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Pramod
Department of Horticulture, Faculty of Agricultural Sciences and Technology, AKS University, Sherganj, Satna, Madhya Pradesh, India

Dr. Abhishek Singh
Department of Horticulture, Faculty of Agricultural Sciences and Technology, AKS University, Sherganj, Satna, Madhya Pradesh, India

Corresponding Author:
Pramod
Department of Horticulture, Faculty of Agricultural Sciences and Technology, AKS University, Sherganj, Satna, Madhya Pradesh, India

Impact of organic manure on growth, yield and quality of Knol Khol (*Brassica oleracea* var. *gongylodes* L.) cv. green wonder

Pramod and Dr. Abhishek Singh

Abstract
The experiment entitled "Impact of Organic Manure on Growth, Yield and Quality of Knol Khol (*Brassica oleracea* var. *gongylodes* L.) cv. Green Wonder" was conducted during Rabi season of the year 2021-2022 on Instructional farm of Department of Horticulture, AKS University, Satna (M.P.). The experiment was laid out in Randomized Block Design comprising of 12 treatments *viz*., T_1- Control, T_2 -2 t/ha PM + 5 t/ha VC, T_3 – 2 t/ha PM + 7 t/ha VC, T_4 – 2 t/ha PM + 10 t/ha VC, T_5 – 5 t/ha PM + 5 t/ha VC, T_6 - 5 t/ha PM + 7 t/ha VC, T_7 -5 t/ha PM + 10 t/ha VC, T_8 -7 t/ha PM + 5 t/ha VC, T_9 - 7 t/ha PM + 7 t/ha VC, T_{10} - 7 t/ha PM +10 t/ha VC, T_{11} -10 t/ha PM + 5 t/ha VC, T_{12} -10 t/ha PM + 7 t/ha VC, each replicated three times. Treatments were randomly arranged in each replication, divided into twelve plots. The results reveal that the application of 10 t/ha Poultry manure + 7 t/ha Vermicompost (T_{12}) gave maximum plant height, highest number of leaves per plant, leaf area per plant, diameter of knob, weight of the knob, yield per plot and knob yield of Knol Khol.

Keywords: Knol Khol, vermicompost, poultry manure, knob yield

Introduction
Knol Khol is an European vegetable, very popular in Kashmir in India. It is a greenish white colored big and round vegetable, somewhat similar to cabbage, although it does not have leaves covering. There are long light green colored extrusions, which come out as its shoots. Knol Khol (*Brassica oleracea* var. *caulorapa* L.) also known as kohl-rabi belongs to the family *cruciferae*. It is a cold, hardy crop and can thrive well in extremely cold weather conditions. The word ´Cole' seems to have come from the abbreviation of the word 'caulis' which means stem Babychand *et al.*, 2017 [1]. It is known by many names in India. It is popular in Kashmir, West Bengal, Maharashtra, Assam, Uttar Pradesh, Punjab and some parts of south India, but it's origin is Europe it is not cultivated commercially. It is characterized by the formation of knob (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 Raj *et al.*, 2014 [12]. The stem is the edible part which enlarges into a round knob immediately above the ground. It has to be harvested before the flesh becomes woody. It is high in minerals and vitamins A and C. Knol khol possess nutritive values such as protein-1.1 g, fat-0.2 mg, fibre-1.5 g, it is also rich in Na-112 mg and Sulphur-143 mg and also contains vit A-36 IU and Vit C-85 mg. The integrated use of nutrients and biofertilizers is the key for sustainable production of different horticultural crops. It is essentially the technical and managerial component for maintaining a balance in the nutrient system between the plant and the growing media Kamal *et al.*, 2013 [7]. The INM system can be developed only through a better understanding of nutrient reserves in the soil, Modern nutrient management strategy has shifted its focus towards the concept of sustainability and eco-friendliness. Intensive use of only chemical fertilizers to achieve high production has created a various problems. The addition of nitrogen enhances vegetative growth and its deficiencies leads to stunted growth with small yellow leaves and low production. Phosphorus plays an important role in several key physiological processes, viz. photosynthesis, respiration, energy storage and transfer, cell division and cell enlargement. Phosphorus is an important structural component of many biochemicals' viz. nucleic acid (DNA, RNA) co-enzymes, nucleotides, phospholipids and sugar phosphate. It stimulates root growth, blooming, fruit setting and seed formation. Potassium is considered essential in photosynthesis, sugar translocation, nitrogen metabolism, enzyme activation, stomatal opening, water relation and growth of meristematic tissue, it acts

