

Original Research Article

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Performance and Preference of Broccoli Varieties Grown under District Fatehgarh Sahib

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ABSTRACT

Broccoli (*Brassica oleracea* var. *italica*. L.) is known for its better taste, flavour and high nutritive and medicinal value. In the world market, about 40 per cent is marketed as fresh and remaining 60 per cent as frozen. Different cultivars of broccoli may differ in the size of plant, size of clusters and buds and firmness of head. The market demand is more for a firm head with small dark green buds. Therefore, the present investigation was conducted at Krishi Vigyan Kendra Fatehgarh Sahib as well as at the farmers' fields in district Fatehgarh Sahib during Rabi seasons of 2019-20, 2020-21 and 2021-22. An on-farm trial was conducted on three different broccoli genotypes i.e. *Palam Samridhi*, F1 Tahoe and F1 Fiesta for their performance and also their preference in the markets (mandis). The broccoli hybrid Tahoe yielded the highest (225.6 q/ ha) followed by Fiesta (220.8 q/ha). An average weight of terminal head of Tahoe was the highest i.e. 520.4 g, whereas, *Palam Samridhi* produced the earliest head under conditions of district Fatehgarh Sahib. As far as broccoli market preference is concerned, immature fully differentiated flower buds heads of Tahoe and Fiesta are preferred in the local market (mandis) of district and adjoining areas like Chandigarh, Ropar, Ludhiana etc. and fetch better prices. Whereas, *Palam Samridhi* variety developed loose head that deteriorates its quality and market acceptance drastically reduced.

Keywords

Broccoli, varieties, yield, head weight, Performance, Market preference

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Introduction

Broccoli (*Brassica oleracea* var. *italica*), belongs to family cruciferae, is a member of Cole group having 18 chromosomes ($2n=18$, $x=9$). The species originated in Mediterranean region. Area under cultivation of cauliflower and broccoli is about 1.12 million hectare in the world with annual production of about 20.88 million tonnes (Anonymous, 2015b). USA is the largest producer

in the world followed by European countries (Dev, 2012). In India it is generally grown in hilly areas of Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir, Nilgiri Hills and Northern plains. In India cauliflower and broccoli are grown over an area of 369 thousand ha with annual production 6745 thousand tonnes (Anonymous, 2015b). The Punjab state produces about 2.29% of the total production of cauliflower in the country and 5.3% of the total vegetable production in the

state. The productivity is 17.78 MT/ha which is the second highest in the country after West Bengal. The production of cauliflower is concentrated in Gurdaspur, Fatehgarh Sahib and Nawansher. About 0.77 lakh MT of cauliflower have been traded in organized markets with average price of Rs 8.87/kg (MIDH, 2012).

Broccoli is known for its better taste, flavour and high nutritive and medicinal value. In the world market, about 40 per cent is marketed as fresh and remaining 60 per cent as frozen. It is used as curries, sauces, stir fried, boiled, steamed, soups, pickles and also eaten as a salad and cooked as a single or mixed vegetable with potato (Thamburaj and Singh, 2001). Fresh broccoli contains 89% water, 7% carbohydrates, 3% protein, and contains negligible fat. A 100-gram reference amount of raw broccoli provides 34 kilocalories of food energy (FDA, 2024). Its consumption strengthens the immune system, prevents anemia, rejuvenates skin and helps to cure heart ailments and diabetes. Obviously, due to the awareness of its higher nutritive values and influx of tourists in the country, this crop has gained popularity in the latest past as a result of which area under broccoli is increasing every year.

Broccoli grows best when exposed to an average daily temperature between 18 and 23 °C (64 and 73 °F) (Branham *et al.*, 2017). In Punjab condition, recommended time of sowing of seed in nursery is mid August to mid September and one month old seedlings are transplanted in the field, however, due to global warming, there is likely to be shift in its sowing time.

But depending upon the demand and good returns from the crop, the broccoli cultivation has gained momentum in the district. The temperature from the months of October to December of the district is congenial for the cultivation of broccoli.

