

ORIGINAL ARTICLE

Assessment of Growth and Yield Attributes of Knol Khol (*Brassica oleracea* var. *gongylodes* L.) Under Multiple Organic Manure TreatmentsAnil Kumar Saxena¹, Suneeta Singh²

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ABSTRACT

A field experiment was planned and conducted during 2021-22 at Horticulture Research Block, School of Agricultural Sciences, SGRRU, Dehradun, Uttarakhand to assess the Growth and Yield attributes of Knol Khol (*Brassica oleracea* var. *gongylodes* L.) under multiple organic manure treatments. The experiment was laid out in randomized block design with three replications and nine treatments. The treatments comprised following levels of different organic manures with different concentrations viz. T1 (Control), T2 (FYM@ 10 t/ha), T3 (Vermicompost @5t/ha), T4 (FYM @5t/ha+Vermicompost @2.5t/ha), T5 (FYM @5 t/ha+VC @2.5 t/ha +Rhizobium@25%), T6 (Vermiwash @50%), T7 (FYM @5t/ha+Vermicompost @2.5t/ha+Vermiwash@25%), T8 (FYM @5t/ha+Vermicompost@2.5t/ha+Vermiwash@25%+Rhizobium @25%) and T9 (Cow urine@ 50%) T10 (FYM @5t/ha+ Vermicompost@ 2.5t/ha+Vermiwash@ 25%+Rhizobium @25%+Cow urine @50%). The sowing of cultivar Suman was done on November 25, 2021. Observations on various growth and yield attributes were recorded. The treatment T10 (FYM@5t/ha+Vermicompost@2.5t/ha+Vermiwash@25%+Rhizobium @25%+Cow urine @50%) recorded the highest plant height (40.33 cm), number of leaves per plants (30.33), leaf length (42.41 cm), leaf width (26.80 cm), fresh plant weight (310.70 g), fresh weight of leaves (135.03 g), knob yield (1.62 Kg/plot) and knob yield (189.7q/ha).

KEYWORDS

• FYM • Vermicompost • Vermiwash • Rhizobium • Plant height • Knob yield

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INTRODUCTION

Knol-Khol (*Brassica oleracea* var. *gongylodes*) belongs to Brassicaceae family and having chromosome $2n=2x=18$. It is a winter season crop and is originated from the coastal countries of Mediterranean region. 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.¹ Knol-Khol is a rabi season cole crop belongs to family Brassicaceae which is originated from the coastal countries of Mediterranean region. It 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. When eaten raw it gives sweetish taste with slight aroma. Knol-khol contain protein 1.1 g, calcium 20 mg, iron 0.4 mg, vitamin A 36 IU and other minerals 0.7 mg per 100 g of edible portion. The knob is generally used as cooked vegetable. It is also utilized for making salad and pickles. Occasionally young leaves are also cooked as vegetable. As it is gaining popularity in the big cities and small towns as well, standardization of agro-techniques for its successful cultivation, particularly in the semi-arid areas is very essential. Organic farming helps in soil health, proper energy flow in soil, crop, water environment systems, keeps biological life cycle alive and helps in sustaining considerable levels in yield.² Farmyard manure refers to the decomposed mixture of dung and urine of farm animals along with litter and left-over material from roughages or fodder fed to the cattle. It contains, on an average, 0.5% N, 0.2% P, and 0.5% K. Incorporation of FYM in the soil and its subsequent decomposition results in enhanced organic carbon content of the soil. Application of FYM into soil increases organic carbon stock. Soil organic matter (SOM) has a large number of exchange sites that ultimately result in higher cation exchange capacity.³ It decomposes in two-three months when it is considered useable in the field. Application of FYM has improved soil physical condition viz., stable soil aggregates, density, soil moisture holding capacity and soil air movement. The organic manure have many advantages in the production of knol-khol as it reduces the soil

erosion, increase the water holding capacity, improves the soils physical, chemical and biological properties. It can be maintained by the use of organic manures such as farmyard manure, poultry manure, and vermicompost. Due to these various beneficial effects the organic manures should be used in abundance.⁴ The combined application of both organic and inorganic fertilizers in optimum quantity which helps to maintain the soil fertility and sustained a higher level of productivity.⁵ Vermicompost is a simple and effective technique to reprocess of agricultural waste, city garbage and kitchen waste along with bioconversion of organic waste materials into nutritious compost by earthworm action. VC technology involves the bio-conversion of organic waste into vermicasts, vermiwash utilizing earthworms. These earthworms feed on the waste and their gut act as the bioreactor where the vermicasts are produced.⁶ These vermicasts are rich in NPK and micronutrients. Consequence of these VC on plant growth is well reported but mostly it used as a main source of 'N' and 'P' is a significant nutrient as a part of some key plant structural components and worked as catalysis in the change of numerous keys of biochemical reactions in plants.⁷ Vermicompost contains plant growth regulators and other plant growth influencing materials created by microorganisms as well as humates, cytokinins and auxins.⁸ Organic manures help in sustainable and economic food production as well as sustainable agriculture. There are specific cultivars for different period of year and no particular cultivar of a group is suitable for growing successfully throughout the year under lower hills of Uttarakhand. Therefore, it is very important to select the suitable cultivar for growing in a particular season with the use of different organic manure.

