# Effect of Integrated Nutrient Management on the Growth, Yield and Soil Nutrient Status of *Brassica oleracea* L. Var. Italica

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## ABSTRACT

*An experiment was conducted to evaluate the effect of INM in farmers' field at gatthaghar, Bhaktapur during October, 2011 to February, 2012. Study on the growt, yield and soil nutrient status of broccoli (Brassica oleracea L. var. Italica) under integrated nutrient management. There were 7 treatment viz. 1/2NPK +5ton/ha FYM ($T_1$), 3/4NPK +2.5ton/ha FYM ($T_2$), 39.96ton/ha FYM ($T_3$), 1/2NPK +2ton/ha vermicompost ($T_4$), 3/4NPK +1ton/ha vermicompost ($T_5$), 4ton/ha vermicompost ($T_6$) and control ($T_7$) with 3 replication. The variety used in the experiment was Centauro. Application of vermicompost and NPK significantly influenced the growth (Plant height, canopy of plant and number of leaves) and yield of broccoli (Brassica oleracea L. var. Italica) @ ½ NPK + 2ton /ha vermicompost ($T_4$) showed better growth and yield than other treatments. The maximum plant height (50.91cm), canopy (51.633cm) and maximum leaf number (12.56). the maximum yield per plant (1.18kg/plant), maximum yield per plot (14.2kg/plot) and maximum yield ton/ha (35.5ton/ha) was obtained from $T_4$. The highest available soil nitrogen status was 339.23kg/ha in $T_6$ , available phosphorus was recorded (132.30kg/ha) in $T_4$ and maximum available potassium was recorded (495.66kg/ha) in $T_4$.*

**Key words**: Integrated nutrient management, NPK, Vermi-compost , FYM, Soil nutrient

## INTRODUCTION

Broccoli (*Brassica oleracea* L. var. *Italica*) is a member of the Brassicaceae family as a wild form of this family, which is found along the Mediterranean region mainly at an altitude 800-2200m above the sea level as the source of income (Decoteau, 2000). It has acquired the status of world popular vegetable crop due to its wider adaptability to various agro climatic conditions.

Broccoli (*Brassica oleracea* L. var. *Italica*) is nutritionally rich and has medicinal value, especially in vitamin, iron and calcium. It contains 3.3 percent protein, high content of vitamin A and C and appreciable quality of thiamine, niacin, fiber, folic acid (*Michaud et al.*, 2002). Likewise it is low in sodium, fat free and calories, vitamin B2 and calcium (Decoteau, 2000). The cancer- fighting properties of broccoli are not new and previous studies have related these benefits to the high levels of active plant chemicals called glucosinolates (Zhao *et al.*, 2007). Eating more than one serving of broccoli a week reduces the risk of prostate cancer by up to 45 percent.

Despite the popularity and wider adaptability of this crop, Majority of our farmers are not able to produce qualitative vegetable at a high yield because of lack of knowledge regarding the proper use of fertilizers. Without the proper management of the manure and fertilizer good production cannot be expected. Therefore proper management of fertilizer is one of the important aspects for the improvement in the crop production.

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In the present context, fertilizers are taken as the major source for the plants nutrient. Obviously the use of fertilizer has increase the crop production. But the increase in the amount of chemical fertilizer is instead of organic fertilizer has left the negative effect on soil fertility. Though the initial production is high, it has not been very effective on a long term basis. It usually leads to a decline in soil organic matter content and other physical degradation like soil pollution which has negative impact on human health. On the other hand the inorganic fertilizers are usually non available and cost high which cannot be afforded by the low income farmers.

Organic fertilizer is important for the proper management of soil fertility. Use organic fertilizer in soil helps plant growth by improving water holding capacity and drought resistance. Moreover it permits better aeration, enhances the absorption and release of nutrients and makes the soil less susceptible to leaching and erosion (Sekhon and meelu 1994). The organic fertilizer is apparently environmental, low cost and can be easily produced by the farmers themselves in local area.

Integrated nutrient management is the required integrated approach for the better agricultural production along with the proper soil management for the long term benefit; it helps to increase soil fertility for sustaining increased crop production through the use of all possible sources viz, organic and inorganic in integrated manner with in the given ecological, social and economic bounding it ensures adequate availability of quality fertilizers to farmers through periodical demand assessment and time supply. Promoting integrated nutrient management, which is soil test, based judicious and balanced use of chemical fertilizers in conjunction with organic manures and bio-fertilizers, promotion of organic farming and ensuring quality control of fertilizers through its implementation.

