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Mean Performance of Knolkhol (*Brassica oleracea* var. *gongylodes* L.) Genotypes for Various Quantitative Traits under Sub Tropical Conditions of Jammu

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A B S T R A C T

The present investigation entitled "Mean performance of knolkhol (*Brassica oleracea* var. *gongylodes* L.) genotypes for various quantitative traits under sub-tropical conditions of Jammu" comprising of thirty genotypes was carried out at Vegetable Research Farm, Division of Vegetable Science and Floriculture, FOA, Chatha, SKUAST-J, Main campus, Chatha to evaluate the mean performance of knolkhol for various Quantitative traits during the year 2016-17. The field experiment was laid out in Randomized Block Design with three replications, spaced at 30 cm × 30 cm. The analysis of variance revealed that mean squares due to genotypes were significant for all the traits highlighting the presence of sufficient genetic variability among the genotypes. Based on the mean performance of genotypes with respect to various growth and yield attributing genotypes namely SJKK-04, G-40 and Green Gold gave yield statistically at par with Early Super White Vienna which had higher yield among the genotypes studied. SJKK-04 was also found to be one of the best performers for number of leaves per plant, net knob weight per plant and gross knob weight per plant. Genotype Early Super White Vienna had maximum marketable knob diameter and took less number of days to marketable knob maturity and Pusa Virat had minimum stalk length and petiole length, respectively.

Introduction

Knolkhol (*Brassica oleracea* var. *gongylodes* L.) 2n=18 belongs to family *Brassicacea* is a cool season vegetable crop. It has its primary centre of origin in Northern Europe. It is also called as kohl rabi (German word) *i.e.* cabbage turnip, since it resemble an above ground turnip. It has importance for both leaves and knobs consumption in India and only knobs in Europe. In India it is widely grown in Jammu and Kashmir, West Bengal and to a limited extent as a rare exotic vegetable in some parts of Maharashtra, Assam, Uttar Pradesh and Punjab (Thamburaj and Singh, 2010). Of late demand for knolkhol has gained momentum in National Capital Region of Delhi and adjoining states because of its wholesome utility as fresh vegetable and value addition products which support the food needs of the people. In Jammu and Kashmir it is a popular vegetable both among rich and poor and

grown in almost all kitchen gardens and also as a commercial crop around cities and towns. In Jammu knolkhol is grown over an area of about 1961 ha and with a production of 54977.60 mt (Anonymous *et al.*, 2014) and is in great demand throughout the year for its varied size of coloured knobs and leaves. Knolkhol is a highly cross pollinated crop and shows tremendous variability in the available germplasm for most of the desirable traits. Genetic variability existing in the cultivated species either through natural processes or through crop breeding is essential for generating new gene complexes for realizing higher economic yield and resistance to biotic and abiotic stresses. There is a scanty of literature regarding the performance of various genotypes for in knolkhol. So the present study will generate the extent of variation among different genotypes for growth and yield attributing traits in knolkhol.

Materials and Methods

The present investigation was carried out under subtropical conditions of Jammu at Vegetable Experimental Farm, Division of Vegetable Science and Floriculture, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology, Main Campus, Chatha, Jammu (J&K) during (Sept–Oct) of the year 2016-17. The experimental field of Division of Vegetable Science and Floriculture, SKUAST, Jammu is situated at 32^{o} 40'N latitude and 74^{o} 58' E longitude and has an elevation of 332 m above mean sea level. The experimental material comprised of 30 diverse genotypes of knolkhol collected from diverse agro-climatic regions of J&K along with two genotypes from IARI, Katrain, one from CSKHPKV, Palampur and three hybrids. The details of the genotypes along with their source are given below in Table 1. The experimental was laid out in Randomized Block Design with three replications during (Sept–Oct) of the year 2016-17. The sowing of all genotypes was done in nursery bed and 25 days old seedlings were transplanted at the spacing of 30 cm between rows and 30 cm between plants within the rows. The package and practices to raise successful crop of knolkhol was followed. Five plants were randomly selected from each replication per genotype for recording the various growth and yield attributing traits. The mean value was used as the replicated data and was subjected to statistical analysis using INDOSTAT software package. The data of quantitative traits were statistically analyzed as per methods out lined by Panse and Sukhatme (1967) for estimating the analysis of variance (ANOVA).