MATERIALS AND METHODS

The present investigation was carried out at Horticulture Research Block, Department of Horticulture, School of Agricultural Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand during the rabi season of 2021-22. The experiment was laid out in Randomized Block Design and replicated thrice. Total ten treatments were viz. T1 (Control), T2 (FYM@ 10 t/ha), T3 (Vermicompost @5t/ha), T4 (FYM @5t/ha+Vermicompost @2.5t/ha), T5 (FYM @5t/ha+VC @2.5 t/ha+Rhizobium@25%),

T6 (Vermiwash@50%), T7 (FYM@5t/ha+ Vermicompost @2.5t/ha + Vermiwash@25%), T8 (FYM@5t/ha+ Vermicompost@2.5t/ha+Vermiwash@25%+Rhizobium@25%) and T9 (Cow urine@ 50%) T10 (FYM @5t/ha+ Vermicompost@2.5t/ha+Vermiwash@25%+ Rhizobium @25% +Cow urine @50%). The Knol khol cultivar 'Suman' was taken for research purpose. The seedlings were transplanted in experimental field on 2nd November, 2021. All the organic manures (FYM, vermicompost, Vermiwash, Rhizobium and cow urine) were

applied manually. Five plants from each treatment in each replication were chosen at random for the thorough study on growth and yield parameters at 30, 60 DAT and at Final harvest stage. Observations were recorded on growth and yield characters with the help of meter scale and vernier calipers and top balance respectively. The obtained data were subjected to the statistical analysis by adopting analysis of variance technique as described by⁹ for the Randomized Block Design (RBD).

Table 1: Treatment Details

Treatments	Combinations	Concentration (per Hectare)	Concentration (per Plot)
T ₁	Control	Soil 100%	Soil 100%
T ₂	FYM	10Ton	1Kg
T ₃	Vermicompost	5Ton	0.5Kg
T ₄	FYM+Vermicompost	5Ton+2.5Ton	0.5Kg+250gm
T ₅	FYM+Vermicompost+ Rhizobium	5Ton+2.5Ton+25ml	0.5Kg+250gm+2.80ml
T ₆	Vermiwash	50%	600ml
T ₇	FYM+Vermicompost+Vermiwash	5Ton+2.5Ton+25%	0.5Kg+250gm+750ml
T ₈	FYM+Vermicompost+Vermiwash+Rhizobium	5Ton+2.5Ton+25%+25%	0.5Kg+250gm+750ml+ 2.80ml
T ₉	Cow urine	50%	600ml
T ₁₀	FYM+Vermicompost+Vermiwash+ Rhizobium+Cow urine	5Ton+2.5Ton+25%+25%+25%	0.5Kg+250gm+750ml+ 2.80ml+300ml

RESULTS AND DISCUSSIONS

Growth attributes

Plant height (cm)

Data pertaining to plant height was recorded at 30 DAT, 60 DAT and at final harvest stage were statistically analyzed and presented in table 2 and depicted in Figure 1. At 30 days after transplanting, the maximum plant height was recorded in treatment T₄ (23.30cm). The treatment T₃ (19.38), T₂ (19.63cm) and T₈ (19.57cm) were at par with each other. Also the treatment T₅ (20.06cm), T₆ (20.02cm), T₉ (20.56cm) and T₁₀ (20.56cm) were at par with each other. However, the minimum plant height (16.35cm) was recorded under the treatment T₁. In case of 60 DAT, the maximum plants height was obtained in treatments T₃ (31.45cm) which was at par with T₅ (31.45cm) and T₆ (31.57cm). Also the treatment T₄ (27.51 cm), T₉ (27.13cm), T₈ (29.12cm) and T₇ (28.53 cm) were at par with each other. The minimum plant height (25.48cm) was recorded under treatment T₁. At final harvest, the plant height was recorded maximum in T₁₀ (40.33cm). The treatment T₆ (37.04cm) and T₅ (37.09cm) were at par with each other. However, significant difference was observed with treatment T₂ (36.76cm) and T₈ (38.65cm). While, minimum

plant height was obtained in the treatment T₁ (29.02cm). The increase in plant height with increased doses of FYM+ vermicompost might be due to enhanced amount of growth promoting substances at higher doses. Similar results were obtained by¹⁰.