Integrated nutrient management aims at achieving efficient use of chemical fertilizers in combination with organic manures. Long term use of chemical fertilizers in intensive cereal based cropping systems reveal a declining trend in productivity even with the application of recommended levels of N, P and K fertilizers. The crop productivity increases from the combined application of chemical fertilizers and organic manures. Such combination contribute to the improvement of physical, chemical and biological properties of soil and nutrient status .sustainable agricultural production incorporates the idea that natural resources should be used to generate increased output and income, especially in low-income groups, without depleting the natural resources base. In this context, INM prepare soil as storehouse of plant nutrient that are essential for overall growth. INM's goal is to integrate the use of all natural and manmade sources of plant nutrients, so that crop productivity increases in an efficient and environmentally sustainable manner, without sacrificing soil productivity of future generations. INM relies on a number of factors, including appropriate nutrient application, conservation and the transfer of knowledge about INM practices to farmers and researchers.

## MATERIAL AND METHODS

The study was conducted from October, 2011 to February 2012 on the farmer's field at Sanothimi, Bhaktapur District, Nepal. The experimental plot was 2x2 square meter. The experiment was laid out in Randomized block design with three replication and seven treatments (Table 1).

The plant height was measured from the ground level to the growing point. The observation was recorded at the end of the growth period for each treatment and

expressed in centimeters. Effective leaves were counted and the mean was calculated. Green photo synthetically active leaves were considered as effective. Senescent and newly emerging leaves were excluded in the counting. The spreading area of the leaves was measured with the help of measuring tape. It was expressed in terms of centimeters.

Table 1 Treatments of experiment

| Treatments | Fertilizers |
|---|---|
| T1 | 1/2NPK+5t/ha FYM |
| T2 | 3/4NPK +2.5t/ ha FYM |
| T3 | 10 t/ha FYM |
| T4 | 1/2NPK+2t/ha vermicompost |
| T5 | 3/4NPK+1t/ha vermicompos |
| T6 | 4t/ha vermicompost |
| T7 | Control |

The observation of yield was recorded at the time of harvesting. Harvest from each plot was weighed and expressed in kg per plot.

Soil sample representing 0-15cm deep soil was collected from the experimental plot during the month February (that is just after harvesting the crop). Three samples from each plot were taken and mixed to form and composite sample. The sample then collected were dried in shade and sieved through a 2mm bronze sieve and stored in cloth bags for analysis.

Available nitrogen was estimated by alkaline permanganate method as modified by Subbiah and Asiz (1956) . Available phosphorus was determined by Modified Olsen's method (Olsen *et al.,* 1954). Available potassium was determined by ammonium acetate method (Hanway and Heidal, 1952)

The statistical analysis of the data was carried out as per method described by Cochran and Cox (1963). The treatment effects were tested at 5 percent level of significance.

## RESULTS AND DISCUSSIONS

### Effect of integrated nutrient management (INM) on the growth of broccoli

The data obtained on effect of INM on the plant height of broccoli was found significant influence by use of various fertilizers. Maximum increment in plant height was 50.91cm observed in T4 (1/2 NPK + 2t/ha vermicompost) and the minimum plant height observed was 38.02cm in T 7 (control) (Table 2).

The best result was obtained in the combination with NPK and vermicompost. This might be due to that vermicompost provide micronutrients such as calcium, zinc, iron, copper in optimum range as well as hold the nutrients accumulated in NPK, so that this combination enhanced the plant growth. Further, data revealed that combining NPK and vermicompost in equal amount give better result compared to other treatment as there might be higher chances of loss of chemical fertilizer due to leaching and volatilization.

This had been supported by Bonkyoon (2004) reported that the plant height of potato was higher in the plots where vermicompost and NPK fertilizer were applied than in the control plot. Alam (2005), stated that combined application of manures and chemical fertilizers performed the highest plant height of cabbage. And recommended dose of fertilizer alone recorded significantly higher values for growth parameters. It could be attributed to the quick and readily availability of major nutrients like N, P and K to plants at earlier stages of plant growth. While organic manures recorded significantly lower values for growth parameters because of slower release of nutrients to the plant Azad (2000)

There was significant influence of different treatments in the plant canopy. The maximum mean value regarding canopy of broccoli was observed 51.635cm in the treatment T4 (1/2 NPK + 2t/ha vermicompost) the minimum mean value was 38.02cm obtained in T7 (control) (Table 2)

The result showed that application of 50% recommended doses of NPK with vermicompost (7.992t/ha) is better growth in respect to plant canopy. Alam (2005) showed that the maximum plant canopy of cabbage was found by 5t/ha vermicompost + 50% recommended doses of chemical fertilizers.

