Original Research Article

~~**ECONOMICS OF CABBAGE PRODUCTION IN VARANASI REGION OF UTTAR PRADESH UNDER DIFFERENT LEVELS OF INTEGRATED NUTRIENT MANAGEMENT**~~

ECONOMICS OF CABBAGE PRODUCTION UNDER DIFFERENT LEVELS OF INTEGRATED NUTRIENT MANAGEMENT IN VARANASI REGION OF UTTAR PRADESH

Abstract

The excess use of chemical fertilizers is hazardous for soil and environmental health. To reduce the level of chemical fertilizers the field experiment was conducted at research farm, Department of Horticulture, Udai Pratap Autonomous College, Varanasi (U.P.) during *Rabi* season of 2016-17. The experiment was laid out in a randomized block design (RBD) with nine treatments replicated thrice. The treatment comprised of different levels of NPK, farmyard manure (FYM), vermicompost, phosphorus solubilizing *mycorrhiza*. The economic analysis of cabbage production, grown in Varanasi region of Uttar Pradesh showed net capital investment varied with different treatments. Results revealed that among the different INM levels, Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + *Azospirillum* @ 5kg ha^{-1} + Phosphorus Solubilizing *Mycorrhiza*@ 5 kg ha^{-1}) registered highest net return followed by Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} + Phosphorus Solubilizing*Mycorrhiza* @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}. Lowest net return was observed with treatment Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1}. Crop alimentation of cabbage by supplying Recommended dose of NPK ha^{-1} (150 kg: 125 kg: 100 kg) recorded highest benefit -cost ratio (3.11) while, application of Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} gives lowest benefit- cost ratio (2.05) among the all INM levels.

Keywords: Cabbage, Bio-fertilizer, farmyard manure, phosphorus solubilizing *mycorrhiza*, vermicompost, Economics

Introduction

Cabbage (*Brassica oleracea* var *capitata* L.) is most important member of genus brassica grown in world. Cabbage is originated from single wild (*Brassica oleracea* var *sylvestris* L.) commonly known as wild cabbage. It was the first Cole crop to be cultivated is a biennial vegetable crop belongs to Cruciferecrucifarae family. It is a temperatecrop and originated from Mediterranean region. The edible part of cabbage is head. Cabbage is used as boiled, cooked, salad, pickling and dehydration purpose. It neutralizes acidity and improves

digestion and appetite (**Katyal and Chadha, 1985**). The major cabbage growing states are Orissa, West Bengal, U.P., Bihar, Karnataka, Maharashtra, Gujrat, Punjab and Himachal Pradesh (Fageria*et al.*, 2003). Uttar Pradesh ranked 8th in the production of Cabbage in with production of 348,940 tonns and average productivity of 33.46 t/ha (Anonymous, 2020). Along with high nutritional value, cabbage also has medicinal value. For enhancing the yield and quality rational application of adequate quantities of plant nutrients is a pre-requisite which can be met both from organic as well as inorganic sources.The use of chemical fertilizers increases after green revolution which ultimately affects the soil and environmental health. To mitigate this problem the concept of Integrated Nutrient Management was introduced. The basic concept of integrated nutrient management is the maintenance of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity. Chemical fertilizers and organic manures play a vital role in vegetable production. The Nutrient supply system is considered one of the basic factors in crop production. It has been established beyond doubt that there is a positive correlation between fertilizer use and crop productivity. Farmers are using excessive chemical fertilizers leads to decline in organic carbon. The excessive use of chemical fertilizers spoils the structure and texture of the soil. Therefore, the use of chemical fertilizer alone may not keep pace with time in the maintenance of soil health for sustaining productivity. Growth and quality of cabbage is remarkably influence by organic and inorganic nutrients. It is established fact that alone use of inorganic fertilizers for the crop is not so good for health of crop and soil because of residual effect but in case of organic manure such problem does not arise and on the other hand it increase the productivity of soil as well as crop growth, quality and yield. Several authors reported that the importance of organic and inorganic fertilizers on the growth and nutritional quality of cabbage. The cultivation of cabbage is required proper supply of plant nutrients. The requirements of these plant nutrients can be provide by applying inorganic fertilizers, organic manures and biofertilizers. Use of different sources of nutrients such as inorganic fertilizers, FYM, vermicompost, biofertilizers in an integrated management to obtain qood quality with timely growth and also maintain the soil health sustainably.

