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Full Length Research Paper

Performance of different varieties and plant spacing on growth and yield of knolkhol (*Brassica oleracea* var.*gongylodes*)

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Abstract

Knol-khol varieties with different plant spacing were evaluated for growth and yield. Highest plant height (26.33 cm), plant spread East-West and North-South (36.89 cm and 36.48 cm, respectively) and leaf area (261.45 cm^2) was observed with the plant spacing of 30 cm × 30 cm. Whereas, maximum stem thickness (11.90 cm) was recorded with variety Purple Vienna. Minimum days taken (52.08) for harvesting, maximum yield per plot (10.33 kg) and per hectare (36.15 t) were recorded with the plant spacing of 20 cm × 20 cm. Though, plant spacing of 30 cm × 30 cm showed best for fresh weight of knob (308.25 g). Among varieties, maximum fresh weight of knob (277.36 g), yield per plot (9.51 kg) and per hectare (33.28 t) were found with variety Purple Vienna. From the findings of the study conducted, it is inferred that 20 cm x 20 cm plant spacing and variety of Purple Vienna is most suitable for knolkhol cultivation under North Gujarat condition.

Key words: Plant spacing, varieties, knoll-khol, knob, yield etc.

INTRODUCTION

Knolkhol (*Brassica oleracea*var. Gongylodes) is popularly known as kohlrabi or mini cabbage in India and belongs to the family Brassicaceae. It is mainly grown in Kashmir, Himachal Pradesh, West Bengal, Maharashtra, Assam, Uttar Pradesh, Punjab and some parts of South India. It is characterized by the formation of knob which is the thickening of the stem tissue. The fleshy turnip-like enlargement of the stem develops entirely above the ground and it is the edible portion. Knobs are either used as salad, cooked or in boiled vegetable forms.

Growth, yield and quality of crop plant are mainly influenced by two major factors *viz*. genotype and cultural management factors. The existing varieties have emerged mostly through selection from wide variability available. The improvement in the crop is mainly achieved through selection and evaluation. For successful cultivation of any crop in any area, the identification of suitable varieties is of prime importance. Spacing determines the plant density and is generally dependent upon the expected growth of a particular crop variety in an agro climatic region. Therefore, optimum plant population is one of the important factors for optimum utilization of natural resources like sunlight, water and nutrients which increases the unit yield. Higher plant population can be achieved by reducing the distance between two rows or between two plants within the row. Hence, a proper geometry to get an appropriate stand is a pre-requisite for higher crop yield per unit area. Present experiment was carried out to find the suitable varieties with respect to plant spacing for growth and yield of knoll-khol under North Gujarat conditions.

MATERIAL AND METHODS

The experiment was carried out at Horticulture Instructional Farm, C.P. College of Agriculture, S. D. Agricultural University, Gujarat during Winter season of

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2014-2015. Experiment was laid out in Split Plot Design with four replications for two type of treatments viz., (main plot treatment) -Plant Spacing (S) and (sub plot treatments)-varieties (V). Plant spacing was with three levels *viz.,* Plot size 3 x1.4m,20 cm x 20 cm (s_1), Plot size 3 x1.5m25 cm x 25 cm (s_2) Plot size 3 x1.5mand 30 cm x 30 cm (s_3) and four varieties *viz.,* White Vienna(v_1), Palam Tender Knob (v_2), Early White Vienna (v_3) and Purple Vienna (v_4). Thus making total twelve treatment combinations. Five plants were randomly selected and tagged for taking observations from all the treatments in each replication. Seedlings were raised one month prior to the transplanting in the main field and then they are transplanted into the well prepared field. Standard package of practices were followed during the entire crop period. The data collected for all growth and yield parameters were subjected to statistical analysis by adopting 'Analysis of Variance'Panse and Sukhatme (1985)techniques as per the procedure of split Plot Design.

RESULTS AND DISCUSSION

Results pertaining to the growth, yield and yield contributing traits are presented in Table 1 to 3.Plant height was significantly influenced by different plant spacing. Maximum plant height (26.33 cm) was observed in s_3 (30 cm × 30 cm) and it was at par with s_2 (25 cm × 25 cm). Among varieties, in respect to plant height showed no significant effect. These results might be due to favorable environmental conditions prevailed during initial growth of crop. Present results are in close to the finding of Uddain *et al*. (2012) in knolkhol and Yadav *et al.* (2013) in cauliflower.