Number of leaves per plant

The number of leaves per plant counted at different stages of crops growth showed significant as presented in table 2 and Figure 2. At 30 DAT, the highest no. of leaves was recorded in T₂ (13.30cm). The treatment T₅ (12.80cm), T₈ (12.23cm), T₇ (11.80cm), T₄ (11.70) and T₃ (11.10cm) were at par with each other. The minimum number of leaves (9.80cm) was recorded under the treatment T₁. In case of 60 DAT, the maximum number of leaves was obtained in treatments T₈ (20.57cm), which was at par with T₅ (20.23cm) and T₈ (20.10cm). The treatment T₇ (19.55cm), T₅ (19.42cm), T₃ (19.28cm), T₂ (18.79cm) T₉ () and T₄ (18.54cm) were also at par with each other. The minimum number of leaves (17.44cm) was recorded under the treatment T₁. However, at final harvest, the number of leaves was maximum recorded in T₁₀ (30.30cm). The treatment T₈ (29.87cm), T₆ (29.30cm), T₅ (28.82cm), T₇ (28.34cm), T₉ (27.96), T₄ (27.62cm) and T₂ (27.52cm) were

at par with each other. While, minimum number of leaves was obtained in treatment T₁ (25.87cm).The probable reasons for enhanced a greater number of leaves, may be due to

promotive effect of macro and micro nutrients on vegetative growth ultimately led to more photosynthetic activities. The findings are in agreement with.¹¹

Table 2: Effect of organic manures on plant height, number of leaves, leaf length and leaf width of Knol khol at different harvest intervals

Treatment	Plant height (cm)				Number of leaves				Leaf length (cm)				Leaf width (cm)			
	30 DAT	60 DAT	At Final Harvest	Mean	30 DAT	60 DAT	At Final Harvest	Mean	30 DAT	60 DAT	At Final Harvest	Mean	30 DAT	60 DAT	At Final Harvest	Mean
T1	16.35	25.48	29.13	23.65	9.80	17.44	25.87	17.70	19.00	25.24	32.17	25.47	11.96	17.31	21.40	16.89
T2	19.63	30.30	36.01	28.64	13.30	18.79	27.52	19.87	21.46	29.41	35.72	28.87	13.27	19.70	23.90	18.95
T3	19.38	31.49	37.87	29.58	10.80	19.28	26.34	18.80	24.53	30.19	37.16	30.63	16.47	20.31	26.80	21.19
T4	23.30	27.51	32.28	27.70	11.70	18.54	27.62	19.28	24.33	28.27	36.06	29.55	18.29	21.92	25.93	22.05
T5	20.06	31.49	37.03	29.53	12.80	19.42	28.82	20.35	25.90	30.13	34.96	30.33	12.36	18.83	24.00	18.39
T6	20.02	31.57	39.04	30.21	11.80	20.10	29.30	20.40	22.13	29.97	35.64	29.24	14.36	18.70	23.90	18.98
T7	21.72	28.53	31.66	27.30	10.36	19.55	28.34	19.42	20.53	31.22	38.52	30.09	15.66	20.33	22.50	19.49
T8	19.53	29.12	38.04	28.90	12.23	20.57	29.87	20.89	23.16	33.22	42.41	32.93	17.25	21.84	24.63	21.24
T9	20.56	27.13	32.33	26.67	11.10	18.66	27.96	19.24	22.40	30.14	38.53	30.36	16.91	20.52	24.56	20.66
T10	20.56	30.13	40.33	30.34	10.20	20.23	30.33	20.25	21.56	28.40	36.30	28.75	18.64	21.73	23.76	21.38
C.D.0.05			3.71				1.58				2.78				1.91	
SE(m) ±			1.24				0.52				0.92				0.64	
SE(d) ±			1.75				0.74				1.31				0.90	
C.V.			7.60				4.65				5.43				5.56	