Materials and Methods

Experimental site and climatic condition

The field experiment was conducted during *Rabi* season (2016-17) at research farm, Department of Horticulture, UdaiPratap Autonomous College, Bhojubeer, Varanasi (U.P.).

Geographically, Varanasi is located at 25.21^0 N latitude and 82.58^0 E longitudes on an elevation of about 80.71 meter sea level in the Gangatic alluvial plain of Eastern, Uttar Pradesh.The soil was sandy loam in texture with low organic carbon. The experimental site falls under a humid-sub tropical climate with maximum summer temperature ranging from 29.6 to 40.3 ^{0}C and minimum ranging from 9.2 to 23.2 ^{0}C in winter. Varanasi region received mean annual precipitation of about 1000 mm. Maximum rainfall in this region was received from mid-June to end of September. However, occasional showers are also very cold whereas summer months are extremely hot and western hot winds locally known as *loo*start from April and continued till the onset of monsoon in the month of June.

Experimental design and treatment details

The experiment was carried out in Randomized Block Design (RBD). The experiment was consisted of nine treatments which were replicated three times. Details of treatments presented in table 1.

The experiment was carried out in Randomized Block Design (RBD) with taking a cabbage variety sriganeshgol (f_1). There were nine treatments *i.e.* T_1:Recommended dose of NPK ha^{-1} (150 kg: 125 kg: 100 kg), T_2:Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1}, T_3:Half dose of NPK ha^{-1} + FYM @15 t ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}, T_4:Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}, T_5:Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}, T_6:Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1}, T_7:Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}, T_8:Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Phosphorous Solubilizing *Mycorrhiza* @ 5 kg ha^{-1} and T_9:Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + *Azospirillum*@ 5 kg ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}. FYM and Vermicompost was applied and well mixed with soil as per treatments before transplanting of seedling. These treatments were replicated three times randomly. The powder of Phosphorus Solubilizing *Mycorrhiza* was mixed with some light fine soil particles and applied just before transplanting as per treatments. *Azospirillum*was used to dipping seedling roots for 30 min just before transplanting. The five to six weeks old healthy and almost uniform seedlings were transplanted in November, 2016 at 60 x 45 cm distance. The crop was fertilized with chemical fertilizers according to treatments. The application of full dose of Phosphorus, Potassium and 1/3rd dose of Nitrogen

as basal dose through urea, diammonium phosphate (DAP) and muriate of potash (MOP). Remaining 2/3rd dose were applied at two split doses *i.e.* 30 DAT and 45 DAT, respectively.

Table No. 1: Treatments Detail

S. No.	Treatments
T_1	Recommended dose of NPK ha^{-1} (150 kg: 125 kg: 100 kg)
T_2	Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1}
T_3	Half dose of NPK ha^{-1} + FYM @15 t ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}
T_4	Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}
T_5	Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}
T_6	Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1}
T_7	Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}
T_8	Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Phosphorous Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}
T_9	Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + *Azospirillum*@ 5 kg ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}

Results and Discussion

As per Table 2it was observed that under all the treatments, overall operations except the use of various nutrient sources and their spreading were common. The additional cost incurred on this account was added to the expenditure on all treatments. The cultivation of cabbage turned labour intensive and created an employment of 184labour days ha^{-1} from nursery raising to soil preparation as well as up to the harvesting and marketing of produce to dispose the produce in main market for getting higher price. Common variable cost and fixed cost for cabbage cultivation and compared with added variable cost through nutrient sources has been mentioned in Table 2 to figure out which nutrient source is cheaper for cabbage nutrition. Results revealed that crop nourished only chemically acquired lesser currency than the integrated use of chemical fertilizers with organic sources.

Cost of cultivation (Rs./ha):

Data presented in table no. 3 is clearly indicated that the highest cost of cultivation was calculated under T_5 (Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1} + *Azospirillum* @ 5kg ha^{-1}) with an expenditure of (118283 Rs/ ha.). The minimum cost of cultivation (89900 Rs/ ha.) was recorded by the use of T_1 (Recommended dose of NPK ha^{-1} (150 kg: 125 kg : 100 kg). Similar finding are also observed by**Jhon (1997)**(Please mention the study).

