

**A REVIEW AND PHYTOCHEMICAL SCREENING ON KNOL KHOL**

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ABSTRACT

Knol-khol (*Brassica oleracea* var. *gongylodes* L.) is a cool season crop belongs to the family Cruciferae and is originated from the coastal countries of Mediterranean region (Choudhary, 1967). Cruciferous vegetables are one of the dominant food crops worldwide. Cruciferous vegetables are vegetables of family Brassicaceae (also called cruciferae). They are good source of many health promoting and potentially protective phytochemicals including folic acid, phenolics, carotenoids, selenium, glucosinolates and vitamin c. A field experiment was carried out to investigate the effect of different manures and fertilizers on the growth and yield of knol-khol (*Brassica*

oleracea var. *gongylodes*). The days taken to knob initiation showed highly significant positive correlation at genotypic and phenotypic levels with days taken to first harvest only, whereas knob diameter, knob length and dry weight of leaves showed negatively significant correlation with days taken to knob imitation at genotypic and phenotypic levels. The days taken to complete harvest showed positive correlation at genotypic and phenotypic levels with Knob diameter, knob length, fresh weight of knob, fresh weight of leaves and dry weight of knob. The Fresh weight of knob showed positive significant correlation at phenotypic and genotypic levels with fresh weight of leaves, whole plant weight and dry weight of leaves. Study concluded that the combination of organic manure and bio-fertilizer improved the growth and yield of knol-khol (*Brassicaoleracea*var. *gongylodes*) plant. Therefore, theapplicationoforganic manure and bio-fertilizers are recommended for knol-khol production.

KEYWORDS: Anti-diabetic, Knol-khol, *Brassica oleracea* var.*gongylodes*, Vermicompost, Antihyperglycemic.

INTRODUCTION

Knol-khol (*Brassica oleracea* var. *gongylodes* L.) is a cool season crop belongs to the family Cruciferae and is originated from the coastal countries of Mediterranean region (Choudhary, 1967). This knob is harvested for human consumption as raw or cooked vegetable for making salad and pickles, young leaves are also cooked as vegetable (Talukder et al., 2013). Knol-khol has enormous nutritional and medicinal values. It contains satisfactory amount of phosphorus (51 mg), potassium (372 mg), calcium (41 mg), iron (0.5 mg), vitamin-A (20 mg), thiamin (0.06 mg), riboflavin (0.04 mg), niacin (0.03 mg) and vitamin-C (66 mg) per 100 g of above ground stem (Duke and Ayensu, 1985). The presence of sulforaphane and other isothiocyanates which act as anti-oxidant and are believed to stimulate the production of protective enzyme in the body (Mishra et al., 2012). The demand of crop is increasing now a day due to its anti-hyperglycemic and anti-carcinogenic properties.^[1] Cole crops are one of the major vegetable groups in the kingdom. Cole crops including cauliflower, cabbage, knol-khol, etc., have economic importance and medicinal value for human health. Knol-Khol (*Brassica oleracea* var. *gongylodes*) is a rabi season cole crop belongs to family Brassicaceae which is originated from the coastal countries of Mediterranean region. In India, the cultivation of knol-khol is popular in Kashmir, West Bengal, Maharashtra, Assam, Uttar Pradesh, Punjab, Odisha and some parts of South India Basically edible part of knol-khol is knob, which is form swelling of the stem tissue above the cotyledons. The crop has tremendous medicinal properties like, acidosis, asthma, cancer, cholesterol level, heart problems, indigestion, muscle and nerve functions, prostate and colon cancer, skin problems, weight loss etc.^[2] The knol-khol (*Brassica oleracea* var. *gongylodes* L.) is a member of the cole crops and belongs to family Brassicaceae or Cruciferae. It has been under cultivation by Romans since 600 B.C. (Bose, 2001). Knol-khol is an important vegetable cole crop after cabbage and cauliflower. It is also called khol rabi (Khol- cabbage and rabi-turnip) and “Ghanthgobhi” in hindi. The edible part of knol-khol is ‘knob’, it is modified swollen stem and it is formed just above the surface of soil. The thickening of cotyledon leaves and long lanceolate thick leaves are present on the knob. It is a cool season vegetable crop and tolerant to the frost injury. The optimum temperature for the cultivation is 15-25°C. Knol-khol requires well drained fertile soils rich in organic matter and soil pH of 5.5 is ideal for its growth. In India, it is mostly grown in Northern parts of Kashmir valley region and also cultivated in selected parts of West Bengal, Uttar Pradesh, Himachal Pradesh, Madhya Pradesh and some parts of Rajasthan.^[3] Plants needed food for their growth and development in the form of proper doses of NPK fertilizers. Nitrogen is a part of chlorophyll molecule,