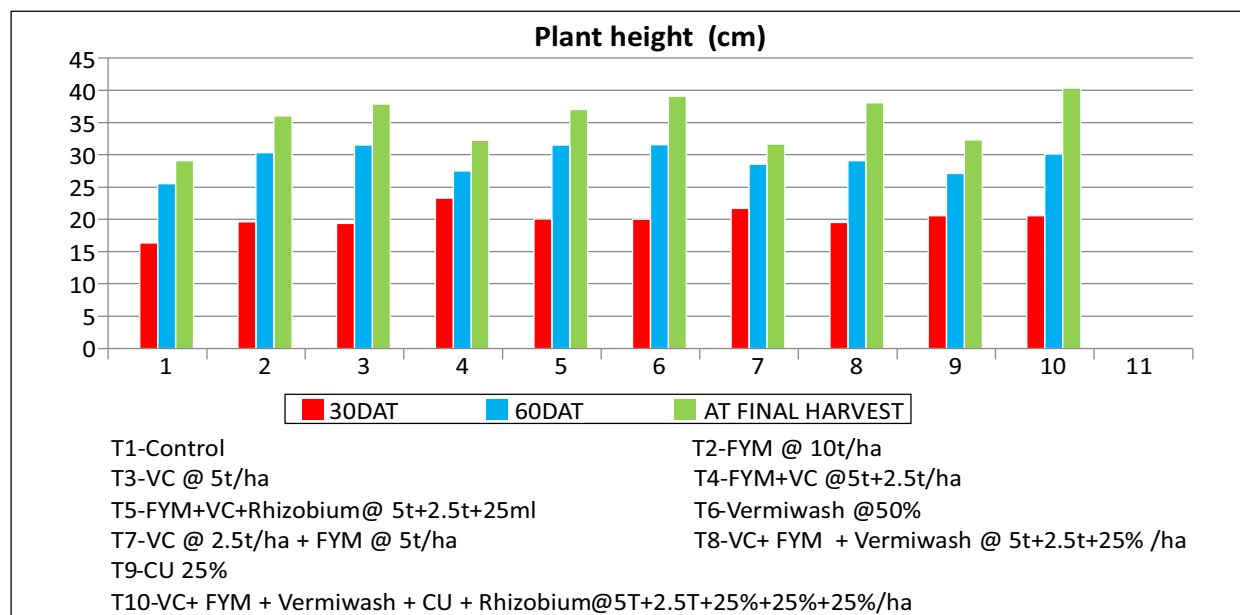


Figure 1: Effect of various organic manures on plant height (cm) at different harvest interval on knol khol

Leaf length (cm)

At 30 DAT, the highest value of leaf length was recorded in treatment T_5 (25.00cm) and the lowest value (19.00cm) of leaf length was recorded under the treatment T_1 (control). In case of 60 DAT, the maximum leaf length was recorded in treatments T_8 (33.22cm). The treatments T_7 (31.22cm), T_9 (30.14), T_3 (30.19cm), T_6 (29.97cm), T_2 (29.41cm), T_{10} (28.40cm) and T_4 (28.27cm) were at par with each other. The minimum leaf length (25.24cm) was recorded under the treatment T_1 . At final

harvest, the leaf length was maximum recorded in T_8 (42.41cm). The treatment T_9 (38.53cm) and T_7 (38.52cm) was at par with each other. However, significant difference was observed with treatment T_3 (37.16cm), T_{10} (36.30cm), T_2 (35.72cm) and T_5 (34.96cm). While, minimum leaf length was observed in the treatment T_1 (32.17cm). The increase in leaf length with increased doses of organic manures might be due to enhanced amount of growth promoting substances at higher doses. Similar, results were obtained by.^{10,12}

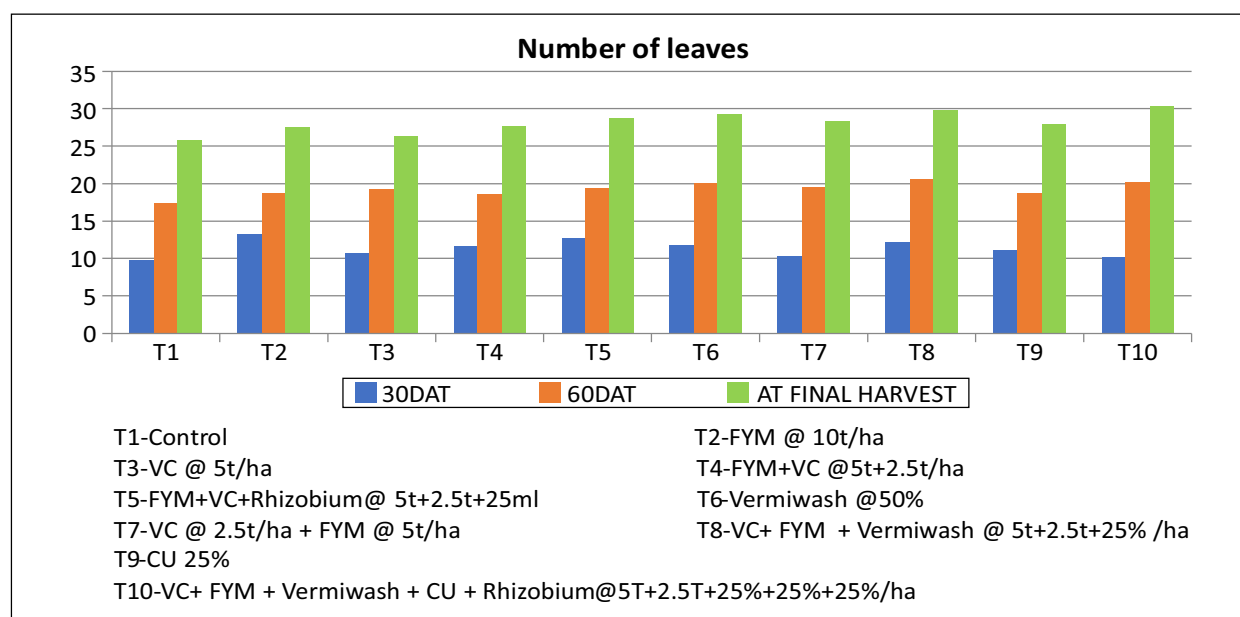


Figure 2: Effect of various organic manures on number of leaves at different harvest interval on knol khol