Results and Discussion

Analysis of variance

The analysis of variance (ANOVA) revealed that mean squares due to genotypes were highly significant for all the traits studied, thereby exhibiting the presence of sufficient genetic variability in the genotypes (Table 2) and considerable scope for improvement of various traits such as plant height, plant frame, petiole length, number of leaves per plant, leaf length, leaf width, stalk length, gross weight /plant, marketable knob weight/plant, marketable knob diameter, harvest index, days to marketable maturity, Earlier workers namely, Santhosha *et al.*, (2014) and Chittora and Singh (2015) have also reported variability in their respective cauliflower material for different set of characters studied.

Mean performance of different genotypes

Growth traits

Plant height ranged from 31.04 cm in genotype Farashi Lajwari Local to 55.78 cm in genotype SKKK-02 with overall general mean of 44.58 cm. Genotypes namely Purple

Vienna-I (55.67), Purple Vienna-II (53.11), King of Market-I (53.11), Mamta (51.82), SJKK-02 (51.21), King of Market –II (49.34), G-40 (48.73), SJKK-04 (48.67), SJKK-05 (48.62) and Nawpura Local (48.04) were found to be statistically at par with SKKK-02 (55.78).The plant frame varies from 41.17 cm in White Vienna to 68.83 cm in SKKK-02 with an overall general mean of 52.79 cm.

Five genotypes viz., SJKK-02 (67.17), Purple Vienna-I (63.00), Mamta (60.00) and SJKK-03 (59.33) were found to be statistically at par with SKKK-02 (68.83).Wide variability was observed for petiole length which ranged between 12.22 cm in genotype Pusa Virat to 24.84 cm in genotype SJKK-05. However, the overall general mean of petiole length was 19.96 cm. Only one genotype namely Farashi Lajwari Local (15.33) was statistically at par with genotype Pusa Virat (12.22).The number of leaves per plant varies from 7.56 in genotype Farashi Lajwari Local to 12.40 in genotye SJKK-04 with over all general mean of 10.65. Genotype namely Early Super White Vienna (12.33), C-2002 and G-40 (11.89); SJKK-03 (11.70), Green Gold (11.40); Palam Tender Knob (11.33), SKKK-01, White Vienna and Farashi Safed Local (11.22), Pusa Virat (10.94), Baramullah Local and Sopore Local (10.78) and Ganderbal Local (10.67) were found to be statistically at par with genotype SJKK-04 (12.40) (Table 3).

The leaf length ranged between 17.60 cm in genotype Early White Vienna to 30.28 cm in genotype SKKK-02 and Purple Vienna-II with an overall general mean of 23.33 cm. The maximum leaf length was observed in genotype SKKK-02 (30.28) which were statistically at par with genotypes *viz*., Purple Vienna-II (28.83), Nawpura Local (27.53), King of Market-I (27.39), Rajouri Local (26.94), SJKK-04 (26.37), Purple Vienna-I (26.11) and G-40 (26.03).The leaf width varies from 12.44 cm in genotype Early White Vienna to 22.67 cm in Nawpura Local with an overall general mean of 16.25 cm. Four genotypes namely SKKK-02 (22.22), Ganderbal Local (20.24), Purple Vienna-II (20.11) and Purple Vienna-I (20.04) were found to be statistically at par with Nawpura Local (22.67). With regards to stalk length genotypes with low stalk length is preferred from breeding point of view and it ranged between 0.50 cm in genotype Pusa Virat and 3 cm in genotype Nawpura Local with an overall general mean of 2.16 cm. None of the genotypes were found to be statistically at par with Pusa Virat (0.50 cm). Similar findings were observed by Manaware *et al.,* (2017) in cauliflower and Chura *et al.,* (2016) in cabbage for number of leaves per plant; Santhosha *et al.,* (2015), Sharma *et al.,*(2018), Chitora and Singh (2013) and Mehra and Singh (2013) for leaf length and leaf width; Kumar *et al.,*(2017) for petiole length, plant spread; Khan *et al.,* (2010) in kale and Singh and Singh (2003) in cabbage for plant height who also reported wide range of variability for various traits in *Brassica oleracea* cultivars.