Like environmental conditions, different cultivars of broccoli have growth, yield and quality parameters varying in similar growing conditions. There are two types of broccolis, the heading type closely resembles cauliflower and forms a large central head. Sprouting or Italian broccoli types form one central sprout and many small florets and these types are suitable for multi-harvesting. Because of these characteristics, heading type is the primary choice of commercial growers and sprouting is liked by subsistence farmers due to longer availability in kitchen gardening (Dahal *et al.*, 2022). Although Punjab Agricultural University, Ludhiana

recommended a cultivar of broccoli under the name Punjab Broccoli No.1 during 1996, but it lost its potential. Thus, keeping in view its importance Punjab Agricultural University approved another cultivar during 2015 under the name 'Palam Samridhi' for cultivation in Punjab. Variety 'Palam Samridhi' is a sprouting type broccoli, having compact green head, free from yellow eye and bracts. It also bears sprouts in the axil of leaves which adds to the total yield, is ready for harvest in 85-90 days after transplanting (Bhat, 2012). Though a very sharp distinction is not possible but the cultivars may differ in the size of plant, size of clusters and buds, firmness of head, colour of head and foliage. The demand is more for a firm head with small dark green buds. While, demand for the side shoots have decreased in recent years possibly due to difficulty in harvesting.

Numbers of superior broccoli varieties are released by different universities and ICAR Institutes So, there is a need to make farmer aware with respect to best performing varieties so that growers of the district get benefited. Keeping in minds response of different varieties and immense potential in district, Krishi Vigyan Kendra, Fatehgarh Sahib conducted an on farm trial to assess the performance and preference of broccoli cultivation in district.

Study Design for On-Farm Testing (Assessment)

To assess the performance and preference of suitable cultivar of broccoli in the district an *on farm trial* was conducted both at Krishi Vigyan Kendra, Fatehgarh Sahib as well as at farmer's fields during Rabi 2019-20, 2020-21, and 2021-22. Fatehgarh Sahib is located at 30.38' N latitude and 76.27° E longitude. The cultivar Palam Samridhi comprised the plant material for investigation was collected from Punjab Agricultural University Ludhiana and two hybrids i.e F1 Tahoe and F1 Fiesta was collected from private source to assess their performance in the district.

Four weeks old seedlings were transplanted when average height of seedlings was about 10-12 cm. The distance between row to row and plant to plant was kept 45 × 45 cm consist four rows with 32 plants in each plot in a plot size of 3.6 × 1.8 m² area. The transplanting was done in the evening followed by light irrigation. After raising seedlings, various intercultural operations such as gap filling, weeding, earthing up, irrigation, pest and disease control were done for better growth and development of the broccoli seedlings.

A basal application of farmyard manure at the rate of 100 tonnes per hectare was applied at the time of soil preparation. The standard recommended dose of fertilizers 125 kg of N (275 kg Urea), 62.5 kg of P₂O₅ (387.5 kg of Single Superphosphate) and 62.5 kg of K₂O (100 kg of Muriate of Potash) per hectare was applied. Nitrogen was applied in two split doses at the time of transplanting and one month after transplanting.

For the record of data five plants were randomly selected and their average was worked out from each unit plot except for total yield, which was recorded plot wise. Data were collected in respect of the parameters viz., plant height, number of leaves per plant, plant spreading, days to 50% head initiation, marketable maturity, head weight, head diameter, and yield per hectare and the pooled replicated mean values of each character was used for statistical analysis according to procedures of [Steel and Torrie \(1981\)](#) using CPCS1 software developed by Department of Math, Stat and Physics, Punjab Agricultural University Ludhiana. Comparison of the significant mean value of different treatment was made at 5 % level of significance.

Results and Discussion

Three years of pooled data (2019-20 to 2021-22) on the performance of three genotypes of broccoli revealed that there is a significant variation for all growth and yield parameters. The hybrid F1 Tahoe recorded maximum plant height (64.5 cm) followed by F1 Fiesta (63.6 cm). Low plant height was recorded in the var. Palam Samridhi (54.17 cm). (Table 1) The variation in diverse genotypes for plant height might be because of their genetic makeup and expression in particular environmental conditions. Similar variability was observed for plant height by [Thakur et al., \(2016\)](#) in 17 broccoli genotypes, among them, Frualora recorded the maximum plant height (61.33 cm); Green calabrese (53.7 cm) produced the tallest plant ([Hafiz et al., 2015](#)) among the five genotypes, while [Singh et al., \(2014\)](#) reported that Palam Samridhi recorded the maximum plant height (58.4 cm) when compared to other genotypes.

