 10 t ha^{-1}) which was at par with treatment T_8 (75 % RDN + FYM @ 10 t ha^{-1} + Azotobactor + PSB) followed by treatment T_9 (75 % RDN + vermicompost @ 5 t ha^{-1}). This might be due to less diameter compared to weight of head under this treatment which resulted in increased the compactness of head. Maximum moisture content of cabbage head (90.9 %) was found in treatment T_4 (100 % RDN + vermicompost @ 10 t ha^{-1} + Azotobactor + PSB) over the rest of the treatments but it did not reach up to the level of significant. The present investigation results were similar to Kumar and Rawat (2002) and Thapliyat, *et.al*., (2008) [6,7].

Physico-chemical Properties of soil

In the study, different treatments of INM did not show their significant influence on EC, pH, available phosphorus and potassium status and bulk density in soil after harvesting of crop but the organic carbon content in soil after harvesting of crop found significant. It is evident from the data presented in [Table-2] indicates that different treatments of INM manifested significant influence on per cent organic carbon. Treatment T_4 (100 % RDN + vermicompost @ 10 t ha^{-1} + Azotobactor + PSB) showed its significant superiority in increasing per cent organic carbon (0.46 %) over rest of the treatments except T_3, T_2 and T_1. The lower organic carbon in soil 0.40 % was recorded with treatment T_8 (75 % RDN + FYM @ 10 t ha^{-1}+ Azotobactor + PSB). An increase in organic carbon status of soil in vermicompost + RDN along with biofertilizers treated plot is mainly due to increase in total microbial population of nitrogen fixing bacteria which in higher biomass production evident from higher yield of crop recorded over FYM. The present investigation results were similar to Ramesh, et.al., 2008 in onion and Yeptho, et.al., (2012) [8,9].

Economics of cabbage

Economics as influenced by different integrated nutrient management treatment. Treatment T_4 (100 % RDN + vermicompost @ 10 t ha^{-1} + Azotobactor + PSB) recorded the highest net realization of ` 244467 $ha^{-1}$ with BCR value of 2.80 followed by $T_6$ (100 % RDN + FYM @ 10 t $ha^{-1}$ + Azotobactor + PSB) registered of ` 243267 ha^{-1} net realization with the maximum BCR value of 5.12.

Application of research: Role of integrated nutrient management is more importance for better crop quality and soil health.

Research Category: Agronomy

Abbreviations:

RDN : Recommended dose of nitrogen
FYM : Farm yard manure
PSB : Phosphate solubilizing bacteria
BCR: Benefit cost ratio

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References

[1] Cochran W.G. and Cox G.M. (1967*) Experimental designs, John Willey and Sons. Inc. New York*, 546-568.
[2] Choudhary S., Soni A.K. and Jat N.K. (2012) *Indian Journal of Horticulture*, 69(4),550-554.
[3] Kumar M., Das B., Prasad K.K. and Kumar P. (2013) *Vegetable Sciences*, 40(1),117-120.
[4] Asokan R., Mohandas S. and Anand L. (2000) *Indian Horticulture*, 45, 1,44-47
[5] Goutham Kishore B.K., Punetha Parul and Bohra Mamta (2018) *International Journal of Agriculture Sciences* ,10(4), 5212-5215.
[6] Kumar M. and Rawat T.S. (2002) *Agriculture Science Digest*, 22 (2):90-92.
[7] Thapliyal A., Uniyal S.P., Bhatt L. and Bhusan B. (2008) *Progressive Agriculture*, 8(2),173-176.
[8] Ramesh P., Panwar N.R., Singh A.B. and Ramana S. (2008) *Indian Journal of Agricultural Sciences*, 78(12), 1033-1037.
[9] Yeptho A.K., Singh A.K., Kanaujia S.P. and Singh V.B. (2012) *Indian Journal of Agricultural Sciences*, 82(3), 236-240.