Earliness

Earliness is highly desirable character in all the vegetables in the sense that the prevailing price in the market is invariably high early in the season (Singh *et al.,* 2017). With respect to days to marketable maturity knolkhol genotype Early Super White Vienna took least number of days after transplanting (45.33) to marketable maturity, whereas, genotype Farashi Lajwari Local took maximum number of days (59.67) with over all general mean of 52.27. Only one genotype G-40 was statistically at par with Early White Vienna with mean value (45.33).These findings are also supported by and Chittora and Singh (2015) and Santhosha *et al.,* (2015) who had also observed significant difference for days to curd initiation and days to marketable curd maturity.

Table.1 List of genotypes along with the source

S. No.	Code	Genotype	Source
Released varieties and advance breeding lines of SKUAST- J and SKUAST- K			
1.	G1	G40	SKUAST-J
2.	G2	SJKK-02	SKUAST-J
3	G3	SJKK-03	SKUAST-J
4	G4	SJKK-04	SKUAST-J
5	G5	SJKK-05	SKUAST-J
6	G6	SKKK-01	SKUAST-K
7	G7	SKKK-02	SKUAST-K
8	G8	SKKK-03	SKUAST-K
Public Sector Varieties			
9	G9	Early White Vienna	Directorate of Agriculture, Jammu
10	G10	King of Market-I	Directorate of Agriculture, Jammu
11	G11	Early SWV	NFCC, Jammu
12	G12	Kargil Local	Kargil
13	G13	Purple Vienna-I	JK krishi vikas Cooperative Ltd, Pulwama
14	G14	Knolkhol White	JK Krishi Vikas Cooperative Ltd, Pulwama
15	G15	King of Market-II	Sultan seeds, Munwarabad
16	G16	Purple Vienna-II	Sultan seeds, Munwarabad
17	G17	Pusa Virat	IARI, Katrain (HP)
18	G18	White Vienna	IARI, Katrain (HP)
19	G19	Palam Tender Knob	CSKHPKV,Palampur
Local Germplasm of J &K			
20	G20	Farashi Lajwari Local	Sopore
21	G21	Farashi Safed Local	Sopore
22	G22	Sopore Local	Sopore
23	G23	Baramullah Local	Baramullah
24	G24	Ganderbal Local	Ganderbal
25	G25	Leh Local	Leh
26	G26	Rajouri Local	Rajouri
27	G27	Nowpora Local	Nawpora
Private sector hybrids			
28	G28	Mamta	Crop Life Hybrid Seeds, Punjab
29	G29	Green Gold	Indus Seeds, Banglore
30	G30	C-2002	Century Seeds, New Dehli

Table.2 Analysis of variance (mean sum of squares) for quantitative traits in knolkhol (*Brassica oleracea* var. *gongylodes* L.)

S. No.	Source of variation/ Characters	Genotypes	Error	CD (5 %)
1	Degrees of freedom	29	58	
2	Plant height (cm)	130.74**	31.94	6.42
3	Plant frame (cm)	152.86**	34.87	6.71
4	Petiole length (cm)	21.72**	5.06	2.56
5	Number of leaves /plant	3.83**	1.32	1.31
6	Leaf length (cm)	39.78**	9.48	3.50
7	Leaf width (cm)	22.07**	3.68	2.18
8	Stalk length (cm)	1.18**	0.12	0.39
9	Gross weight/plant (g)	10712.23**	2468.14	56.45
10	Marketable knob weight/plant(g)	6431.748*	1747.62	47.50
11	Marketable knob diameter (cm)	1.48**	0.25	0.57
12	Harvest index (%)	96.31**	17.85	4.80
13	Days to marketable maturity	38.47*8	4.31	2.36
14	Yield per plot (kg/plot)	1292.27**	255.80	10.99

Table.3 Mean performance of Knolkhol (*Brassica oleracea* var. *gongylodes* L.) for various quantitative traits during main season (Sept-Oct 2016-17)