The number of leaves per plant is an important character that might influence the yield. The maximum number of leaves per plant was recorded as (19.47) in F1 Tahoe, followed by F1 Fiesta (18.63). The lowest number of leaves was noticed in the variety Palam Samridhi (17.68). (Table 1) Lower number of leaves in some cultivars was probably due to slow rate in leaf initiation which would

be an inherent character of the cultivars. [Bagale et al., \(2024\)](#) observed similar differences among varieties in number of leaves which may be due to the variation in their inherent genetic capacity. This wide variation in vegetative growth of the different varieties was also recorded by earlier investigators ([Prashanthi et al., 2022](#); [El-Helaly, 2006](#)). Similar results were also recorded by [Damato \(2000\)](#); [Damato and Trotta \(2000\)](#); [Sharma \(2003\)](#); [Siomos et al., \(2004\)](#) and [Singh et al., \(2014\)](#) and [Renbomo and Biswas \(2014\)](#). In this investigation, plant spreading (E-W direction) (64.5 cm) and plant spreading (N-S direction), (63.45 cm), were recorded in F1 hybrid Tahoe whereas, minimum values were recorded in Palam Samridhi Variety. This similarity and dissimilarity among the varieties in plant spreading may be attributed to the variability in their genetic configuration. These results are close conformity with the finding of [Thakur et al., \(2016\)](#).

From the perusal of data given in table 2, it was observed that a significant minimum number of days for 50 % head initiation was recorded with F1 Tahoe (54.45) followed by F1 Fiesta (54.91), and the maximum number of days were taken by Palam Samridhi (55.23). It was also observed from Table 2 that the days to marketable maturity of head after transplanting was minimum i.e 62.5 days in F1 Tahoe followed by Fiesta (65.2 days) whereas maximum days were taken by Palam Samridhi (86.3 days). This shows that the phenological characteristics of plants highly depend on varieties. The variation on days to head initiation among varieties might be due to its genetic makeup of a short vegetative phase which enhances early head initiation and maturity. Similar findings were obtained by [Nooprom and Santiprachi \(2013\)](#) as well as [Thapa and Rai \(2012\)](#) in broccoli. This similarity and dissimilarity among the genotypes for the number of days taken for head initiation may be attributed to the variability in their genetic configuration along with the suitability of the climatic conditions of a particular zone. Palam Samridhi was found superior, which gave higher yield (184.5q/ha) followed by Green Speed (173.74q/ha), Green Giant (156.23q/ha) and Palam Haritika (144.84q/ha) respectively in combination with best head formation under northern hill zone of Chhattisgarh ([Churasiya and Pandey, 2020](#)). Palam Samridhi recorded minimum days taken for head initiation (50.49 days) and for first head harvest (71.11 days) [Tejaswani et al., \(2018\)](#). These results are in agreement with the conclusions of ([Thakur et al., 2016](#) and [Gogoi et al., 2016](#)) in broccoli.

Table.1 Performance of different varieties with respect to number of leaves per plant, Plant height and plant spread at harvesting

Treatments	Number of leaves per plant	Plant height	Plant spreading (EW) direction (cm)	Plant spreading (N-S) direction (cm)
Palm Samridhi (University Recommendation)	17.68	54.17	52.00	57.00
Tahoe (Farmer’s Practice)	19.47	64.5	63.45	59.32
Fiesta (New innovation)	18.63	63.6	62.32	55.43
C.D. at 5 %	0.16	0.90	0.64	0.94

Table.2 Performance of different varieties with respect to days taken for head initiation, days taken for marketable maturity, weight of head, head size, yield per plot (kg) and yield per hectare (q)