as root booster, stalk strengtheners, protein builder, and breathing regulator and retard the diseases, but it is not effective without its co-efficient such as N and P Mehta *et al.*, 2015 [9]. The increasing use of chemical fertilizers to increase vegetable production has been widely recognized but its long run impact on soil health, ecology and other natural resources are detrimental which affect living organisms including beneficial soil microorganism and human being. Organic manure has the capability of supplying a range of nutrients and improving the physical and biological properties of the soil. However, at high level of crop production, these nutrients are not adequate. Poultry manure is a by-product of this production and is rich in nutrients, which can provide a major source of nitrogen (N), phosphorus (P) and trace elements for crop production Dadhich *et al.*, 2015 [5]. This material can also improve physical and biological fertility of soil, making it ideal for land application as a fertiliser. The application of vermicompost to soil is considered as a good management practice in any agricultural production system because of the stimulation of soil microbial growth and activity, subsequent mineralization of plant nutrients, and increased soil fertility and quality.

Materials and Methods

The experiment entitled "Impact of Organic Manure on Growth, Yield and Quality of Knol Khol (*Brassica oleracea* var. *gongylodes* L.) cv. Green Wonder" was conducted during Rabi season of the year 2021-2022 on Instructional farm of Department of Horticulture, AKS University, Satna (M.P.). The experiment was laid out in Randomized Block Design comprising of 12 treatments *viz*., T_1- Control, T_2 -2 t/ha PM + 5 t/ha VC, T_3 – 2 t/ha PM + 7 t/ha VC, T_4 – 2 t/ha PM + 10 t/ha VC, T_5 – 5 t/ha PM + 5 t/ha VC, T_6 -5 t/ha PM + 7 t/ha VC, T_7 -5 t/ha PM + 10 t/ha VC, T_8 -7 t/ha PM + 5 t/ha VC, T_9 -7 t/ha PM + 7 t/ha VC, T_{10} -7 t/ha PM +10 t/ha VC, T_{11} - 10 t/ha PM + 5 t/ha VC, T_{12} -10 t/ha PM + 7 t/ha VC, each replicated three times. Treatments were randomly arranged in each replication, divided into twelve plots. The seeds were sown on 26th October 2021, germination started and transplanted on 29th November 2021 the recording of observations was done 15 days after transplanting and subsequent readings were recorded after every 15 days interval. The crop was harvested on 17th February - 2022. Thirty days old healthy and uniform seedlings of Knol khol cv. Green wonder were transplanted in the evening hours in each bed at prescribed with spacing 60 to 50 cm on 29th November 2021. Well decomposed Poltymanure, Vermicompost was applied after land preparation as for recommendation. Light irrigation was given after transplanting. The first light irrigation is given soon after sowing to ensure proper germination and the subsequent irrigation were given at the interval of 10–20 days. Flood irrigation was given once in week during the entire period of crop growth. Plant protection measures were followed to control the pest and diseases. Soil treatment with copper fungicide (Phytolan) at the rate of 3 ml/ 10 litres of water was drenched to protect the seedling from fungal infection. Roger was used @ 10 ml/ 10 litres of water.

Results and Discussion

Data mentioned in table 1 clearly revealed that the optimum levels of nutrients were found to significantly improve plant height at all the growth stages. The maximum plant height at 30, 45 and 60 days after transplanting (DAT) was recorded due to T_{12} with 10 t/ha PM + 7 t/ha VC (10.55, 18.42 and 26.98cm respectively) and minimum plant height was recorded from the treatment T_1 with Control (3.28, 6.31 and 14.08cm, respectively). The highest number of leaves per plant at 30, 45 and 60 days after transplanting (DAT) was recorded from T_{12} with 10 t/ha PM + 7 t/ha VC (4.73, 13.89 and 22.78 respectively) and lowest number of leaves per plant was recorded from the treatment T_1 with Control (3.07, 6.18 and 10.43 respectively). The diameter of stem (cm) at 45 DAT was found to the significant among the treatments. The Maximum diameter of stem (1.83cm) was recorded in T_{12} with 10 t/ha PM + 7 t/ha VC, followed by T_{10} as (1.69cm) 7 t/ha PM +10 t/ha VC. Minimum diameter of stem (1.07cm) was recorded in T_1 with Control.