amino acid, proteins, nucleic acid and pigments (Cavazza and Bianco, 2005). It is mainly cultivated in Maharashtra, Madhya Pradesh, Himachal Pradesh, Punjab, Haryana, West Bengal and Jammu and Kashmir. Besides it is also cultivated in some parts of southern states (Nagar G 2019).^[4] 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.^[5] Knol-khol is a heavy feeder and shows good response to fertilizer application. Balanced dose of nitrogen play an important role in improving productivity and quality of knol-khol. Nitrogen increases vigour of plant, assimilation area and size of knob (Rai et al., 2003). Knol-khol crop is gaining commercial importance especially under South Konkan conditions. However, so far very limited attempts have been made to study the various production practices for knol-khol in Konkan agro-climatic conditions. It is high time to recommend the spacing as well as nitrogen levels for commercial conditions of knolkhol.^[6] The numbers of small farms are increasing over time mainly due to division and subdivision and sale and resale of farms. These small farms are inefficient for growing crops such as wheat, cotton, sugarcane and rice, since a lot of money resource is prerequisite for growing these crops. With such circumstances, crops that are short duration and fetch high returns are suitable for such farms. Such crops are vegetables that not only give high returns but they are also a cheap source of essential nutrients. The present study has analysed the cost and return analysis as well as technical efficiency of knol-khol producing farms of Jammu region of Jammu & Kashmir state. Three districts Jammu, Udhampur and Samba are selected for the said study. DEA (Data Envelopment Analysis) have been used for the estimating the technical efficiency. Farmers in the study area used purchased as well as home produced inputs.^[8] Phosphorus plays a vital role in several key physiological processes, viz. photosynthesis, respiration, energy storage and transfer, cell division and enlargement. It stimulates root growth,

blooming, fruit setting and seed formation (Memon, 1996). It is one of the important cole crops of Jammu and Kashmir union territory and is cultivated on an acreage of about 2712 hectares with production of 55118MT in Jammu province (Anonymous, 2017). Knol khol is known by many names in J&K such as Kholrabi, Kadam and Gaanth Gobhi. It is an annual vegetable and belongs to the family Cruciferaceae and genus 'Brassica'. Enlargement of the stem is fleshy edible portion, commonly known as knob that develops entirely above the ground. Both the green leaves and knobs are used as culinary at tender age and when the knobs become fibrous used for pickle purpose.^[9] Again use of organic matter in crop production may have many advantages over inorganic fertilizer. Organic matter reduces soil erosion, increases water holding capacity, and improves physiochemical and biological conditions of the soil. Besides nitrogen, phosphorus, potassium and sulfur, a considerable amount of micronutrients is also present in organic matter. Knol-khol is a short duration crop so easily soluble organic manure should be applied for its cultivation. Organic manure helps to conservation of soil moisture. Available soil moisture also helps taking other nutrients for the plants. With the available soil moisture nitrogen fertilizer also may be available to the plants. In this way organic manure helps up taking of nitrogen fertilizer.^[10]



Figure 1: Cultivation and Collection of Knol khol.



Figure 2: Various Variety of Knol Khol.