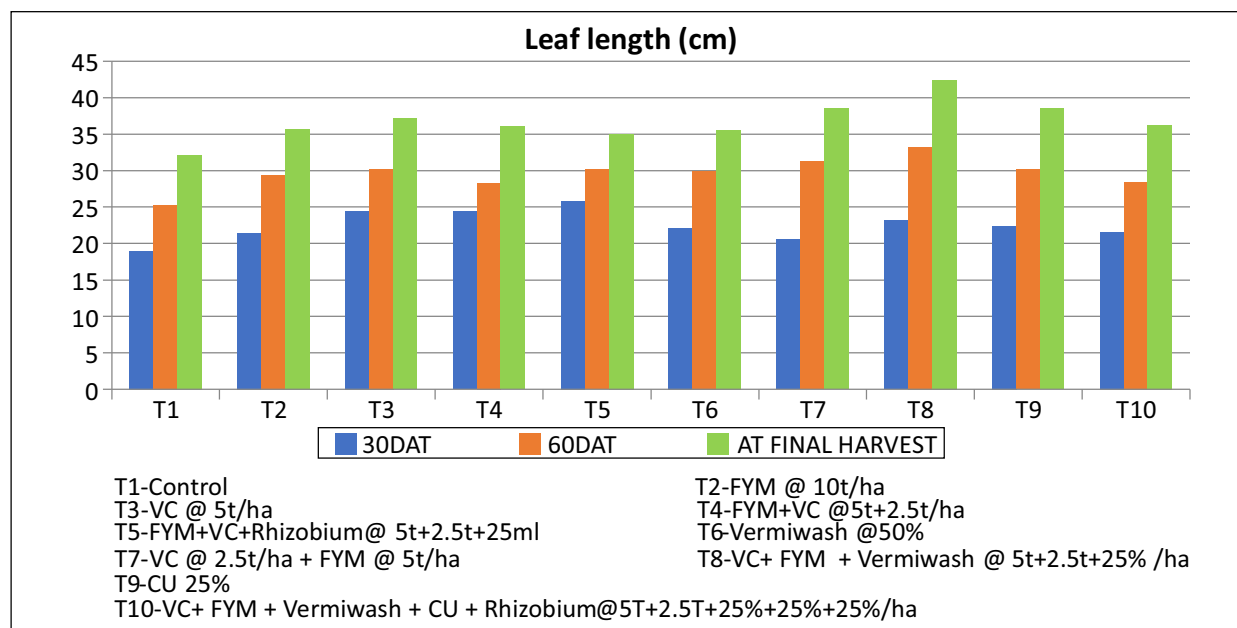


Figure 3: Effect of various organic manures on leaf length (cm) at different harvest interval on knol khol

Leaf width (cm)

At 30 DAT, the highest value of leaf width was recorded in treatment T₁₀ (18.63cm) and lowest value (11.96cm) was recorded in T₁ (control). At 60 days after transplanting, the maximum leaf width was reported in T₈ (21.84cm), which was at par with T₁₀ (21.73cm), T₄ (21.93cm), T₇ (20.33cm), T₉ (20.52cm) and T₃ (20.31cm). The treatment T₂ (19.70), T₅ (18.83) and T₆ (18.70cm) were also at par with each other. The minimum leaf width (17.31cm)

was recorded in T₁. At final harvest days after transplanting, the leaf width was maximum recorded in T₃ (26.40cm). The treatment T₄ (25.47cm), T₈ (24.63), T₉ (24.56) and T₅ (24.00cm) were at par with each other. While minimum leaf width was reported in the treatment T₁ (21.40cm). This might be due to the continuous nutrient availability by the use of organics. This is found to be in accordance with findings of.¹³