Maximum plant spread East-West& North- South (36.89 cm and 36.48 cm, respectively) was observed with plant spacing of 30 cm × 30 cm and it was at par with 25 cm × 25 cm in case of plant spread (N-S). Minimum plant spread East-West (31.86 cm) and North- South (32.60 cm) was recorded when crop was grown in 20 cm × 20 cm plant spacing. The significant difference for plant spread due to different plant spacing might be due to favorable tempospatial growing conditions. These results are in conformity with the finding of ElMagd *et al.* (2006) in broccoli.

Maximum number of leaves/plant (8.76) was recorded in s_2 (25 cm × 25 cm) and Purple Vienna variety (8.81). This may be because of number of leaves/plant generally governed by genetic behavior of the variety. These results are in line with the finding of Boroujerdnia *et al.* (2007) in Romaine lettuce. Maximum leaf area (261.45 cm^2)per plant was recorded with treatment (s_3)30 cm × 30 cm, which was (258.04 cm^2) at par with s_2(25 cm × 25 cm) whereas, minimum leaf area (235.21 cm^2)was recorded with treatment s_1(20 cm × 20 cm).

Difference in leaf area by variable plant spacing might be due to the favorable environmental conditions leads to increase in leaf size. Results are in conformity with the finding of Cebula *et al.* (1996) in white cabbage. Maximum stem girth (11.90 cm)was recorded in Purple Vienna which was statistically at par with White Vienna. Whereas, minimum stem girth (11.00 cm) was recorded in variety Palam Tender Knob. Variation in stem girth among different varieties might be due to genetic difference. These results are in conformity with the finding of El-Bassiony *et al.* (2014) in kholrabi and *Giri et al.* (2013) in broccoli. Minimum days (52.08) taken for harvesting was reported in s_1 (20 cm × 20 cm) which was at par with s_2 (25 cm × 25 cm), whereas, s_3 (30 cm × 30 cm) was recorded significantly maximum days (57.48) taken for harvesting.

Plant spacing significantly influenced days taken for harvesting, earliness in harvesting might be due to favorable growing condition due to short day and low temperature during head formation. Similar findings observed by Korus (2010) in kale and El-Bassiony *et al.* (2014) in kholrabi.

Maximum fresh weight (308.25 g) of knob was recorded in s_3(30 cm × 30 cm). Significantly minimum fresh weight of knob (224.56 g) was observed in s_1 (20 cm × 20 cm). Among varieties, maximum fresh weight (277.36 g) of knob was observed in Purple Vienna which was statistically at par with Palam Tender Knob and Early White Vienna. Whereas, minimum fresh weight (258.50 g) of knob was recorded in White Vienna variety. These might be due to long distance spacing was exposed to avoided any setback to the growth, rather it provided congenial atmosphere among the different growing environment. These results are in conformity with the finding of [10] in Brussels sprout and Korus (2010) in kale.

Maximum yield (10.33 kg)per plot was recorded in s_1 (20 cm × 20 cm), which was statistically at par with s_2(25 cm × 25 cm), whereas, minimum yield (6.89 kg) per plot was recorded under treatment s_3 (30 cm × 30 cm). Among varieties, their influence on yield per plot was found significant. Significantly maximum yield (9.51 kg) per plot was recorded with variety Purple Vienna which was statistically at par with Palam Tender Knob and Early White Vienna. Similar trend was observed and maximum yield per hectare (36.15t) was obtained with treatment s_1 (20 cm × 20 cm) and it was statistically at par with s_2 (25 cm × 25 cm), whereas, minimum yield (24.12 t) per hectare was recorded in s_3 (30 cm × 30 cm).In case of varieties, their effect on yield per hectare was found significant. Maximum yield (33.28 t) per hectare was recorded in Purple Vienna variety which was statistically at par with Palam Tender Knob and Early White Vienna. Whereas, minimum yield (30.18 t) per hectare was recorded in White Vienna.

