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## Effect of different varieties and spacings on yield and quality of cabbage (*Brassica oleracea* L. var. *capitata*)

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### Abstract

The field experiment was conducted at Horticulture Research Farm-I, Babasaheb Bhimrao Ambedkar University, Lucknow (U.P.), during rabi season of 2020-21 and 2021-22 to study the effect of varieties and spacing on growth and yield of cabbage (*Brassica oleracea* var. *capitata* L.). Four varieties and four spacings with three replications were evaluated in factorial randomized block design. Among the varieties Golden Acre had taken earliest days for head initiation (51.67) and days to head harvest (72.97) days. Variety Golden Acre significantly produced the highest head diameter (15.67cm), weight of head (1.43 kg) and weight of whole plant (3.71 kg) were noted. The maximum TSS (6.748) and total sugar (3.93) were noted in variety Pusa Cabbage Hybrid-82. In spacing point of view, the highest value of yield and quality attributes were noted under Golden Acre and Pusa Cabbage Hybrid-82 respectively. The maximum weight of whole plant (3.95 kg), number of heading leaves (18.9) and maximum diameter of head (15.67 cm) were recorded in spacing 45×45 cm. Whereas the maximum yield (695.53 q/ha) were recorded in 45×45 cm spacing in cabbage.

**Keywords:** Varieties, spacings, yield, cabbage, *Brassica oleracea* L. var. *capitata*

### Introduction

Cabbage (*Brassica oleracea* var. *capitata* L) is a member of the Cruciferae family. It is native to Western Europe and the Mediterranean region's Northern shores. Cabbage is believed to have evolved from a wild type that grew on the chalk cliffs of Eastern England as well as along the coasts of Denmark and North-Western France. Cabbage is an important vegetable, extensively cultivated in India and other countries. In India, it was introduced in 15<sup>th</sup> century from Portugal (Singh *et al.*, 2005) [13]. It is one of the prominent leafy vegetable crops used for both as salad and cooking. Among the Cole crops, cabbage is one of the most important commercial vegetable crops in India. It is widely grown all over India and abroad for its high nutritive values, high productivity and wider adaptability. It can withstand rough handlings as well as long distance transport and thus a versatile vegetable crop. A group of vegetables that are known as Cole crops include cabbage, kale, brussels sprouts, cauliflower, broccoli and kholrabi. The ancestor of all these crops, the wild cabbage, cliffs cabbage (*Brassica oleracea* var. *syivetris*) was native to the Mediterranean region from which a vast array of varieties have been evolved *Brassica oleracea* var. *capitata* (Singh and Sharma, (2001) [12] and Kochhar, (2010) [5]. India ranks second in area and production of cabbage in the world after China. It is grown in 397 thousand hectares with production of 9207 thousand metric tons and productivity of 19.8 metric tonnes per hectare in India. The major cabbage growing states are Uttar Pradesh, Karnataka, Bihar, West Bengal, Odisha, Gujarat, Punjab, Himachal Pradesh, Haryana and Rajasthan. In Uttar Pradesh, it is grown in 401 thousand hectare with a production of 9272 thousand metric tons and highest productivity of 23.12 metric tonnes per hectare. The availability of suitable high yielding varieties and optimal plant spacing may assist farmers in achieving higher returns per unit area, as well as effective nutrient absorption and solar energy trapping. Because of changes in 16 morphology and phenology, the cultivars respond to plant density differently (Prasad *et al.* 2010) [10]. Different cultivars have different growth, yield and quality parameters varying with growing conditions (Thapa *et al.* 2012) [16].

The spacing of crop may be varied according to climatic condition, soil fertility and cultivar suitability to a specific region. The plant was more vigorous in terms of leaf size when the spacing was broader, which could be owing to less competition for light, nutrients and moisture as compared to when the spacing was closer (Bairwa *et al.* 2017) [1]. Vegetable crop

cultivation requires a high population density, which is widely used for a variety of crops. Closer spacing can help to reduce weeds, enhance soil protection, increase fertilizers efficiency and increase yields (Neto *et al.* 2016) [8]. Plant density is an important variable for achieving maximum yields and uniform vegetable maturity. Differentiation of density of plants per unit of area gives possibility of regulation of the size of edible part of such vegetables as *e.g.* cauliflower, broccoli, kohlrabi or lettuce. The yield may be attributed to a great extent on the method of production management practices. Use of proper spacing is one of the many factors of improved cultivation practices, it influences on the yield contributing characters and consequently on the yield. The use of proper spacing is an important factor for securing higher yield of desirable head of cabbage. Dense planting can produce higher head yield owing to the presence of a greater number of plants per unit area although they produce smaller head or knobs, irrespective of varieties (Rahman *et al.* (2007) [11], Prasad *et al.* (2010) [10] and Moniruzzaman, (2011) [7].