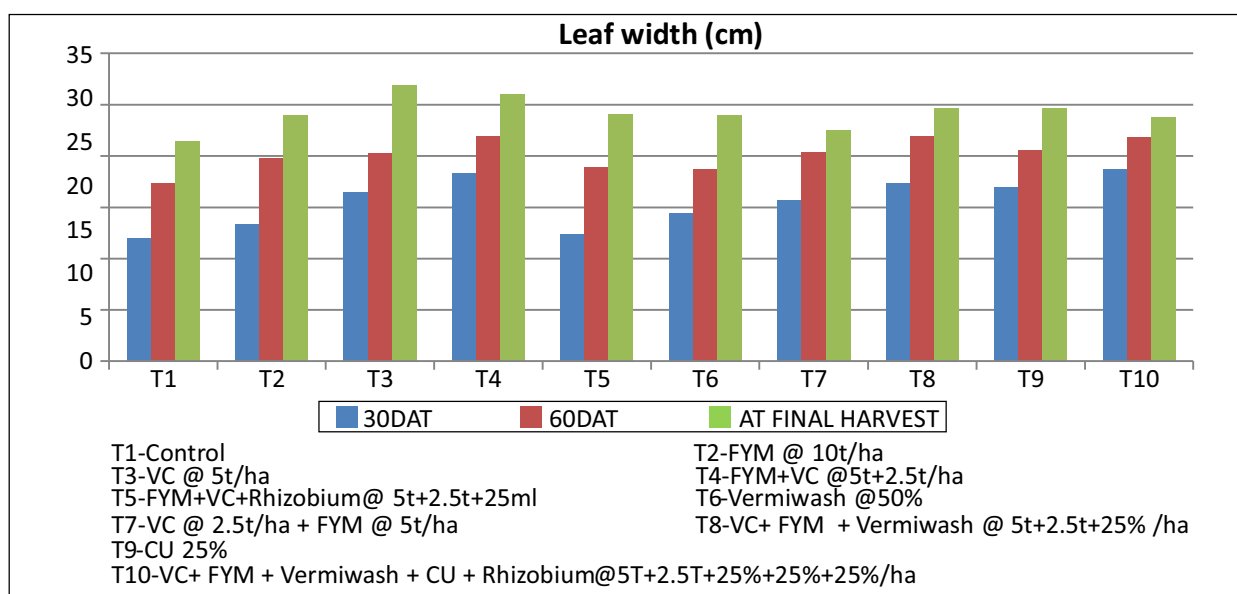


Figure 4: Effect of various organic manures on leaf width (cm) at different harvest interval on knol khol

Fresh plant weight (g)

The data regarding the total fresh weight of plant was presented in the table 3. The highest fresh weight of plant (310.70g) was recorded in T10 with VC @ 2.5t/ha + FYM @ 5t/ha + CU 25% + Vermiwash 25% + Rhizobium @ 250ml and lowest in T1 (189.20g). The results show

significant differences between the treatments. The increase in fresh weight of plant may be due to the excellence of high level of organic manures was producing good growth of knol khol plants which show higher total fresh weight of plant. The findings are in similar with.¹⁴

Table 3: Effect of organic manures on Fresh plant weight(g), Fresh leaf weight(g), Knob yield (kg/plot) and Total yield (q/ha) of Knol khol at final harvest

Treatment	Fresh plant weight (g)	Fresh leaf weight (g)	Knob yield (kg/plot)	Total yield (q/ha)
T1	189.20	77.46	0.81	81.70
T2	284.87	94.50	1.73	173.3
T3	242.00	82.00	1.53	153.7
T4	241.77	95.63	1.26	126.3
T5	229.58	81.26	1.26	126.0
T6	247.57	87.66	1.62	162.7
T7	238.10	88.43	1.09	109.7
T8	251.60	89.46	1.14	114.3
T9	263.13	92.50	1.65	165.0
T10	310.70	135.03	1.89	189.7
C.D.0.05	39.92	24.38	0.17	17.04
SE(m) ±	13.33	8.14	0.05	5.69
SE(d) ±	18.86	11.51	0.08	8.05
C.V.	9.24	15.26	7.03	7.03

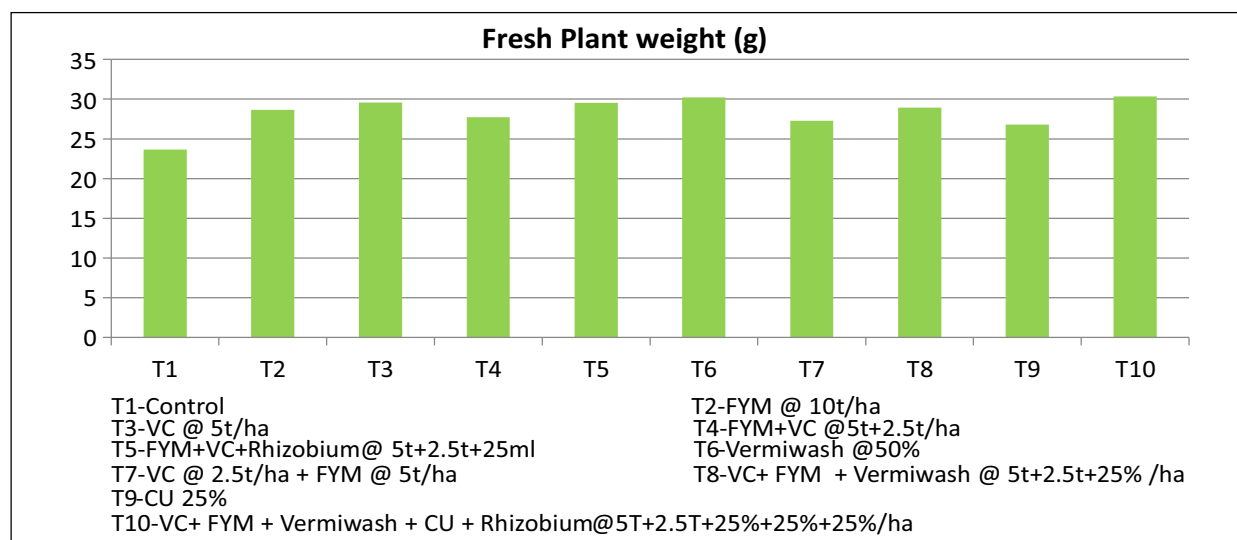


Figure 5: Effect of different organic manures on fresh plant weight (g) of knol khol at final harvest