This variation might be due to the availability of nutrients especially nitrogen and could be due to the improvement of soil water holding capacity as mentioned earlier by Roe and Cornforth (2000). Furthermore, compost activates many species of living organisms, which release phytohormones and may stimulate the plant growth and absorption of nutrients Arisha et al. (2003). Such organisms need nitrogen for multiplication. This is plausible reason that use of vermicompost with inorganic fertilizer showed a beneficial effect on dry matter accumulation.

The maximum number of leaves recorded was 12.58 in the T4 (1/2 NPK + 2t /ha vermicompost) which was statically on a par with T5 (3/4NPK+1t/ha vermicompos) 12.39 followed by T2 (3/4NPK + 2.5 t/ ha FYM) 12.38 and T1 (1/2NPK+5t/ha FYM) 12.28. The minimum number of leaves per plant (8.8) was found in control (Table 2)

The highest numbers of broccoli were obtained by application of 60 and 80 kg vermicompost with 60 kg inorganic fertilizer. This variation might be due to the availability of nutrients especially nitrogen and could be due to the improvement of soil water holding capacity as mentioned earlier by Roe and Cornforth (2000). Furthermore, compost activates many species of living organisms, which release phytohormones and may stimulate the plant growth and absorption of nutrients (Arisha *et al.,* 2003). Such organisms need nitrogen for multiplication. This is plausible reason that use of vermicompost with inorganic fertilizer showed a beneficial effect on dry matter accumulation.

Table 2: Effects of INM on the Growth of Broccoli

| Treatments | Plant Height (cm) | Canopy Area (cm) | Number of leaves |
|---|---|---|---|
| T1(1/2NPK+5t/haFYM) | 46.58 | 47.07 | 12.23 |
| T2 (3/4NPK + 2.5t/ha FYM) | 48.42 | 49.801 | 12.38 |
| T3 (10t/ha FYM) | 39.65 | 45.25 | 10.43 |
| T4(1/2NPK+ 2t /ha vermicompost) | 50.91 | 51.633 | 12.58 |
| T5 (3/4NPK+1t/ha vermicompos) | 48.87 | 49.37 | 12.39 |
| T6 (4t/ha vermicompost) | 41.68 | 46.136 | 10.48 |
| T7(control) | 41.68 | 38.33 | 8.8 |
| CD (0.05) | 1.9903 | 1.3353 | 1.5177 |
| F | 60.8377 | 100.7657 | 15.1955 |
| CV (%) | 2.49 | 1.60 | 5.34 |

**Effect of integrated nutrient management (INM) on yield on the of broccoli**

The maximum yield was obtained by the application of T4( ½ NPK + vermicompost 2t/ha) i,e, 1.18kg/plant which was statically on a par with T5(¾NPK +vermicompost 1t/ha) i,e, 0.91kg/plant while the minimum yield 0.65kg/plant was recorded in the treatment T7 (control) (Table 3)..

Reasons for increased yield by the application of NPK and vermicompost could be attributed to vermicompost retain nutrients and increased uptake of NPK.

Data recorded on effect of organic and integrated nutrient management on morphological and yield contributing parameters of broccoli suggests that for getting higher yield treatment of Vermicompost at 5.24t/ha+1/2NPK (chemical fertilizers) would be most suitable as it resulted in maximum yield/ plot, which was statically higher than all the treatments. These results are in line with the findings of Sharma (2000) in which he found that integration of organic and inorganic fertilizers application significantly increased the head yield over inorganic fertilizers alone and also over control. Higher yields with the application of Vermicompost in combination of recommended dose of NPK was also reported by Ranjit (2010). Present investigation reveals that partial substitution of inorganic fertilizers through vermicompost is highly effective and higher levels of vermicompost emerged as better organic source over that of farmyard manure.

Table 3 Effect of INM on the Yield of Broccoli (*Brassica oleracea* L. var. *Italica*)

| Treatments | Yield (kg/plant) | Yield (kg/plot) | Yield (ton/ha) |
|---|---|---|---|
| T1(1/2NPK+5ton/ha FYM) | 0.85 | 10.24 | 850 |
| T2 (3/4NPK +2.5 ton/ ha FYM) | 0.88 | 10.6 | 883 |
| T3(10ton/ha FYM) | 0.68 | 8.2 | 683 |
| T4(1/2NPK+2ton/ha vermicompost) | 1.18 | 14.2 | 1183.3 |
| T5(3/4NPK+1ton/ha vermicompos) | 0.91 | 11 | 916.6 |
| T6( 4ton/ha vermicompost | 0.85 | 10.2 | 850 |
| T7(control) | 0.65 | 7.8 | 650 |
| f- test | 4.2764 | 2.0521 | 4.2858 |
| CV% | 17.04 | 15.95 | 17.04 |
| CD (0.05) | 0.2608 | 2.7932 | 7.8055 |