Vegetables are important constituents of Indian agriculture and also provide nutritional security due to their short duration, high yielding capacity with nutritional richness. Our country is blessed with diverse agro-climates with distinct seasons, making it possible to grow wide variety of vegetables. Vegetable plays an important role in the balanced diet by providing not only energy but also supplying vital protective nutrients like, proteins, vitamins, minerals, dietary fibers, micronutrients and antioxidants. In vegetables, Brassicaceae are one of the most diversified families with wide range of variation in crops that supplied edible products. Knol-khol (*Brassica oleracea* var. *gongylodes*) is a Rabi season crop originated from the costal countries of Mediterranean region. Among the Cole crops, it is comparatively hardy and short duration crop. It belongs to brassicaceae family and closely related to cabbage. It has been under cultivation by Romans since 600 B.C. (Bose, 2001).

Knol-khol is a heavy feeder and shows good response to fertilizer application (Shalini et al., 2002). It requires nutrient for growth and development in the form of proper doses of NPK.

Adequate supply of nitrogen enhances vegetative growth and favors the transformation of carbohydrates into proteins (Haque and Jakhro, 1996).^[11] Phosphorus plays a vital role in several key physiological processes, such as photosynthesis, respiration, energy storage and transfer, cell division and cell enlargement and it also stimulates root growth (Memon, 1996).^[13]

In India, the cultivation of knol-khol is popular in Kashmir, West Bengal and some parts of South India. Knol-khol (*Brassica oleracea* var. *gongylodes*) is a winter season crop and is originated from the coastal countries of Mediterranean region (Choudhary, 1967). It is commonly grown in Northern India and also in some parts of Rajasthan. The stem swells and stores edible food material specially starch and sugars. When consumed as raw it gives sweetish taste with slight aroma. The stem develops entirely above ground, which is edible and vary delicate in flavour and texture (Singh, 1989). Knol-khol is characterized by formation of knob (tuber) which arises from thickening of the stem tissue above the cotyledon. The formation of knob is best seen at the temperature range of 15-18°C. The fleshy turnip like enlargement develops entirely above the ground. The knob is harvested for human consumption either as raw or cooked.^[14] Optimal plant spacing is very important for crop production through efficient utilization of light, nutrient and water by the plants. Higher plant population adversely affects on yield per unit area by hampering the vegetative and reproductive growth of plant. Closer spacing and higher densities of knol-khol increase yield per hectare but the quality is decreased. Considering these facts the present study was undertaken to find out suitable variety and optimum spacing for higher growth and yield of knol-khol.^[15] The efficient and judicious use of the major sources of plant nutrients in integrated approach so as to get maximum economic yield without any deleterious effect on physico-chemical and biological properties of the soil is the aim of the integrated nutrient management (Sarkar et. al., 2020). The increase in yield, crop water use efficiency, grain quality, economic return and sustainability are the major advantages of INM (Wu and Ma, 2015). Indiscriminate use of chemical fertilizers has caused serious damage to the yield, soil health and ecology which also affects physico-chemical along with biological properties of soil. On the other hand, the organic sources of nutrients viz. FYM, poultry manure, neem cake etc., are gaining importance for sustainable crop production which should be integrated with chemical fertilizers for efficient utilisation of nutrients.^[17] Integrated nutrient management (INM) aims to maintain and improve soil fertility for longterm crop productivity by maximizing all organic, inorganic, and biotic resources in a coordinated manner that is