### Materials and Methods

A field experiment was carried out at Babasaheb Bhimrao Ambedkar University, Lucknow, (U.P.) during rabi season of 2020-21 and 2021-22. The experimental site is situated at 800 92' East longitude and 260 76' North latitude and 123 meter above MSL (Mean Sea Level). The climate of Lucknow is characterized by subtropical with hot, dry summer and cool winters. The soil of experimental field is sandy loam and slightly alkaline in nature with soil pH 8.2. Seedlings of 30 days old were transplanted on November 26<sup>th</sup>, 2019-20 and November 26<sup>th</sup>, 2021-22. In a Factorial Randomized Block Design with three replications, four varieties *viz.* Pusa Mukta, Golden Acre, Pusa Cabbage Hybrid-1 and Pusa Cabbage Hybrid- 82 with four spacings *viz.* 45 × 30 cm, 45 × 45 cm, 60 × 45 cm and 60 × 60 cm were evaluated. The application of recommended dose of fertilizer (180: 120: 100 kg ha<sup>-1</sup> NPK) through urea, diammonium phosphate and muriate of potash. Appropriate management practices were adopted. Randomly five plants were selected in each plot and data were recorded on the plant height, leaves per plant, leaf length, leaf width, plant spread, stem girth, days to head initiation and days to harvest, weight of whole plants, weight of head, polar diameter, equatorial diameter, core length, volume of head and yield. The Total Soluble Solids (<sup>0</sup>Brix) were determined by using Hand refractometer. The data of both years were pooled and analysed statistically as per methods advocated by Panse and Sukhatme (1985) [9].

### Results and Discussion

#### Yield Parameters

Results revealed that all the varieties of cabbage exhibited significant variation in their performance in terms of yield attributes and quality characters.

#### Effect of varieties on yield attributes

The effect of varieties on head initiation found non-significant. However, the data on pooled mean basis (Table 2) revealed that the head initiation days (53.06) was recorded in Pusa Cabbage Hybrid -1 followed by Pusa Cabbage Hybrid-82 (52.04) while, the minimum head initiation days taken (51.67) was found in Golden Acre. The maximum days to head harvest (78.54) was noticed in Pusa Cabbage Hybrid-82 followed by Pusa Cabbage Hybrid -1 (76.13) and minimum

days to head harvest (72.97) in Golden Acre. The maximum weight of whole plant (3.71 kg) was noticed in Golden Acre whereas, the minimum values (3.16) was observed in Pusa Mukta. Maximum weight of head (1.430 kg) was found in Golden Acre followed by Pusa Cabbage Hybrid-82 (1.363 kg) whereas, the minimum value (1.147 kg) was observed in Pusa Mukta. The maximum polar length (15.38 cm) was found in Golden Acre followed by Pusa Cabbage Hybrid-82 (15.04 cm) and minimum value (13.93 cm) was observed in Pusa Mukta. The maximum equatorial length (14.72 cm) was found in Golden Acre followed by Pusa Cabbage Hybrid-82 (13.86 cm) and minimum value (13.04 cm) was observed in Pusa Mukta. The significant and maximum yield per plot (18.98 kg) was observed in Golden Acre followed by (18.02 kg) Pusa Cabbage Hybrid -1 and minimum (16.31 kg) was noticed in Pusa Mukta. The maximum yield per hectare (595.67q/ha) was observed in Golden Acre followed by (569.25 q/ha) Pusa Cabbage Hybrid -1 and minimum (507.48 q/ha) was noticed in Pusa Mukta. Similar finding were reported by Iqbal *et al.* (2010) [3] in knolkhol crop.