**Effect of INM on the soil nutrient (NPK) status after harvest of broccoli**
*Available Nitrogen*

The available nitrogen contain was maximum in T6 (4t/ha vermicompost) than any other treatment. The maximum available nitrogen contain was 339.23kg/ha which was statistically at par with T4 (1/2NPK + 2t/ha vermicompost). However the minimum recorded was 289.45kg/ha in T7 (control) treatments (Table 4)

In spite of using chemical fertilizers, the nitrogen was found low in NPK treated soil, which might be due to leaching and volatilization loss. In the same way mineralization of chemical fertilizers is faster than that of vermicompost. Chemical fertilizers must have been leaching away whereas in vermicompost applied soil the applied vermicompost holds the nutrients and retained from losses. So, higher value of total nitrogen in vermicompost treated soil is due to the slow but continuous releases of nitrogen from vermicompost. Similar results was found by Tripathi & Gregory (2002) while studying the nitrogen content by using bio-fertilizers and chemical fertilizers.

*Available phosphorus*

Available phosphorus was found maximum in T4 (1/2 NPK + 2t/ha vermicompost) 132.30kg/ha which was statistically at par with T2 (1/2NPK +2.5t/ha FYM) and it was lower in T7 (Control) with the value of 84.1kg/ha compared with other mean value of treatments. (Table 4)

These finding showed that the use of vermicompost released and retains the phosphorus in soil because of enzymatic activities of microbial organism this had been support by Phosporus is the constituent of Adenosine Diphosphate (ADP) and Adenosine Triphosphate (ATP), which is absorbed by the plants in the form of $H_2PO_4$ at lower pH value and in the form of $HPO_4^{2-}$ at higher pH (Asthana and Asthana 2003).

*Available potassium*

The maximum mean value of available potassium contain 495.66kg/ha was recorded in T4 (1/2 NPK +2t/ha vermicompost) which was followed by mean value of 487.21kg/ha in T5 (3/4NPK+ 1ton/ha vermicompost), 470.66kg/ha in T1 (1/2NPK +5t/ha FYM) and 465.33kg/ha in T2 (1/2NPK +2.5t/ha FYM) and the minimum content was recorded 386.02kg/ha in T7(Table 4).

This showed that the combination of NPK and vermicompost gives the better result than their sole use. Potassium is essential to plants for the formation and transfer of carbohydrates in photosynthesis, and also for protein synthesis. It is needed to strengthen the plant's structure.

In FYM, K remains in water-soluble forms and thus does not need to be mineralised before becoming plant available. Chemical fertilizer makes plant nutrient readily to the plant and leaching chance is lower so that combination of vermicompost and chemical fertilizer improved the available potassium in soil.

Table 4: Effect of INM on the Soil Macro Nutrient Status after harvest of broccoli

| Treatments | Available N (kg/ha) | Available P (kg/ha) | Available K (kg/ha) |
|---|---|---|---|
| T1(1/2NPK+5t/ha) | 326.57 | 128.4 | 470.66 |
| T2(3/4NPK +2.5t/ ha FYM) | 322.3 | 130.47 | 465.33 |
| T3 (10ton/ha FYM) | 291.7 | 97.65 | 432.33 |
| T4(1/2 NPK + 2t/ha vermicompost) | 333.71 | 132.30 | 495.66 |
| T5 (3/4NPK+1t/ha vermicompos) | 318.54 | 129.74 | 487.21 |
| T6 (4t/ha vermicompost) | 339.23 | 99.50 | 455.13 |
| T7(control) | 289.45 | 84.1 | 386.02 |
| CD (0.05) | 10.8504 | 2.6141 | 7.2728 |
| F | 48.38 | 1104.8494 | 220.4877 |
| CV (%) | 1.93 | 0.91 | 0.89 |

## CONCLUSION

It is concluded that the combination of@ 1/2NPK + 2t/ha vermicopost (T4) is effective improving the plant growth, leaf number, canopy growth and yield of broccoli. The height soil available nitrogen@ (339.23kg/ha) were observed with T6 and available P (132.30kg/ha) and available K (495.66kg/ha) were observed with treatment T4. From this experiment it is concluded that 1/2NPK+2t/ha vermin-copost(T4) can be suggested as good source of plant nutrient for broccoli.

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