Genotype	Plant height (cm)	Plant frame (cm)	Petiole length (cm)	Number of leave per plant	Leaf length (cm)	Leaf width (cm)	Stalk length (cm)	Gross weight per plant (g)	Marketable knob weight per plant (g)	Marketable knob diameter (cm)	Harvest Index (%)	Days to marketable maturity	Yield per plot (kg)
G_1 (G-40)	48.73	52.67	20.56	11.89	26.03	18.63	1.68	516.77	426.80	7.63	82.66	46.67	5.96
G_2 (SJKK-02)	51.21	51.08	21.44	12.33	23.98	16.63	1.86	520.75	413.37	7.07	79.68	49.78	4.96
G_3(SJKK-03)	46.33	59.33	20.77	11.70	23.13	16.26	1.58	507.19	400.28	7.05	79.21	49.67	4.80
G_4 (SJKK-04)	48.67	51.17	21.38	12.40	26.37	16.90	1.93	530.13	447.29	7.61	84.25	49.33	6.04
G_5 (SJKK-05)	48.62	54.50	24.84	11.00	24.22	15.46	2.00	496.75	397.01	7.20	79.73	50.00	4.76
G_6 (SKKK-01)	44.06	51.67	22.62	11.22	23.91	14.58	2.16	420.27	325.78	6.63	77.62	50.00	4.15
G_7 (SKKK-02)	55.78	68.83	22.78	9.44	28.83	22.22	2.92	508.78	357.86	6.97	70.38	55.00	4.56
G_8 (SKKK-03)	43.60	56.83	19.11	10.11	22.89	14.63	2.28	405.00	332.46	7.21	81.97	50.33	4.24
G_9 (Early White Vienna)	37.19	43.17	18.22	10.00	17.60	12.44	1.36	425.00	374.00	7.10	88.19	49.67	4.77
G_{10} (King of Market-I)	53.11	46.17	21.69	11.00	27.39	17.65	1.91	440.43	337.65	6.98	76.11	55.00	5.29
G_{11} (Early Super White Vienna)	44.08	52.50	22.91	12.33	21.31	15.29	1.13	491.73	444.38	7.93	90.50	45.33	6.10
G_{12}(Kargil Local)	43.56	49.00	19.18	10.45	21.97	15.41	2.39	418.89	325.64	6.96	77.55	50.33	4.40
G_{13} (Purple Vienna-I)	55.67	63.00	20.56	9.22	26.11	20.04	2.81	530.04	378.47	7.04	71.47	56.67	4.58
G_{14} (Knolkhol White)	43.77	47.83	19.73	10.89	22.78	14.11	2.64	440.09	378.26	7.23	85.88	50.00	4.82
G_{15} (King of Market-II)	49.34	52.17	17.06	9.11	20.48	16.00	2.55	360.23	325.17	7.13	90.22	55.00	4.06
G_{16} (Purple Vienna-II)	53.11	58.33	22.92	9.78	28.83	20.11	2.89	461.50	356.02	6.80	77.29	57.00	4.45
G_{17} (Pusa Virat)	31.41	46.33	12.22	10.94	18.05	15.67	0.50	332.29	281.90	5.40	85.46	59.33	3.81
G_{18}(White Vienna)	36.00	41.17	18.22	11.22	18.42	13.00	2.80	383.43	320.72	6.83	83.63	50.33	4.33
G_{19} (Palam Tender)	37.09	49.67	16.38	11.33	18.87	14.09	2.02	427.55	360.26	7.30	84.38	50.33	5.16
G_{20} (Farashi Lajwari Local)	31.04	45.83	15.33	7.56	17.61	13.95	1.62	326.67	303.43	5.63	93.09	59.67	4.10
G21 (Farashi Safed Local)	35.34	47.00	19.90	11.22	20.06	13.11	1.87	429.45	365.10	7.33	85.61	52.63	4.90
G_{22} (Sopore Local)	41.78	57.67	20.11	10.78	26.22	17.28	2.70	423.89	337.78	6.40	79.74	56.67	4.05
G_{23} (Baramullah Local)	40.76	43.00	19.16	10.78	20.91	13.36	2.83	362.78	280.65	6.00	77.75	50.89	3.58
G_{24} (Ganderbal Local)	44.44	58.67	21.61	10.67	25.22	20.24	2.21	455.66	373.27	6.11	81.99	50.48	4.48
G_{25} (Leh Local)	39.38	51.50	16.77	10.33	19.79	14.40	2.48	389.45	310.97	6.76	79.80	50.67	3.96
G_{26}(Rajouri Local)	45.29	49.17	21.33	8.78	26.94	15.72	1.22	383.89	300.19	4.63	78.16	56.00	3.60
G_{27} (Nawpura Local)	48.04	59.00	24.22	10.00	27.53	22.67	3.00	472.78	343.37	6.82	72.33	56.33	4.12
G_{28} (Mamta)	51.82	60.00	19.22	9.78	30.28	18.60	2.97	520.00	390.64	7.10	75.19	56.67	4.98
G_{29} (Green Gold)	45.80	44.17	19.44	11.40	23.95	15.30	2.63	497.78	428.93	7.60	86.19	49.00	5.57
G_{30} (C-2002)	42.50	49.17	19.11	11.89	20.28	13.80	1.88	460.11	400.56	7.30	87.04	49.33	5.31
GM	**44.58**	51.78	19.96	**10.65**	**23.33**	**16.25**	2.16	444.64	360.61	**6.86**	81.44	52.27	4.66
SE m±	3.26	3.41	1.30	0.66	1.78	1.11	0.20	28.68	24.14	0.29	2.44	1.20	0.29
CV(%)	12.68	11.19	11.28	10.79	13.20	11.81	16.01	11.17	11.59	7.27	5.19	3.96	10.91
CD(0.05)	9.24	9.65	3.68	1.88	5.03	3.14	0.57	81.20	68.33	0.82	6.90	3.39	8.26.