#### Effect of spacing on yield attributes

The effect of spacing also on head initiation found non-significant. However, the data on pooled mean basis (Table 3) revealed that the head initiation days (52.53) was recorded in 60 cm x 45 cm followed by 60 cm x 60 cm (52.18) while, the minimum head initiation days taken (51.73) was found in 45 cm x 45 cm. The maximum days to head harvest (75.91) was noticed in 60 cm x 60 cm followed by 60 cm x 45 cm (75.49) and minimum days to head harvest (74.74) in 45 cm x 45 cm. The maximum weight of whole plant (3.95 kg) was noticed in 45 cm x 45 cm whereas, the minimum values (2.38 kg) was observed in 45 cm x 30 cm. Maximum weight of head (1.560 kg) was found in 45 cm x 45 cm followed by 60 cm x 45 cm (1.415 kg) whereas, the minimum value (0.799 kg) was observed in 45 cm x 30 cm. The maximum polar length (15.84 cm) was found in 45 cm x 45 cm followed by 60 cm x 45 cm (15.36 cm) and minimum value (12.48 cm) was observed in 45 cm x 30 cm. The maximum equatorial length (15.11 cm) was found in 45 cm x 45 cm followed by 60 cm x 45 cm (14.48 cm) and minimum value (11.46 cm) was observed in 45 cm x 30 cm. The significant and maximum yield per plot (21.43 kg) was observed in 45 cm x 45 cm followed by 45 cm x 30 cm (18.46 kg) and minimum (14.04 kg) was noticed in 60 cm x 60 cm. The maximum yield per hectare (695.53 q/ha) was observed in 45 cm x 45 cm followed by 45 cm x 30 cm (590.48 q/ha) and minimum (408.24 q/ha) was noticed in 60 cm x 60 cm. These findings are supported by those of Chaubey *et al.* (2001) [2] and Khatiwada (2001) [4] in cabbage, Srivastava *et al.* (2011) [19] in cauliflower, Arin *et al.* (2003) [20], and Tejaswani *et al.* (2018) [14]. These results are in close conformity with the findings of Thirupal *et al.*, (2014) [17] in broccoli.

#### Quality Parameters

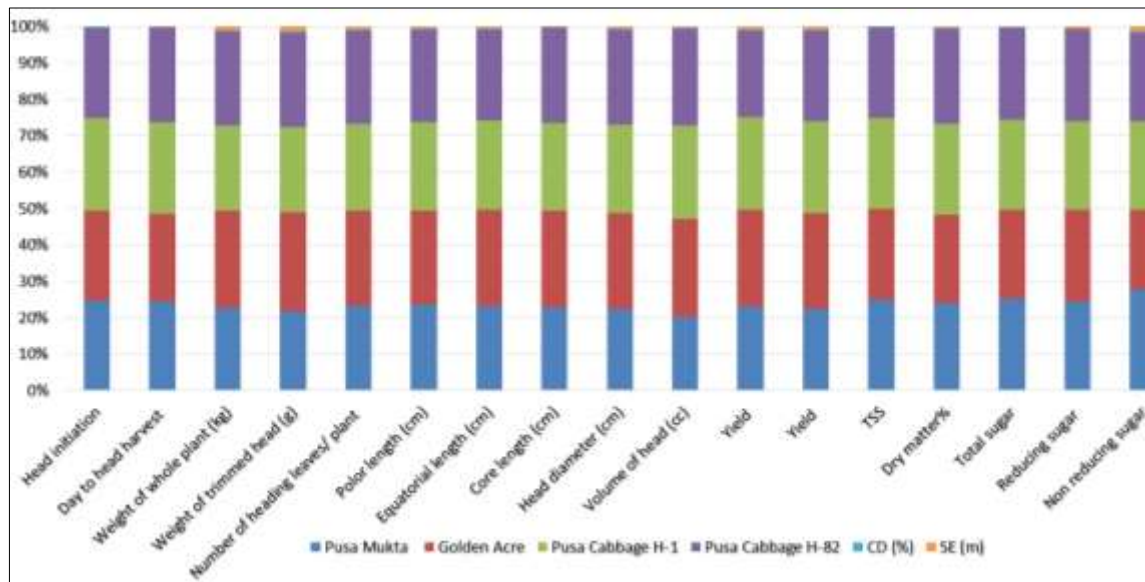
Data table 2.1 revealed that different varieties had significant effect on quality parameters of cabbage and maximum TSS (6.74 <sup>0</sup>Brix) was found in Pusa Cabbage Hybrid-82 followed by Pusa Mukta (6.69 <sup>0</sup>Brix). However, minimum TSS (6.72 <sup>0</sup>Brix) was noted in Golden Acre. The maximum TSS (7.15 <sup>0</sup>Brix) was obtained in 45×45cm spacing and minimum (6.17 <sup>0</sup>Brix) in spacing 45×30cm. The maximum Dry Matter (8.00) was noticed in Pusa Cabbage Hybrid -82 and followed by