appropriate for each cropping system and farming situation, taking into account the ecological, social, and economic implications. As they grow quickly knolkhol can be directly seeded in the field.^[18] The cabbage and cauliflower are the most widely consumed vegetables from cole crops, but knol-khol is also becoming more popular due to its anti-hyperglycemic and anticarcinogenic characteristics. A cole crop is grown during the Rabi season, Knol-Khol (*Brassica oleracea* var. *gongylodes*) is a member of the Brassicaceae family and is native to the Mediterranean coastal nations. Carbohydrates and minerals like calcium, magnesium, phosphorus, sodium, sulphur, and others are abundant in Knol-khol. It is also a good source of nutritional fibre, antioxidants like vitamins A, C, E, and carotene. Moreover, it has isothiocyanates like sulforaphane and other types that are thought to encourage the body to produce defence mechanisms (Banotra *et al.*, 2017).^[19] Green revolution in India has led to intensive cultivation with the introduction of high yielding varieties of crops and adoption of modern agricultural technologies such as multiple cropping systems, irrigation and intensive use of high analysis fertilizers. This led to the removal of higher amount of nutrients resulting in multiple nutrient deficiencies especially the micronutrients and zinc in particular. Replenishment of micronutrients to soil has not received much attention, leading to their deficiency. Under these conditions application of zinc fertilizer is necessary for healthy crop growth and quality. Hence the present study was undertaken with an objective to find the effect of zinc on soil properties and quality of Knol Khol.^[21] Knol-khol can be grown from seeds, but frequently it is cultivated from transplants, especially for early market supply. Shrinking land resources coupled with increased demand for food to feed the burgeoning population has over exploited the cultivated lands and posed a serious challenge to the traditional resilience characteristics of these crop lands. Furthermore, imbalanced and inappropriate use of inorganic nutrients devoid of requisite quantity of organics has not only worsened the soil resource base by reducing the population of beneficial microorganisms and the factor productivity of most of the crop lands but also deteriorated the quality of the crops. Increased health consciousness among the masses has augmented the demand for safe and quality foods for which a comprehensive food production technology needs to be developed with emphasises on quality enhancement and yield stability in comparison to the yield and quality aspects realized under conventional practices of crop production. In fact, it is not affordable for an average Indian farmer to jump immediately from inorganic source of nutrients to organics in their crop production programme as it may lead to unbearable drastic reduction in crop yields in the initial years. This may become possible through the progressive substitution of organic sources of nutrients in place of in organics to meet crop

nutrient requirement for attaining higher and stable crop yield of better quality with an improvement in soil health. Therefore, experiment entitled ‘Impact of differential substitution nutrients through Organics on yield, nutrient uptake and profitability of Knol-khol.’^[22]

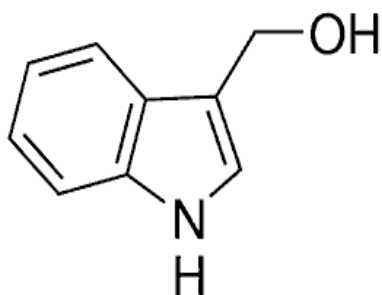


Figure 3: Chemical Structure of Knol Khol

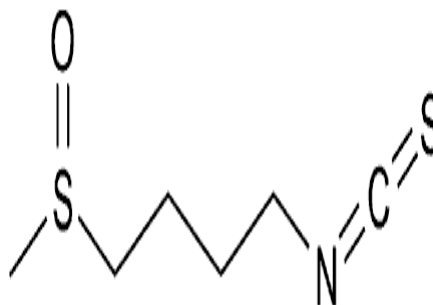


Figure 4: Sulforaphane Carbinol.

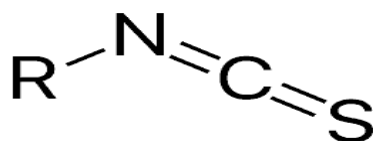


Figure 5: Indol-3-Isothiocyanates.

Application Knol khol

- **Plant growth and biomass**

Plant growth and biomass were analyzed by standard method. The number of leaves counted after the interval of days. Plant height and length of knob was measured with the help of scale meter. Dry and fresh weight of the plant part was determined by using hot air oven and weighing balance.

- **Yield and quality characteristics**

Yield characteristic was determined by the weight of total yield (kg plo1) and total yield (q ha1). Quality characteristic including total soluble solid (Brix) and vitamin C (mg 100g⁻¹) was determined by the standard method.^[2]

- **Growth attributes**

The effect of spacing on plant height, no. of leaves and plant spread was found significant. The highest plant height (41.18 cm), no. of leaves (16.66), plant spread (52.54 cm) was recorded in 30×40 cm spacing. Similar results were recorded by Mansa (2017) in red cabbage, Kakani (2012) in cauliflower, Malviya (2017) in broccoli and Haque et al., (2015) in cabbage whereas, the effect of spacing on average leaf area was found nonsignificant.^[6]

MATERIAL AND METHODS

Plant material

Knol-khol leaves were shade dried followed by hot air oven drying at 50° centigrade and then ground to a fine powder and stored in air tight container for the analysis. Fresh knol-khol leaves were grinded in the mixer for the collection of juice.