Yield and yield attributing traits

Marketable knob diameter, gross weight per plant, marketable knob weight per plant, yield per plot and harvest index are the important traits which reflects the yield potential of particular genotype. Marketable Knob diameter was found maximum in genotype Early White Vienna (7.93) and was minimum (4.63) in Rajouri Local with an overall general mean of 6.86 cm. Genotypes namely G-40 (7.63), SJKK-04 (7.61),Green Gold (7.60), Farashi Safed Local (7.33), Palam Tender Knob (7.30), Knolkhol White (7.23), SKKK-03 (7.21 cm), SJKK-05 (7.20 cm) and King of Market-II (7.13 cm) found to be statistically at par with Early Super White Vienna (7.93 cm).The gross weight per plant measured varied from 326.67 g in genotype Farashi Lajwari Local to 530.13 g in genotype SJKK-04 with an overall general mean of 444.64 g. Genotypes namely Purple Vienna-I (530.04), SJKK-02 (520.75), Mamta (520.00), G-40 (516.77), SKKK-02 (508.78), SJKK-03 (507.19), Green Gold (497.78), SJKK-05 (496.75), Early Super White Vienna (491.73 g), Nawpura Local (472.78 g) and Purple Vienna-II (461.50) were found to be statistically at par with SJKK-04 (530.13). The highest marketable knob weight/plant of 447.29 g/plant was recorded in genotype SJKK-04 and the lowest of 280.65 g/plant in genotype Baramulah Local with overall general mean of 360.61 g/plant. Genotypes *viz*., Early Super White Vienna (444.38), Green Gold (428.93), G-40 (426.80), SJKK-02 (413.37), C-2002 (400.56), SJKK-03 (400.28), SJKK-05 (397.01) and Mamta (390.64) were statistically at par with SJKK-04 (447.29). Harvest index varied from 70.38% in genotype Purple Vienna-I to 93.09 % in genotype Farashi Lajwari Local with an overall general mean of 81.44 %. The maximum harvest index was observed in genotype Farashi Safed Local (93.09) which were statistically at par with five genotypes *viz*., Early Super White Vienna (90.50), King of Market-II (90.22), Early White Vienna (88.19), C-2002 (87.04) and Green Gold (86.19) and the yield/plot varied from 3.58 kg/plot in genotype Baramullah Local to 6.10 kg/plot in genotype Early Super White Vienna with an overall general mean of 4.64 kg/plot. Four genotypes namely SJKK-04 (6.04), G-40 (5.9), Green Gold (5.57), C-2002 (5.31) and King of Market-I (5.29) were found to be statistically at par with Early Super White Vienna (6.10kg/plot). Considerable amount of variability was observed with respect to range and mean values all the traits studied. The results are in agreement with those of Manaware *et al.*, (2017) in cauliflower and Chura *et al.*, (2016) in cabbage; Sharma *et al.*, (2018) and Santhosha *et al.*, (2015) who had also reported considerable variation for gross weight per plant and marketable yield per plant in cauliflower and Kumar *et al.*, (2017) for harvest index.

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