

## **EVALUATION OF DIFFERENT GENOTYPES OF BROCCOLI IN DRY TEMPERATE CONDITIONS OF KINNAUR DISTRICT OF HIMACHAL PRADESH IN INDIA**

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**Abstract:** Broccoli is one of the most important and popular vegetable crops in many countries of the world due to its good organoleptic and high nutritive value. The present investigations were carried out at the Experimental Farm of Vegetable Research Station, Kalpa, Kinnaur and Himachal Pradesh during summer season of 2012 with the objective of evaluation of the varieties suited for the dry temperate conditions of Kinnaur District of Himachal Pradesh. Seventeen genotypes of broccoli were evaluated for different horticultural and yield traits. The evaluation of the genotypes revealed that there was an ample scope to grow broccoli due to prevailing suitable agro-climatic conditions of the dry temperate region of Kinnaur district of Himachal Pradesh. On the basis of the performance of the varieties it may be concluded that genotype Early White Sprouting produced highest yield per plant along with good number of lateral heads, bigger central head size as compared to check varieties viz., Green Head and Palam Smridhi. This variety can further be exploited for commercial cultivation in Kinnaur District of Himachal Pradesh.

**Keywords:** Kinnaur; Evaluation; Broccoli; Head; yield.

### **INTRODUCTION**

Broccoli is an important winter season vegetable crop which resembles cauliflower. Its commercial cultivation started around 1923 (Ouda and Mahadeen 2008). It is widely cultivated in many European and American countries of the world due to its good organoleptic and high nutritive value (Dhillon et al 2005). Broccoli is an Italian word derived from 'Brachium' meaning an 'arm of the branch'. Broccoli is grown for its immature heads which are consumed as salad in curry and soup. It is cherished for its delicious taste, flavour and nutritive value which has been reported to prevent cancer. Although broccoli is most nutritive crop yet its cultivation is restricted to some pockets around metropolitan cities only. With the change in food habits and nutrition consciousness among consumers, this crop is gaining popularity in Himachal Pradesh also. There is a tremendous scope of increasing area

under broccoli grown in the state because it becomes off –season to the plains of north India fetching remunerative prices to the farmers.

Kinnaur district of Himachal Pradesh has the boon of producing off-season vegetables which brings golden returns to the farmers. Dry temperate conditions of Kinnaur District has been found to be very suitable for the quality production of broccoli. Moreover hotels and restaurants in Kinnaur have a great demand for broccoli because thousands of tourists visit Kinnaur in summer and winter seasons. Farmers are ignorant about the production technology of broccoli. However no research work has been conducted on the evaluation of cultivars of broccoli suitable for the dry temperate zone conditions of Himachal Pradesh. Availability of suitable high yielding cultivars of broccoli may help the farmers to achieve more returns per hectare. Hence there is an urgent need to evaluate and select the most appropriate cultivar suited to agro climatic conditions of Kinnaur District of Himachal Pradesh. Therefore the present study was planned with the objective to identify and promote promising varieties with high productivity.

#### **MATERIALS AND METHODS**

Present investigations were carried out at the Experimental Farm of Vegetable Research Station, Kalpa, Kinnaur, Himachal Pradesh during summer season of 2012. The experimental site is located at an elevation of 2770 m a.m.s.l with the latitude and longitude. It falls under the high hills dry temperate zone of Himachal Pradesh. The experiment material comprised of seventeen genotypes of broccoli including checks i.e Green Head and Palam Smridhi. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Sixteen plants of each genotype were planted at a spacing of 60x45 cm in a plot size of 2.4 x 1.8 m. The crop was watered regularly. Recommended fertilizer doses of N,P,K were applied as as suggested in the Packages and Practices, UHF, Nauni. Observations were recorded on ten randomly selected plants and average was calculated. Plants were observed for characters like Plant frame ( $\text{cm}^2$ ), Number of lateral heads, Central head size ( $\text{cm}^2$ ), Peduncle length (cm), Plant height (cm), Leaf area ( $\text{cm}^2$ ), Head yield per plant (g/plant), Days to central head, Harvest duration( days), Colour of the head and Shape of the leaf.

#### **RESULTS AND DISCUSSION**

The analysis of variance was carried out for nine characters under study. The F- value revealed highly significant differences for all the characters viz., Plant frame ( $\text{cm}^2$ ), Number of lateral heads, Central head size ( $\text{cm}^2$ ), Peduncle length (cm), Plant height (cm), Leaf area ( $\text{cm}^2$ ), Days to central head, Harvest duration (days), Head yield per plant (g/plant). The

mean values obtained for these traits have been presented in Table-1. The colour of the head and shape of the leaf have been presented in Table-2.

Plant Frame is an important character in deciding number of plants per unit area. Comparison of genotypes revealed significant differences for plant frame in broccoli. The mean performance of the genotypes revealed maximum plant frame ( $4786.66 \text{ cm}^2$ ) in Verde Calbrese which was found in statistical proximity with the genotype, G-9 ( $4724 \text{ cm}^2$ ). Number of lateral heads accounts for 50 percent of total yield in broccoli (Bose, 1986), therefore breeder is always interested to select a genotype producing more number of lateral heads in addition to compact and bigger size central heads. Maximum number of lateral heads (15.29) was observed in Frualora which was statistically at par with Broccoli No. 1(14.27), G-7(14.26), DPGB-12 (13.72) and BI-5297(13.60). The results are in conformity with the results of Khattra et al (1997) and Vanparys (1999) who also reported considerable variation for number of lateral heads in broccoli.