Pusa Cabbage Hybrid -1 (7.68) whereas, minimum (7.36) in Pusa Mukta. The maximum dry matter (7.82) was obtained in 45×45cm spacing and minimum (7.54) in spacing 45×30cm. These results have parity with Zaki *et al.* (2015) [18] in Broccoli and Mishra *et al.* (2022) in cabbage. In case of variety the maximum value of total sugar (3.93) was noticed in Pusa Cabbage Hybrid-82 and followed by Pusa Mukta (3.88). In case of spacing the maximum total sugar (4.37) was observed in 45 ×45cm whereas, the minimum values (3.50) was observed in 45×30cm. The maximum reducing sugar (2.86) was observed in Pusa Cabbage Hybrid-82 and minimum reducing sugar (2.76) was noticed in Pusa Cabbage Hybrid-1. In case of spacing the maximum reducing sugar (3.10) was observed in 45×45 cm whereas, the minimum value of reducing sugar (2.58) was observed in 60×60. The maximum

non-reducing sugar (1.21) was observed in Pusa Mukta and minimum non- reducing sugar (0.96) was noticed in Golden Acre. In case of spacing the maximum non- reducing sugar (1.26) was observed in 45×45 cm whereas, the minimum value of non- reducing sugar (0.90) was observed in 45×30. These findings are in close conformity with Singhal *et al.* (2009) [14] and Kumar and Rawat (2002) [6] in Cabbage. Based on two year field experiment, it can be concluded that the effect of varieties and their spacing on the yield and quality of cabbage was significant. The Golden Acre with spacing 45×45 cm proved to be most effective in increasing the yield of cabbage. The maximum yield was obtained in Golden Acre with spacing 45×45 cm may be recommended for cultivation in Lucknow condition of Uttar Pradesh.

**Table 1:** Effect of varieties on yield and quality of cabbage (Mean of 2 years).

Varieties	Head initiation	Day to head harvest	Weight of whole plant (kg)	Weight of trimmed head (g)	Number of heading leaves/plant	Polar length (cm)	Equatorial length (cm)	Core length (cm)	Head diameter (cm)	Volume of head (cc)	Yield (kg/plot)	Yield (q/ha)	TSS	Dry matter %	Total sugar	Reducing sugar	Non reducing sugar
Pusa Mukta	51.84	73.52	3.16	1.147	16.14	13.93	13.04	5.38	13.42	1241.76	16.31	507.48	6.692	7.36	3.885	2.764	1.21
Golden Acre	51.67	72.97	3.71	1.430	18.08	15.38	14.72	6.21	15.67	1654.76	18.98	595.67	6.720	7.44	3.819	2.855	0.96
Pusa Cabbage H-1	53.06	76.13	3.26	1.238	16.51	14.56	13.81	5.66	14.52	1570.41	18.02	569.25	6.740	7.68	3.827	2.761	1.06
Pusa Cabbage H-82	52.04	78.54	3.61	1.363	17.79	15.04	13.86	6.16	15.64	1631.25	16.83	564.23	6.748	8.00	3.934	2.862	1.07
CD (%)	0.70	0.18	0.050	0.025	0.21	0.14	0.14	0.02	0.151	9.26	0.22	6.98	0.056	0.046	0.016	0.022	0.019
SE (m)	N.S.	0.51	0.143	0.071	0.59	0.41	0.41	0.03	0.426	26.21	0.63	19.74	N.S.	0.129	0.045	0.063	0.055