Fresh leaf weight (g)

The data regarding the fresh leaf weight was presented in the table 3. The maximum fresh weight of leaf (135.03g) was recorded in T10 with (VC @ 5t/ha + FYM @ 10t/ha + CU 25% + Vermi wash 25% + Rhizobium @ 250ml). The lowest total fresh weight of plant was

recorded in control T1 (77.46 g). The increase in fresh weight of leaves may be due to the excellence of high level of organic manures was producing good growth of knol khol plants which show higher total fresh weight of leaves. The findings are in similar with.¹⁵

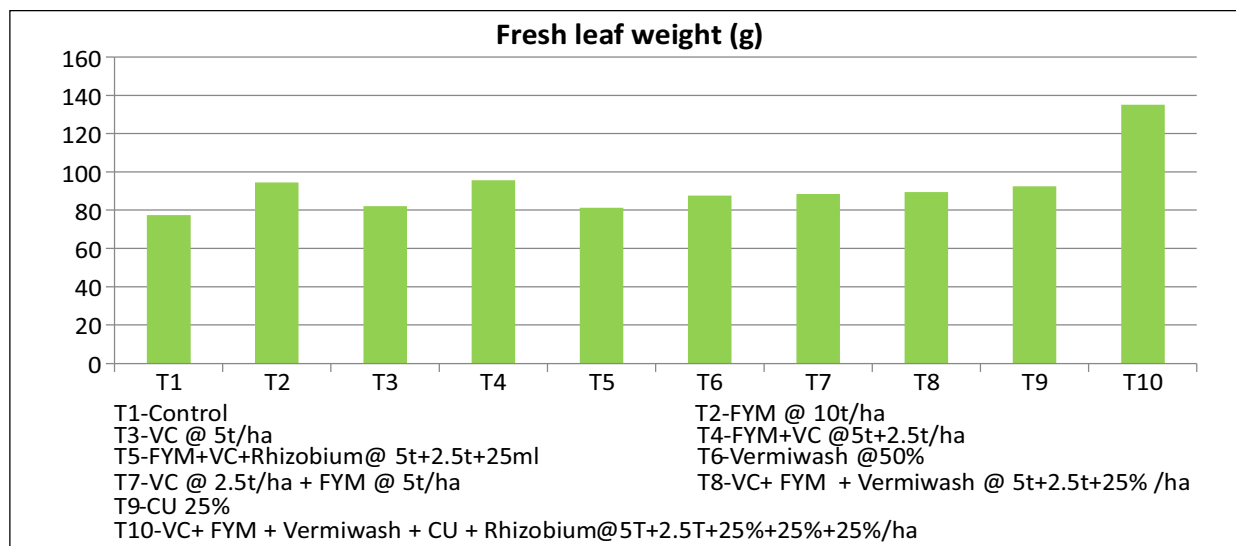


Figure 6: Effect of different organic manures on fresh leaf weight (g) of knol khol at final harvest

Yield attributes

Knob yield (kg/plot)

The maximum knob yield per plot was recorded in T10 (0.81 kg/plot) with (VC@ 5t/ha+FYM@10t/ha+CU 25%+Vermiwash 25% + Rhizobium @ 250ml). Whereas, the minimum knob yield was recorded T1 (0.29 kg/plot) under control condition. That

performance was influenced by the forms and levels of organic manure. Better plant growth by the increased availability of nutrients and accelerated mobility of photosynthates from source to sink as influenced by the growth hormones released or synthesized from growing knob. Similar results were obtained by.¹⁶