Qualitative phytochemical evaluation (Handa, 1995) Extraction

The coarse powder and juice of knol-khol was extracted with petroleum ether, chloroform, methanol and water at the ratio of 30:70. The extracts of knol-khol powder and juice were collected separately and filtered using Whatman filter paper. All the extracts were concentrated and the excessive solvents were evaporated under vacuum.^[7]

The experiment was laid out in naturally ventilated polyhouse made up of galvanized iron pipe and covered with 800-gauge UV stabilized polythene film. The experimental plots were prepared by making raised beds of 30 cm height and each measuring 3.0 × 2.7 m² gross plot size by mixing well rotten FYM in soil at the rate of 12.5 tons per hectare. Mulching was done prior to transplanting with black polythene sheet of 200- gauge thickness and holes were made appropriate distance as per the treatments. Twenty-eight days old seedlings of Early F1 hybrid were used for transplanting into main field. At the time of transplanting, half dose of nitrogen, full dose of phosphorus and potassium were applied in experimental plots and thoroughly mixed in soil. Remaining half dose of nitrogen was top-dressed four weeks after transplanting. All the crop management practices were adopted during cropping season. The knobs were harvested after attaining optimum stem size (5-8 cm). From each treatment five plants were selected randomly for recording observations during the both cropping periods. The field data were analyzed statistically as suggested by Gomez and Gomez (1984).^[12] The field experiment was carried out at the Horticulture Farm, Sher-e-Bangla Agricultural University (SAU), Dhaka during the period from October, 2010 to January, 2011. The experiment was consisted of 12 treatment combinations of four varieties e.g. V1: White Vienna, V2: Big Ball, V3: UFO, V4: Early 005 and three spacing, viz. S1 (30 em x 15 ern), S2 (30 em x 20 ern), S3 (30 em x 25 ern). Seedlings were raised at Horticulture Farm, SAU, Dhaka under special care. Four seedbeds were made for four varieties of 3 m x 1 m size under the polythene tunnel. Two factor experiments were laid out in the Randomized Complete Block Design (RCBD) with three replications.^[15] The present investigation was conducted with the long-term experimental field laid out in 2010 at College of Agriculture,

Bhubaneswar, Odisha. The experimental site is located at 20° 15' 86" north latitude and 85° 28' 68" east longitude and at an elevation of 25.9 m above mean sea level (MSL) and 60 kms west of the Bay of Bengal. The climate was hot and humid sub-tropical with dry season prevailing from October to June and wet season from July to September. The soil of the experimental site belongs to order Inceptisols having loamy sand texture and comes under sub-group vertic ustochrept. From the existing long term field experiment, the present observations were recorded during kharif 2018.^[16]

Location and climate

A two year field experiment was carried out during Rabi season of the year 2011-12 and 2012-13 at Experimental Farm of Regional Agricultural Research Station, Rajouri, SKUAST-Jammu. The experimental farm is situated at 32.520° N latitude and 74.01° E longitude at an elevation of 958 m above mean sea level. The place experiences hot dry summers, humid rainy season and extended winter season. The topography of the place is predominantly hilly and undulating. The soil of the experimental field was clayey in texture with 196.5 kg/ha available N, 8.1 kg/ha P₂O₅, 124 kg/ha available K₂O and having a pH of 7.67. The knol khol variety 'G-40' developed by SKUAST-Jammu, having ability to produce seeds under diverse agroclimates ranging from subtropical plains to mid and high hills of Jammu and Kashmir was used for experimentation.

Nursery raising

Seeds were sown in the 1st week of September on the raised nursery beds (3m x 1m size) in lines 5cm apart. Healthy seedlings were ready for transplanting after 4 weeks of sowing. Seedlings were transplanted on 1st week of October during both the years.