The maximum gross income of (Rs.447690/ ha.) was calculated from Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + *Azospirillum* @ 5kg ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}while the minimum gross income (346210 Rs./ ha.) was calculated under Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} during experimental period.

The net profit was calculated by subtracting the cost of cultivation from the gross income. Found the maximum net profit (337907 Rs./ ha.) with use of Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + *Azospirillum* @ 5kg ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}. was obtained which is the best from other treatments. However, the minimum net income (232627 Rs/ ha.) was worked out from Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1}during 2016-17.

The maximum cost: benefit ratio (1:3.11) was noted under Recommended dose of NPK ha^{-1} (150 kg :125 kg : 100 kg). However, minimum cost : benefit ratio (1:2.05) was recorded from Half dose of NPK ha^{-1} + FYM @ 15 t ha It is clearly indicated that treatment Recommended dose of NPK ha^{-1} (150 kg :125 kg : 100 kg) was found better than other treatments and this ratio is also farmer's point of view, which helps in taking decision for crop production of cabbage crop.Almost Similar findings were also reported by the researchers like **Thronsbu*get al.* (2000), Magray*et al.* (2013).**(Please mention the study).

Table 2: Treatment wise comparative economics of cost of cultivation of Cabbage

Treatments	Common Fixed Cost (Rs. ha^{-1})	Added Variable cost (Rs. ha^{-1})	Total cost of cultivation (Rs.)
T_1: Recommended dose of NPK ha^{-1} (150 kg :125 kg : 100 kg)	**79065**	**10835**	**89900**
T_2: Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1}	**79065**	**34518**	**113583**
T_3: Half dose of NPK ha^{-1} + FYM @15 t ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}	**79065**	**38318**	**117383**
T_4: Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}	**79065**	**38418**	**117483**
T_5: Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}	**79065**	**39218**	**118283**
T_6: Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1}	**79065**	**29018**	**108083**
T_7: Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}	**79065**	**30018**	**109083**
T_8: Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Phosphorous Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}	**79065**	**29918**	**108983**
T_9: Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + *Azospirillum* @ 5kg ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}.	**79065**	**30718**	**109783**

Table 3: Economics of cabbage production under different treatments involved in cultivation

Symbol	Treatments	Cost of cultivation (Rs./ha.)	Yield (q/ha.)	Gross income (Rs. /ha.)	Net income (Rs./ha.)	Benefit :Cost Ratio
T_1	Recommended dose of NPK ha^{-1} (150 kg : 125 kg : 100 kg)	89900	369.42	369420	279520	3.11
T_2	Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1}.	113583	346.21	346210	232627	2.05
T_3	Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}	117383	382.01	382010	264627	2.25
T_4	Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}	117483	405.96	405960	288477	2.46
T_5	Half dose of NPK ha^{-1} + FYM @ 15 t ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}	118283	445.47	445470	327187	2.77
T_6	Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1}	108083	378.55	378550	270467	2.50
T_7	Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + *Azospirillum* @ 5 kg ha^{-1}	109083	394.36	394360	285277	2.62
T_8	Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} +Phosphorous Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}.	108983	435.59	435590	326607	3.00
T_9	: Half dose of NPK ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + *Azospirillum* @ 5kg ha^{-1} + Phosphorus Solubilizing *Mycorrhiza* @ 5 kg ha^{-1}.	109783	447.69	447690	337907	3.08