**Fig 1:** Effect of varieties on yield and quality of cabbage

**Table 2:** Effect of spacing on yield and quality of cabbage (Mean of 2 years)

Spacings	Head initiation	Day to head harvest	Weight of whole plant (kg)	Weight of trimmed head (g)	Number of heading leaves/plant	Polar length (cm)	Equatorial length (cm)	Core length (cm)	Head diameter (cm)	Volume of head (cc)	Yield (kg/plot)	Yield (q/ha)	TSS	Dry matter %	Total sugar	Reducing sugar	Non reducing sugar
45×30	51.97	75.01	2.38	0.799	15.21	12.48	11.46	5.56	13.55	979.12	18.46	590.48	6.176	7.54	3.500	2.594	0.90
45×45	51.93	74.74	3.95	1.560	18.19	15.84	15.11	6.01	16.20	1863.75	21.43	695.53	7.155	7.82	4.371	3.104	1.26
60×45	52.53	75.49	3.80	1.415	17.62	15.36	14.48	5.94	15.72	1693.33	16.20	542.39	6.679	7.55	4.080	2.963	1.11
60×60	52.18	75.91	3.61	1.402	17.51	15.24	14.39	5.92	13.77	1561.96	14.04	408.24	6.890	7.56	3.520	2.583	0.93
SE (m)	N.S.	0.51	0.143	0.085	0.59	0.41	0.41	0.03	0.426	26.21	0.63	19.74	0.158	0.129	0.045	0.063	0.055
CD (%)	0.70	0.18	0.050	0.025	0.21	0.14	0.14	0.02	0.151	9.26	0.22	6.98	0.056	0.046	0.016	0.022	0.019

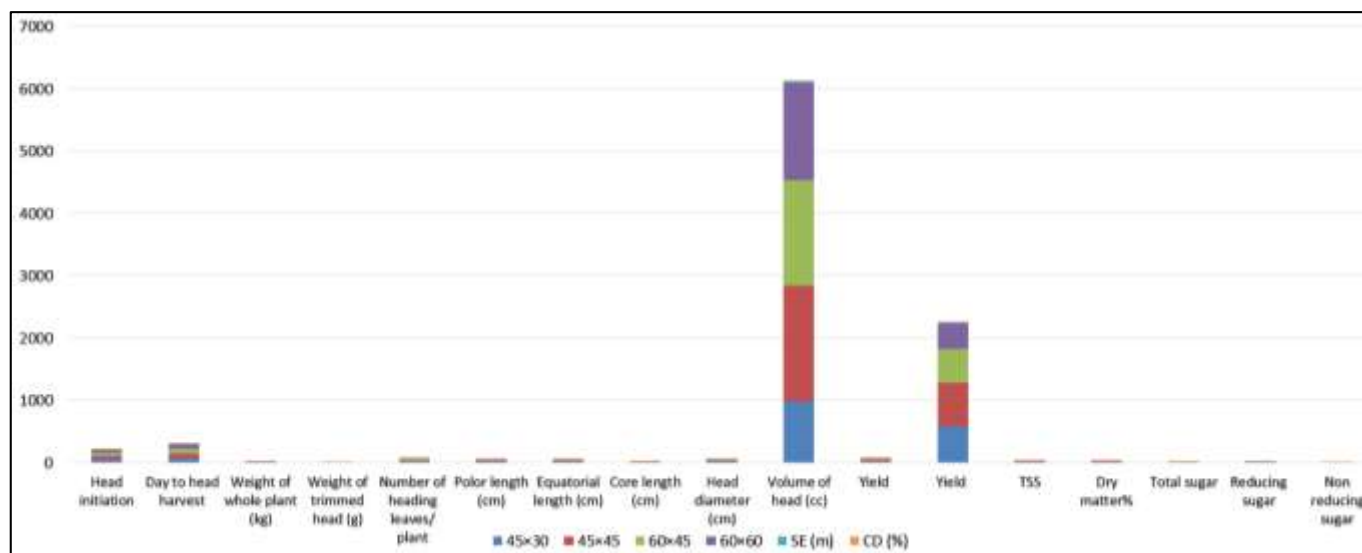


Fig 2: Effect of spacing on yield and quality of cabbage

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