The vegetative and reproductive phase of plant growth was mainly influenced by day length, hours of bright sunshine received and suitable temperature prevailing during growth and head formation period. These results

Table 1. Effect of different plant spacing and varieties on plant height (cm), plant spread (E-W) and plantspread (N-S).

Treatments	Plant height (cm)	Plant spread (E-W) (cm)	Plant spread (N-S) (cm)
Spacing			
20 cm × 20 cm (s_1)	23.13	31.86	32.60
25 cm × 25 cm (s_2)	25.63	36.32	35.19
30 cm × 30 cm (s_3)	26.33	36.89	36.48
S.Em ±	0.80	1.05	0.69
CD (p=0.05)	2.35	3.08	2.03
CV % (Error. A)	12.79	12.01	7.96
Varieties			
White Vienna (v_1)	24.83	35.21	35.14
Early White Vienna (v_2)	24.32	35.49	35.16
Palam Tender Knob (v_3)	25.17	34.20	33.89
Purple Vienna (v_4)	25.80	35.19	34.82
S.Em ±	0.60	0.67	0.52
CD (p=0.05)	NS	NS	NS
S X V			
S.Em ±	1.05	1.15	0.90
CD (p=0.05)	NS	NS	NS
CV % (Error. B)	8.37	6.59	5.19

Table 2. Effect of different plant spacing and varieties on number of leaves per plant, leaf area (cm^2) and stem girth (cm).

Treatments	Number of leaves per plant	Leaf area (cm^2)	Stem girth (cm)
Spacing			
20 cm × 20 cm (s_1)	8.61	235.21	11.11
25 cm × 25 cm (s_2)	8.76	258.04	11.40
30 cm × 30 cm (s_3)	8.60	261.45	11.48
S.Em ±	0.21	6.06	0.18
CD (p=0.05)	NS	17.77	NS
CV % (Error. A)	9.51	9.64	6.45
Varieties			
White Vienna (v_1)	8.43	249.47	11.33
Early White Vienna (v_2)	8.80	250.00	11.09
Palam Tender Knob (v_3)	8.59	251.14	11.00
Purple Vienna (v_4)	8.81	255.66	11.90
S.Em ±	0.18	4.82	0.17
CD (p=0.05)	NS	NS	0.49
S X V			
S.Em ±	0.30	8.35	0.29
CD (p=0.05)	NS	NS	NS
CV % (Error. B)	7.01	6.64	5.13

are in conformity with the finding of Whitwell *et al.* (1981) in Brussels sprout, Korus (2010) in kale and Uddain *et al.* (2012) in knolkhol. The significant yield different among the varieties may be due to genetical parameter. Each individual genotype or variety has its own specific characteristics which are inheritant. Accordingly variation in yield parameters may be attributed to the genetic difference of varieties leads to better yield. These results

Table 3. Effect of different plant spacing and varieties on days taken for harvesting, fresh weight of knob (g), yield per plot (kg) and yield per hectare (t).

Treatments	Days taken for harvesting	Fresh weight of knob (g)	Yield per plot (kg)	Yield per hectare (t)
Spacing				
20 cm × 20 cm (s_1)	52.08	224.56	10.33	36.15
25 cm × 25 cm (s_2)	55.22	274.09	10.12	35.42
30 cm × 30 cm (s_3)	57.48	308.25	6.89	24.12
S.Em ±	1.78	6.62	0.31	1.09
CD (p=0.05)	5.22	19.41	0.91	3.19
CV % (Error. A)	12.96	9.84	13.65	13.65
Varieties				
White Vienna (v_1)	54.07	258.50	8.62	30.18
Early White Vienna (v_2)	52.95	265.59	8.95	31.34
Palam Tender Knob (v_3)	55.05	274.42	9.37	32.79
Purple Vienna (v_4)	57.64	277.36	9.51	33.28
S.Em ±	1.34	4.87	0.23	0.80
CD (p=0.05)	NS	14.28	0.67	2.35
S X V				
S.Em ±	2.32	8.43	0.40	1.39
CD (p=0.05)	NS	NS	NS	NS
CV % (Error. B)	8.46	6.27	8.70	8.70

are in aggregate with those obtained by Whitwell *et al.* (1981)in Brussels sprout, Kleinhenz and Wszelaki (2003) in cabbage and Gajewski *et al.* (2007) in broccoli.

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