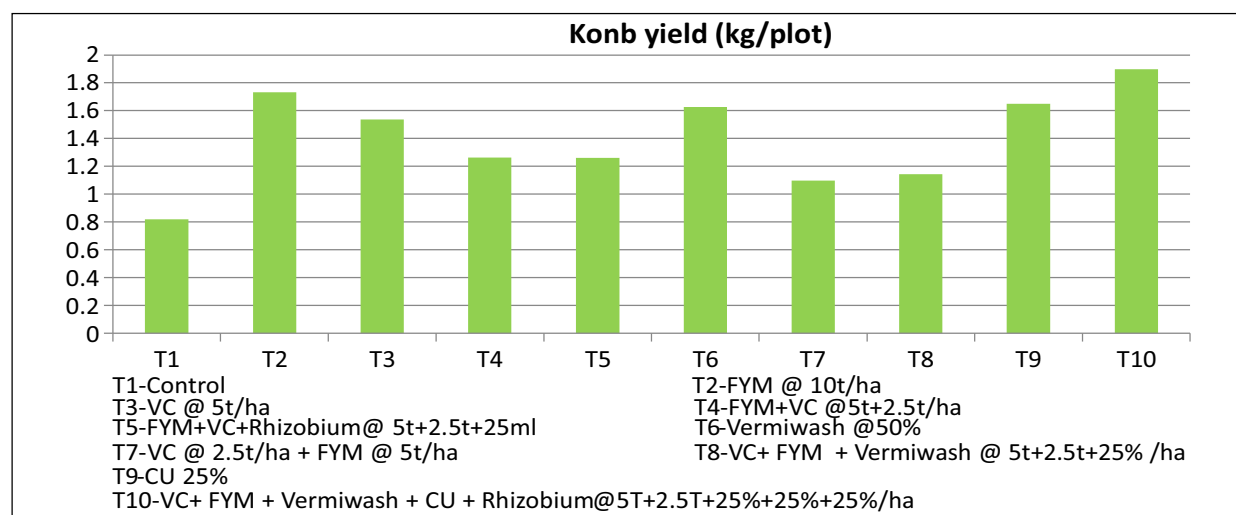


Figure 7: Effect of different organic manures on knob yield (kg/plot) at final harvest

Knob yield (q/ha)

The data regarding knob yield of various treatments and are presented in table 3. The total knob yield varied significantly from 81.7q/ha (T₁) to 189.7q/ha (T₁₀). The maximum yield was recorded in the treatment T₁₀ (189.7q/ha). This might be due to better plant growth

by the increased availability of nutrients and accelerated mobility of photosynthates from source to sink as influenced by the growth hormones released or synthesized from growing media, as a result the yield of knob was increased. Similar result was obtained by.^{17,18}

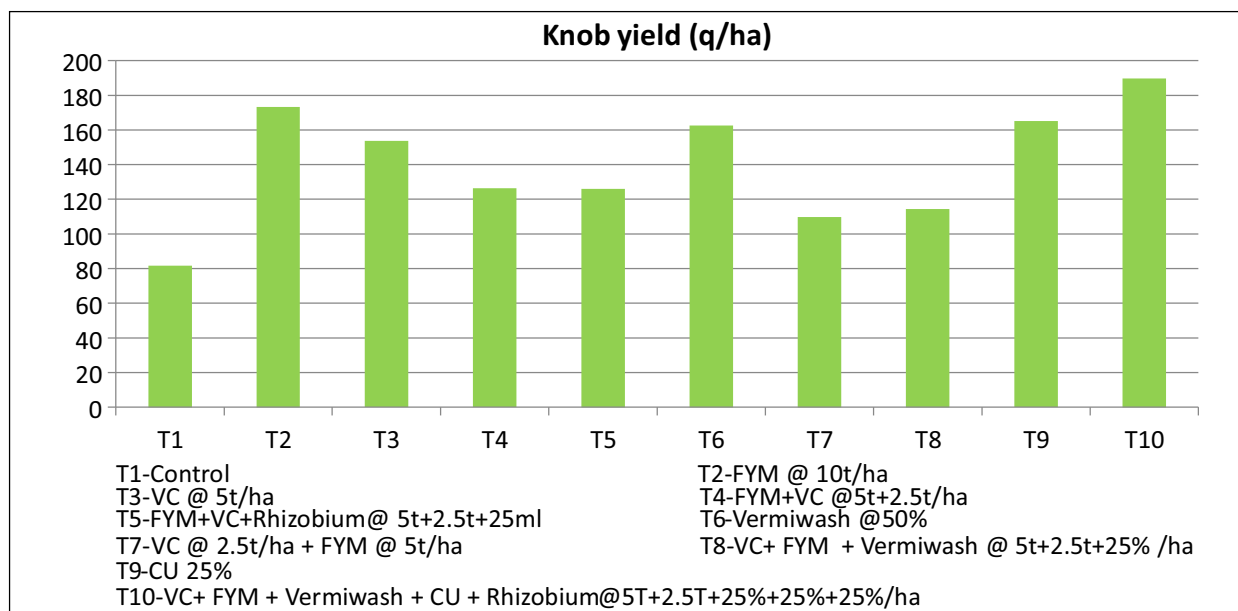


Figure 8: Effect of various organic manures on knob yield (q/ha) at final harvest

CONCLUSION

On the basis of present investigation on “Analysis of the Growth and Yield attributes of Knol Khol (*Brassica oleracea* var. *gongylodes* L.) under multiple organic manure treatments, it can be concluded that different organic manures with combination of FYM@5t/ha + VC@2.5t/ha + cow urine @ 25%+Vermiwash 25%+Rhizobium + 25% as treatment T10 was found to be the most operative treatment for increasing plant height, number of leaves, leaf length, leaf width, fresh plant weight, fresh leaf weight, knob yield (kg/plant) and knob yield (q/ha). In the present investigation, supplementation of FYM, vermicompost along with cow urine improved soil fertility status which resulted in higher yield performance. Therefore, it could be recommended under present agro-climatic conditions in order to obtain sustainably growth and higher yield of knol khol.

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