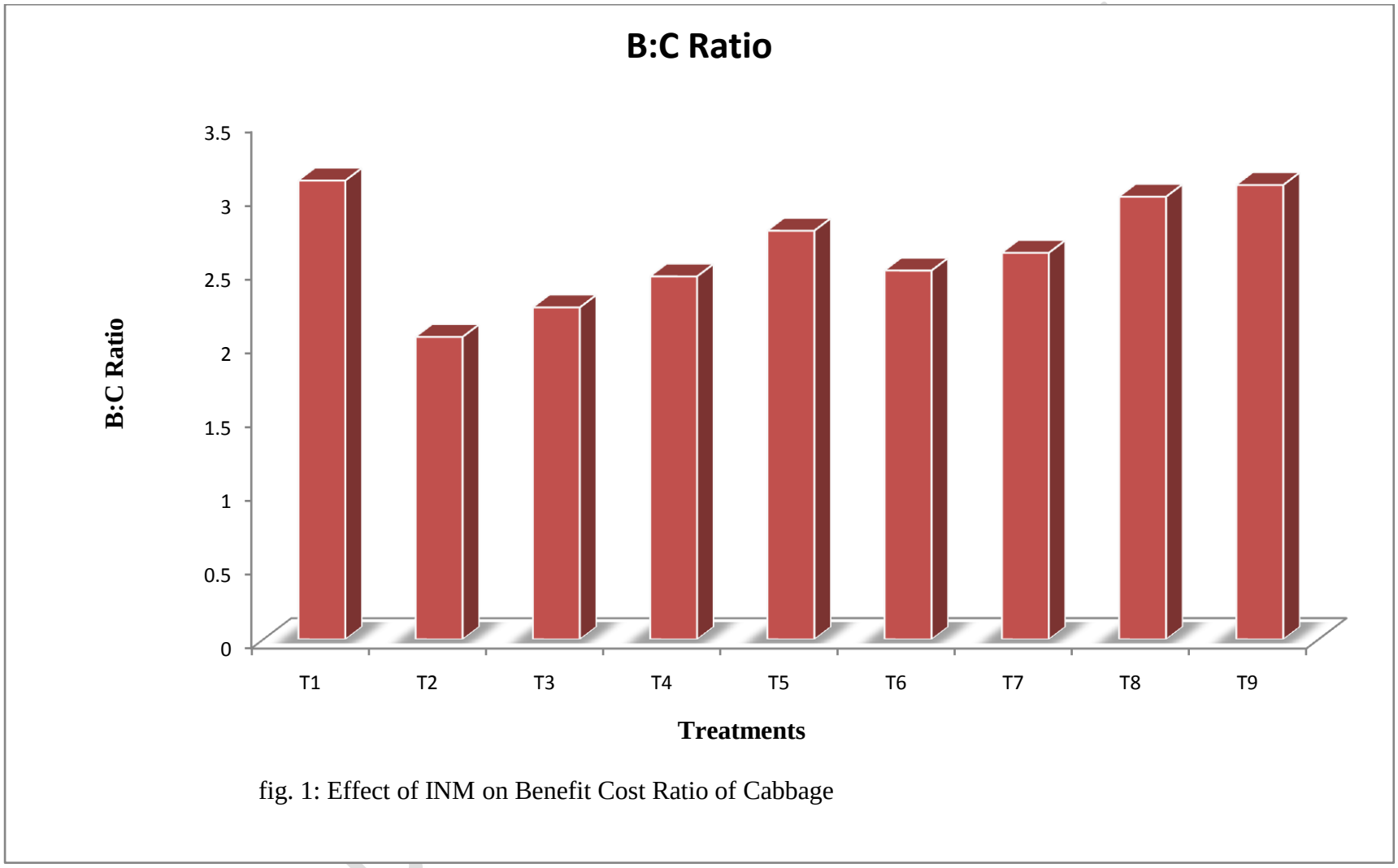

fig. 1: Effect of INM on Benefit Cost Ratio of Cabbage

Conclusion:

~~This study illustrates that only application of chemical fertilizers for nutrient management in cabbage variety Sri ganeshgol (f_1), showed best profitable output over integrated nutrient management. Use of NPK @ 100% of RDF is more productive and remunerative for nourishment of cabbage crop. But the continuous use of chemical fertilizers solely may cause harmful effect on soil as well as on surrounding environment and may also the chemical residue also reached in food chain which is hazardous for human health. So, from the study it is recommended that integrated use of fertilizers and organic manures not only sustain the yield it's also mitigate from above mentioned problems.~~

This study demonstrates that, when compared to integrated nutrient management, the sole use of chemical fertilizers for nutrient management in the cabbage variety Sri Ganesh gol (f1) produced the most lucrative results. For the purpose of feeding cabbage crops, it is more productive and profitable to use NPK at 100% of RDF. However, the constant application of chemical fertilizers alone may have detrimental effects on the soil and the environment around it. Chemical waste may even enter the food chain and endanger human health. According to the study, using fertilizers and organic manures in tandem not only helps to sustain yield but also helps to minimize the issues described above.

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