Treatments	Days taken for head initiation	Days to marketable maturity	Weight of head (g)	Head Size		Yield per plot (kg)	Head Yield (q/ha)
				Length (cm)	Breadth(cm)		
Palm Samridhi (University Recommendation)	55.23	76.3	323.8	9.5	12.5	5.32	185.2
Tahoe (New innovation)	54.45	62.5	520.4	11.5	17.5	6.33	225.6
Fiesta (New innovation)	54.91	65.2	440.6	11.0	12.5	6.00	220.8
C.D. at 5 %	1.37	1.84	1.67	0.87	0.72	0.33	1.12

Table.3 Benefits: Cost of different Broccoli varieties grown in the district

Treatments	Yield (q/ha)	Gross return (Rs)	Cost of cultivation (Rs)	Net returns (Rs)	B:C Ratio
PalamSamridhi	185.2	2,22,240	38,902	1,80,338	4.6
Tahoe	225.6	4,06,080	50,506	3,55,574	7.0
Fiesta	220.8	3,97,440	50,813	3,46,627	6.8

It was depicted from Table 2 that the highest head diameter was recorded in F1 Tahoe (11.5 cm, 17.5 cm) followed by F1 Fiesta (11.0 cm, 12.5 cm) and the least was recorded in Palam Samridhi (9.5 cm, 12.5 cm).

The maximum head weight per plant (520.4 g); head yield per hectare (225.6 q) were recorded in F1 Tahoe followed by F1 Fiesta (440.6 g and 220.8 q respectively) and the lowest yield was noticed with var. Palm Samridhi (185.2 q/ha). The maximum head weight per plant and yield per hectare might be due to the result from the

compact head. The head weight and yield per hectare was maximum in Palam Kanchan (357.5 g; 210.7 q) followed by Palam Samridhi (342 g; 195.6 q) as reported earlier by [Singh et al., \(2014\)](#). Similar differences are found for head weight per plant (375g, 523.33g, 154.8g respectively), head yield per hectare (145.47 q, 175q, 70.75q respectively) by [Thapa and Rai \(2012\)](#); [Thakur et al., \(2016\)](#); [Bhangre et al., \(2011\)](#) among the different broccoli genotypes at various climatic conditions. These significant differences for head diameter and head yield per hectare among diverse genotypes might be due to the

own-genetic makeup of the genotypes and their suitability to the environmental conditions. Similar results were observed by Thakur *et al.*, (2016).

It was depicted from Table 3 that the highest return obtained from *Tahoe* of Rs 3,55,574/- followed by *Fiesta* (Rs 3,46,627/-) and the minimum net returns obtained from *Palm Samridhi* of Rs 1,80,338/-. Similarly highest benefit: cost ratio of 7.0 was calculated from *Tahoe* and lowest benefit: cost ratio of 4.6. The increase in benefit: cost ratio is due to increase in yield as well as fetch more prices in the market as compared to *Palm Samridhi*.

Market Preference

As far as broccoli head preference is concerned, immature fully differentiated flower buds heads of *Tahoe* and *Fiesta* are preferred in the local market (mandis) of district and adjoining areas like Chandigarh, Ropar, Ludhiana etc. and fetch better prices. Whereas, *Palam Samridhi* variety developed loose head that deteriorates its quality and market acceptance drastically reduced.

Broccoli being a new crop for farmers of district, it has the potential to replace/supplement cauliflower due to its better nutritive character and market price, especially in mandis located in cities and in adjoining areas also. Keeping in mind the above, *Tahoe* and *Fiesta* has higher potential than *Palam Samridhi*. KVK put efforts in collaboration of state department and other agencies for wider acceptability of broccoli through frontline demonstrations so that able to expand the area under broccoli cultivation in the district. *Tahoe* has emerged as better option for the vegetable growers of the district as it shows superior results in comparison to *Palam Samridhi* in terms of head compactness and yield attributes.

Palm Samridhi shows loose head that does not acceptable in the market. On the other hand, *Tahoe* exhibits compact head formation that will be able to fetch more returns. In conclusion, *Tahoe* variety exhibited superior values of harvest index among all the varieties. Also in terms of head compactness *Tahoe* showed more compact head followed by *Fiesta* as compared to variety *Palm Samridhi*.

Author Contributions

Arvind Preet Kaur: Investigation, formal analysis, writing—original draft. Vipran Kumar Rampal: Validation, methodology, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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