Crop raising

Three ploughings were done to bring the field into fine tilth and well rotten farm yard manure (FYM) @ 20t/ha was incorporated 15 days before actual transplanting and rest of inorganic fertilizers were applied at the rate of 100 kg N, 50 kg P₂O₅ and 50 kg MOP as per the recommendations in package of practices of vegetables crops (Anonymous, 2018). 1/3rd dose of N and full doses of P₂O₅ and MOP were applied as basal dose. Remaining 2/3rd of N was top dressed in two equal amounts after 30 and 45 days of transplanting. An additional dose of 50 kg N, 50 kg P₂O₅ and 50 kg MOP with crop, whereas as given to the in situ crop. All the other intercultural operations were carried out as per recommended in the package of practices.^[20]

A field experiment was conducted for two years at research farm of division of Agronomy at SKUASTJammuduring kharif 2015 and 2016 to assess the effect of differential substitution of nutrients throughorganics on yield, nutrient uptake and economics of basmati rice in irrigated Shivalik foothills of J&K. Thepooled data of two year study on basmati rice revealed that grain yield, straw yield and total nutrientuptake in basmati rice were significantly influenced by differential substitution of nutrients through organicsin irrigated Shiwalik foothills of J &K. Significantly higher pooled grain yield (30.38 q/ha) and straw yield(72.42 q/ha) of two year of basmati-370 were recorded with treatment 100% RDF which were foundstatistically at par with yields recorded with treatments T12, T16, T2 and T6 whereas significantly lowest grainand straw yield of basmati-370 were recorded with treatment 100 % NPK through FYM which was foundstatistically at par with treatment 100 % NPK through vermicompost and 100 % NPK through vermicompostand FYM (1:1) in grain and straw yield whereas significantly higher (75.37 kg/ha) total N uptake, total Puptake (13.13 kg/ha) and total K uptake (86.53 kg/ha) were recorded with treatment T11. Further, highestnet returns (Rs 66056/ha) and b:c ratio (3.18) in basmati-370 after two years were recorded with treatment100% NPK whereas lowest net returns (Rs 23213/ha) and b:c ratio (0.68) were recorded with treatment 100% NPK through Vermicompost in basmati rice.^[22]

PHYTOCHEMICAL SCREENING OF KNOL KHOL^[7]

Table 1: Preliminary Phytochemical Screening of Knol-Khol Powder Extract.

Sr. No.	Name of the chemical test	Petroleum ether extract	Chloroform extract	Methanol extract	Distill water extract
1.	Alkaloids	-	-	+	+
2.	Gylcosides	-	+	-	+
3.	Steroids	+	+	+	+
4.	Flavonoids	+	-	+	+
5.	Saponin	+	+	-	+
6.	Tannin	-	-	+	+
7.	Terpenoids	+	-	-	+
8.	Phytosterols	-	-	+	+

Table 2: Preliminary Phytochemical Screening of Knol-Khol Juice Extract.

Sr. No.	Name of the chemical test	Petroleum ether extract	Chloroform extract	Methanol extract	Distill water extract
1.	Alkaloids	+	+	+	+
2.	Gylcosides	+	-	+	+
3.	Steroids	+	+	-	+
4.	Flavonoids	+	-	+	+
5.	Saponin	-	-	-	+
6.	Tannin	+	+	-	+

7.	Terpenoids	+	+	-	+
8.	Phytosterols	-	-	+	+

CONCLUSION

On the basis of one year field experimental results it was concluded that the effect of phosphorus was clearly indicated the increased growth, yield and quality on knol-khol. The present studied was conducted to investigate the effects of different organic manures and fertilizer management practices on the growth and yield of knol-khol. Results on main and combined effect of different organic manures and fertilizer management practices and their interactions have been presented and discussed here. Fertilizers were an important factor for plant growth and productivity. Bio fertilizers including organic manure are environmental friendly fertilizers and give better nutrient supply to plant and increase agriculture production and improve soil health. The study showed that the combination of organic fertilizers and manures give a better result of yield and quality parameters of knol-khol.

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