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# Productivity, Nutrient Uptake and Recovery by Knolkhol Crop Under the Influence Of Inm Practice in Inceptisols of Bhubaneswr, Odisha

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***Abstract:*** *The experiment was undertaken at the field site of College of Agriculture, OUAT, Bhubaneswar during rabi seasons for two consecutive years ( 2012-13 and 2013-14) to study the response of Knolkhol to different INM practices. The experiment was consisting of 10 treatments was laid in randomized block design with three replications and the treatments included T1-Absolute control, T2-100% NPK + FYM, T3-100% NPK + VC, T4-100% NPK + FYM + BF, T5-100% NPK +VC + BF, T6-100% NPK + L + FYM + BF, T7-100%NPK+L+VC+BF, T8-100%NPK, T9-BF, T10-100% NPK + BF. Bio-inoculation alone increased the knob yield by 12%, with 100% NPK + Organics (FYM + VC) by 11.0%, with 100% + PMS + Organics by 18.5 or 20.5 percent. The recovery of N increased from a level of 29.2 to 68.1 percent, P from 27.8 to 58.1 percent, K from 62 to 117 percent and S from 12 to 32.1 percent. The BF component in combination with 100%NPK, STD + organics and STD + Organic + PMS(L) increased the recovery of nutrients, considerably emphasizing their need for efficient nutrient management.*

## INTRODUCTION

The cabbage and cauliflower are the most commonly used vegetables among cole crops but demand for knolkhol (*Brasica oleracea* var. gongylodes L.) also is increasing now-a-days in the Eastern part of India , including Odisha. 100g edible portion of Knolkhol provides 36 calories of energy , 20 IU vitamin A, 50mg vitamin C,1.95% Ca, 0.60%P, 3.7% K, 185ppm Fe and 15ppm Cu[8]. It was reported that due to its anti-hyperglycaemic and anticarcinogenic properties it cures human bowl cancer. It also contains sulphoraphanes and other isothiocyanates which are believed to stimulate the production of protective enzymes in the body. Knolkhol is characterized by the formation of knob (stem tuber) which arises from a thickening of the stem tissue above the cotyledons. The fleshy turnip-like enlargement of the stem develops entirely above the ground. This knob is harvested for consumption as raw or cooked vegetable, though in some parts, young leaves are also consumed. Knolkhol is a heavy feeder crop and shows good response to fertilizer application [3].

Chemical fertilizers are needed to get good crop yields, but their abuse can harmful for the environment [7]. The increased use of chemicals under intensive cultivation has not only contaminated the ground and surface water but has also distributed the harmony existing among the soil, plant and microbial population [1]. Bio-fertilizers on the other hand are cost effective and renewable source of plant nutrients to supplement the parts of chemical fertilizers. The plants absorb all the nutrients in the ionic form irrespective of the sources through, which they are supplied. The nutrients from the organic and inorganic sources differ only in their relative availability for crop uptake. The nutrients release by the organic manures is gradual slow and will become available for crop the uptake for a longer duration due to its slow decomposition rate. Hence integrated nutrient approach can be followed in case of knolkhol crop.

## MATERIALS AND METHODS

The experiment was undertaken at the field site of College of Agriculture, OUAT, Bhubaneswar which

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is located on 22°152 north latitude , 80°222 east longitude and 25.5m above sea level during rabi season, *i.e.* October'2012 to January'2013 and October'2013 to January'2014.The total annual rainfall received during 2012 and 2013 was 184.5 mm and 850 mm respectively. The maximum temperature observed during the cropping period was 32.9°C (2012-13) and 32.1°C (2013-14) and minimum temperature observed during cropping period was 19.3°C (2012-13) and 19.0°C (2013-14).

The experiment was conducted on loamy sand (inceptisol) with pH 6.30, organic carbon 6.44(g $kg^{-1}$), available N, P, K was 352.0, 109.0,67.0 kg $ha^{-1}$ respectively. The experiment consisting of 10 treatments was laid in randomized block design with three replications. The treatments included T1-Absolute control, T2-100% NPK + FYM, T3-100% NPK + VC, T4-100% NPK + FYM + BF, T5-100% NPK + VC + BF, T6-100% NPK + L + FYM + BF, T7-100% NPK + L + VC + BF, T8-100%NPK, T9-BF, T10-100%NPK + BF.The bioinoculants for the crop was consortia of micro-organisms, comprising of Azotobacter, Azospirillum and PSB in 1:1:1 ratio, 4kg each $ha^{-1}$, inoculated to pre-limed (5%) vermicompost in 1:25 ratio and incubated for 7 days at 30% moisture and applied in the rhizosphere @10g per each seedling at the time of planting of the seedlings.