Maximum leaf area per plant (738.11cm^2) was recorded in the treatment T_{12} with 10 t/ha PM + 7 t/ha VC, followed by T_{10}as (732.83cm^2) 7 t/ha PM +10 t/ha VC. Minimum leaf area per plant (422.46cm^2) was recorded in the treatment T_1 with Control. Minimum days required for 50 percent knob initiation (34.81) was recorded in the treatment T_{12} with 10 t/ha PM + 7 t/ha VC, followed by T_{10} as (35.36) 7 t/ha PM +10 t/ha VC. Maximum days required for 50 percent knob initiation (43.10) was recorded in the treatment T_1 with Control. Minimum days required for 100 percent knob initiation (42.16) for duration of flowering was recorded in the treatment T_{12} with 10 t/ha PM + 7 t/ha VC, followed by T_{10} as (43.08) 7 t/ha PM +10 t/ha VC. Maximum days required for 100 percent knob initiation (54.63) was recorded in the treatment T_1 with Control. Minimum days required for knob maturity (54.27) for duration of harvesting was recorded in the treatment T_{12} with 10 t/ha PM + 7 t/ha VC, followed by T_{10} as (55.08) 7 t/ha PM +10 t/ha VC. Maximum days required for knob maturity (69.85) for duration of harvesting was recorded in the treatment T_1 with Control. These results are substantiated with Shah *et al.* (2010) [13], Ganesh *et al.* (2011) [6], Chateijee *et al.* (2012) [3], Lal *et al.* (2015) [8], Banotra *et al.* (2017) [2], Ola *et al.* (2019) [10], Paczka *et al.* (2020) [14], Patyal *et al.* (2021) [11] and Choudhary *et al.* (2022) [4] in Knol Khol.

Maximum diameter of knob (7.61cm) was recorded in the treatment T_{12} with 10 t/ha PM + 7 t/ha VC, followed by T_{10} as (7.43cm) 7 t/ha PM +10 t/ha VC. Minimum number of diameter of knob (4.11cm) was recorded in the treatment T_1 with Control. Maximum fresh weight of knob (132.72 g) for duration of harvesting was recorded in the treatment T_{12} with 10 t/ha PM + 7 t/ha VC, followed by T_{10} as (130.26 g) 7 t/ha PM +10 t/ha VC. Minimum fresh weight of knob (62.36 g) for duration of harvesting was recorded in the treatment T_1 with Control. Maximum yield per plot (1.592 kg) was recorded in the treatment T_{12} with 10 t/ha PM + 7 t/ha VC, followed by T_{10} as (1.563 kg) 7 t/ha PM +10 t/ha VC. Minimum yield per plot (0.748 kg) was recorded in the treatment T_1 with Control. Maximum knob yield (26.54 tones/hectare) was recorded in the treatment T_{12} with 10 t/ha PM + 7 t/ha VC, followed by T_{10} as (26.05 tones/hectare) 7 t/ha PM +10 t/ha VC. Minimum knob yield (12.47 tones/hectare) was recorded in the treatment T_1 with Control.

Based on the results of the study in Knol Khol, it is concluded that with application of 10 t/ha Poultry manure + 7 t/ha Vermicompost (T_{12}) gave maximum plant height, highest number of leaves per plant, leaf area per plant, diameter of knob, weight of the knob, yield per plot and knob yield of Knol Khol.

Table 1: Effect of Organic Manure on Growth and Yield of Knol Khol

Treatments	Plant height (cm)	Number of leaves per plant	Diameter of Stem (cm) 45 DAT	Leaf area per plant (cm^2)	Days required for 50 % knob initiation	Days required for 100 % knob initiation	Days required for knob maturity	Diameter of knob (cm)	Fresh Weight of knob (g)	Yield (kg/plot)	Yield (tones/ hectare)
T_1	14.08	10.43	1.07	422.46	43.10	54.63	69.85	4.11	62.36	0.748	12.47
T_2	17.63	13.08	1.13	536.30	40.33	50.14	63.40	5.02	114.44	1.373	22.89
T_3	18.22	14.72	1.15	627.27	39.42	49.33	62.64	5.59	119.17	1.430	23.83
T_4	19.14	16.20	1.20	632.45	37.25	48.70	61.13	6.17	122.58	1.470	24.52
T_5	18.86	15.56	1.18	631.17	38.02	47.09	60.94	5.74	121.89	1.462	24.37
T_6	20.48	18.35	1.40	633.56	37.61	46.86	59.51	6.42	123.03	1.475	24.60
T_7	22.39	19.07	1.25	635.42	36.52	46.00	58.76	6.72	126.07	1.512	25.21
T_8	21.55	18.92	1.34	634.11	37.19	45.37	57.62	6.60	124.54	1.494	24.90
T_9	23.95	20.11	1.48	728.59	36.27	45.12	57.21	6.86	128.04	1.536	25.61
T_{10}	26.07	21.13	1.69	732.83	35.36	43.08	55.08	7.43	130.26	1.563	26.05
T_{11}	25.01	20.27	1.56	729.18	35.33	44.75	56.33	7.25	129.33	1.551	25.86
T_{12}	26.98	22.78	1.83	738.11	34.81	42.16	54.27	7.61	132.72	1.592	26.54
S.Ed(±)	1.17	0.11	2.73	2.02	0.37	0.06	0.42	0.33	0.33	0.04	0.03
CD at 5%	2.45	0.22	5.50	4.04	0.76	0.14	0.46	0.68	0.68	0.08	0.05

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