The soil test based dose of fertilizers for knolkhol was 150-38-63-13-10-10 kg N-P-K-S-Borax-Zn sulphate $ha^{-1}$ .The sources of organics were FYM and vermicompost applied @5 and 2.5*t* $ha^{-1}$ mixed with either FYM and Vermicompost as per the treatment. Observations on characters like knob yield (*q* $ha^{-1}$), dry matter content, nutrient uptake and apparent recovery of nutrients by the knob were recorded in each replication of all the treatments in both year.

## RESULT AND DISCUSSION

The knob is the economic portion of knol-khol crop. The pooled knob yield varied significantly between 16.5 and 320.0q $ha^{-1}$ (Table 1), under the influence of long term INM practice including use of BFs with soil test dose of fertilizers, organic sources and soil ameliorant. Bio-inoculation alone increased the knob yield by 12%, with 100% NPK + Organics (FYM + VC) by 11.0%, with 100% + PMS + Organics by 18.5 or 20.5 percent.

Fertilizer application had significant influence on knob yield which was 78 percent higher over no fertilizers application (106.5q $ha^{-1}$) indicating that the crop is high fertilizer responsive one. Integrating organics with fertilizers application on an average increased the crop productivity by 40.2 percent. Bioinoculation of crop combined with fertilizers and organic addition resulted in extra yield increase of 10.7 percent. Acid soil amelioration with lime when integrated with all other practices increased the yield by 8 percent compared to no liming.

As regards the impact of integrated fertilizer management, it could be concluded that integrated application of inorganic (100% NPK), organic (VC) and biological sources (BF) with soil ameliorant (L) significantly increased the knob yield over the control and sole application of inorganic fertilizers, sole application of biological sources, integrated application of organics (F/VC). This might be attributed to the gradual and steady release of both micro and macro nutrients from vermicompost and biofertilizers, which might have helped in the plant metabolic activity, resulting in early vegetative growth. The increased vegetative growth , balanced C/N ratio and increased synthesis of carbohydrates in turn increased crop yield [2], [9], [12].

The total dry matter production as observed in course of experimentation was maximum when knol-khol received nutrient sources in an integrated manner at optimal recommended dose, the total dry matter production varied between 14 and 42.70 q $ha^{-1}$. The variation in dry weights of the studied crop treated with different nutrient sources may be due to higher availability and increased uptake by knob [15].

Knolkhol removes large quantity of N, P, K and S from soil. The crop received external N application 150kg $ha^{-1}$ as inorganic source. Though FYM 5 t $ha^{-1}$ and Vermicompost 5 t $ha^{-1}$ , the crop had received additional dose of N of 25 and 27.5 kg $ha^{-1}$ .In FYM added treatment the crop received 175kg $ha^{-1}$ , and in VC added one it was 177.5 kg $ha^{-1}$ .Crop receiving integrated sources of nutrients had higher N content than no or non-integrated treatments. Bioinoculation either alone or integrated with organic and inorganic increased its nutrient. The total N uptake varied between 27.5kg $ha^{-1}$ to 123.5kg $ha^{-1}$ , lowest due to no fertilizers or no manure application absolute control and highest due to crop fertilized with inorganics, organic (VC), BFs and lime application [4], [5].

The knolkhol crop had received phosphorous nutrition of 16.6kg P (38kg$P_2O_5$) $ha^{-1}$ as inorganic,

15kg P through FYM 25 t $ha^{-1}$ and 10 kg P through vermicompost@ 5 t $ha^{-1}$. Therefore in 1005 NPK + FYM and NPK + VC treatments the quantities of P added were 31.6 and 26.6 kg $ha^{-1}$ respectively. The total uptake varied between 5.5 and 1.4 kg $ha^{-1}$. Application of BFs alone significantly influenced P uptake by the crop. Inorganic nutrition of crop had significant positive influence on P uptake compared to no organic nutrition. Combining organic nutrition with inorganic sources, further addition of BFs along with soil liming considerably increased P uptake.

The crop received K through inorganic fertilizers @51kg K $ha^{-1}$, when added with FYM and VC the amount of K added were 20 and 14 kg $ha^{-1}$ respectively. For 100% NPK + FYM it was 71kg $ha^{-1}$ and for 100%NPK + VC it was 65kg K $ha^{-1.}$ The total K uptake varied between 33.4 and 115.4 kg $ha^{-1}$. Biofertilizers application either alone or added with FYM0VC increased K uptake significantly. Fertilizers application alone or combined with organic, biofertilizers and lime application had significant influence on increasing *k* uptake by the crop.

The sulphur nutrition of the crop was maintained through soil supply, addition through fertilizers and organic sources. The total uptake varied between 2 .0 and 16.0kg $ha^{-1}$. Application of fertilizers to the crop had considerable influence on its uptake than BFs application alone or with organics. Integration of organics with inorganic fertilizers further BFs application and liming of soil had significant influence on its uptake.

In intensive agriculture nutrient recovery through crop is of paramount importance because the cost intensive input-fertilizers should be properly utilized for economic benefit of farmer and stability of cropping system by maintaining soil productivity. Inoculating the crop with biofertilizers increases the recovery of nutrients considerably and more particularly in N and p. Maximum recovery was obtained when the crop was applied with vermicompost and biofertilizer . The recovery of nutrient further increased with integration of chemical fertilizer with biofertilizers , vermicompost and lime.

The recovery of N increased from a level of 29.2 to 68.1 percent, P from 27.8 to 58.1 percent , K from 62 to 117 percent and S from 12 to 32.1 percent. The BF component in combination with 100%NPK, STD + organics and STD + Organic + PMS(L) increased the recovery of nutrients, considerably emphasizing their need for efficient nutrient management [16], [15], [13], [10], [6], [14], [11].

## CONCLUSION

Finally it is concluded that not only chemical fertilizers can produce a good yield but application of organic manure like vermicompost along with biofertilizer and can also achieve the yield target under better management practices. Simultaneously the organic manures are locally available, eco friendly and helpful to sustain the soil health.The optimal or sub optimal dose of chemical fertilizers along with vermicompost and biofertilizers in presence of lime resulted in higher knob yield besides increasing increasing available nutrients and total N,P,K and S in plants than control and 100% NPK alone.

| | *Treatment* | *Pooled Knob Yield (q $ha^{-1}$)* | *Dry matter content (q $ha^{-1}$)* | | | *Nutrient Uptake (kg $ha^{-1}$)* | | | | *Apparent Nutrient Recovery* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *Knob* | *Leaf* | *Total* | *N* | *P* | *K* | *S* | *N* | *P* | *K* | *S* |
| 1 | Abolute Control | 106.5 | 7.70 | 6.30 | 14 | 27.50 | 5.50 | 33.40 | 2.00 | – | – | – | – |
| 2 | BF | 119.8(12)* | 10.37 | 7.83 | 18.2 | 40.50 | 7.60 | 47.20 | 2.70 | – | – | – | – |
| 3 | STD | 190.1 | 13.30 | 10.20 | 23.5 | 66.90 | 9.70 | 64.50 | 6.30 | 29.2 | 27.8 | 62 | 12 |
| 4 | STD + BF | 204.0(7.8)** | 13.90 | 11.80 | 25.7 | 71.20 | 10.20 | 70.80 | 4.00 | 32.5 | 32.2 | 75 | 12.8 |
| 5 | STD + F | 263.3 | 17.70 | 13.50 | 31.2 | 97.40 | 14.40 | 96.20 | 8.90 | 50.1 | 32.9 | 90 | 17.3 |
| 6 | STD + VC | 269.6 | 18.90 | 13.70 | 32.6 | 99.30 | 15.30 | 92.00 | 8.90 | 50.1 | 39.4 | 88 | 18.0 |
| 7 | STD + F + BF | 291.5(10.7)*** | 21.63 | 13.90 | 35.5 | 112.60 | 16.20 | 107.60 | 14.20 | 59.9 | 39.2 | 107 | 28.4 |
| 8 | STD + VC + BF | 298.7(11.0)*** | 21.60 | 14.40 | 36.0 | 113.20 | 16.60 | 103.70 | 15.50 | 59.6 | 43.9 | 106 | 28.8 |
| 9 | STD + L + F + BF | 317.3(20.5)*** | 25.07 | 15.20 | 40.27 | 124.90 | 21.40 | 115.40 | 15.20 | 68.1 | 58.1 | 117 | 30.1 |
| 10 | STD + L + VC + BF | 320.0(18.7) | 24.30 | 15.70 | 40.0 | 123.50 | 19.40 | 107.10 | 16.00 | 65.5 | 55.3 | 111 | 32.1 |
| | CD(P = 0.05) | 13.9 | 1.24 | 0.79 | 1.82 | 4.53 | 3.49 | 4.17 | 0.94 | – | – | – | – |

*Data in the parenthesis indicate percent increase over control

STD = 100% NPK, VC = Vermicompost, F = FYM, BF = Biofertilizer,

**Data in the parenthesis indicate influence of BFs use

***Data indicate percent increase over BF+F/BF+VC

Therefore integrated management of inorganics and organic application along with biofertilization can be used to boost the production of knolkhol and at the same time enrich the soil with residual nutrients so as benefit the succeeding crop , thus help to maintain the soil fertility.

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