Central head size is an important character contributing towards total yield and quality. Maximum head size was recorded in Palam Smridhi ( $182.53 \text{ cm}^2$ ), a check variety which was in statistical proximity with Palam Haritika ( $177.09 \text{ cm}^2$ ) and Early White Sprouting ( $176.16 \text{ cm}^2$ ). These genotypes can further be used in the crossing programme to breed superior varieties for central head size in broccoli. Data pertaining to peduncle length showed that Early White Sprouting showed the maximum peduncle length ( $5.17 \text{ cm}^2$ ) which was statistical superior to all the genotypes understudy. Wide range of variability (33 cm to 61.33 cm) was observed for plant height in the present experiment. The maximum plant height was recorded in genotype Frualora (61.33 cm) which was found statistically at par with Broccoli No. 1 (59.43 cm) and Atlantic (58.21 cm). Leaf area is an important character and considerable variation for this trait was observed in the experiment understudy. Maximum leaf area was observed in Early White Sprouting ( $594 \text{ cm}^2$ ) having statistical proximity with Frualora ( $587.66 \text{ cm}^2$ ). Yield per plant remains the major objective in any breeding programme. In broccoli net yield is the sum total of weight of central head and lateral sprouts thereby during selection due consideration should be given to number of lateral heads in addition to compact and larger central head. Larger magnitude of variation was observed for yield in the experiment understudy. Yield per plant varied from 249 g to 523.33 g. Maximum yield /plant was recorded in Early White Sprouting (523.33 g) having statistical superiority to all the genotypes understudy including the checks. The present findings are in statistical

proximity with the findings of Vanparys (1999), Rooster and Callens (1999) and Callens (2000).

Days to central head is an important character of broccoli which helps in selecting genotypes for earliness. In the present study Verde Calbrese took minimum days to central head (94.00) and maximum days to central head was taken by Broccoli No-1 (133.00) days. Hence Verde Calbrese genotype can be used for breeding early varieties in broccoli. Harvest duration in broccoli is an important parameter which needs special consideration as it not only ensures the regular supply of vegetables but also avoids glut in the market. Longest harvest duration was observed in BI 5297 (27 days) genotype closely followed by Palam Smridhi (26.66 days), Green Head (26.00 days) and Verde Calbrese (24.00 days). Colour of the head was visually observed. Two Types of head colours were found in broccoli viz., Green and Purple. Genotypes viz., BI-5297, Covolo Broccolo and Frualora produced purple coloured heads while rest of the genotypes produced green coloured heads. Leaf shapes were categorized into three type's viz., Oblong, Elliptic and Lanceolate. Genotypes like Broccoli No.-1, Convolo Broccolo, Di Natala Fugia Ricia had elliptic leaf shapes and genotypes viz., Verde Calbrese, Frualora, Early White Sprouting, Broccolo Di Minestra Sptilata, Atlantic and Palam Smridhi had lanceoalte leaf shape while rest of the genotypes had oblong leaf shape.

## CONCLUSION

The present study revealed that the growth, yield and yield attributing characters significantly differed within the different varieties. On the basis of the performance of the varieties it may be concluded that genotype Early White Sprouting produced highest yield per plant along with good number of lateral heads, bigger central head size as compared to check varieties viz., Green Head and Palam Smridhi. This variety can further be exploited for commercial cultivation in Kinnaur District of Himachal Pradesh.

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**Table 1: Mean performance of Broccoli genotypes with respect to different traits**

Sr. No.	Genotype	Plant Frame (cm <sup>2</sup> )	No. of lateral heads	Central Head size(cm <sup>2</sup> )	Peduncle length (cm)	Plant height (cm)	Leaf area (cm <sup>2</sup> )	Head Yield (g/plant)	Days to central head	Harvest Duration
1.	Atlantic	3607.00	13.22	128.59	3.39	58.21	482.00	390.00	108.00	13.00
2.	BI 5297	4280.00	13.60	120.27	3.40	44.31	448.00	353.33	100.00	27.00
3.	Broccoli No. 1	3484.66	14.27	86.93	3.29	59.43	405.00	348.66	133.00	11.00
4.	Broccoli Di Minestra Sptilata	2470.00	12.42	147.69	3.57	53.25	535.00	386.00	111.00	18.66
5.	DPG- B-12	2080.00	13.72	147.43	3.86	49.12	393.00	292.66	116.66	23.33
6.	Di Natala Fugia Ricia	3780.00	12.70	163.63	3.41	45.00	340.00	249.00	107.00	18.00
7.	Convolo Broccolo	3778.00	13.40	139.86	3.42	55.00	394.33	330.00	122.00	23.00
8.	Early white Sprouting	1790.00	11.57	176.16	5.17	52.00	594.00	523.33	102.00	21.00
9.	Frualora	1120.00	15.29	163.49	4.27	61.33	587.66	497.00	131.00	16.00
10.	G-9	4724.00	13.20	105.56	3.47	40.00	225.00	260.00	107.00	19.000
11.	G-7	4075.00	14.26	98.04	4.43	33.00	524.00	302.66	110.00	13.00
12.	Palam Haritika	4045.00	12.87	177.09	4.41	46.66	516.00	430.00	98.00	20.00
13.	Palam Kanchan	3052.00	14.45	168.08	4.43	47.00	540.00	437.33	110.00	25.00
14.	Palam Smridhi	3551.33	11.90	182.53	4.43	46.66	332.00	381.33	98.00	26.66
15.	Green Head	3385.33	13.37	140.29	4.46	45.00	385.33	368.00	102.00	26.00
16.	Lawanaya	3919.00	13.52	131.86	3.67	42.33	387.66	362.33	105.00	21.00
17.	Verde Calbrese	4786.66	12.41	129.06	3.52	43.66	353.33	371.00	94.00	24.00
18.	CD 0.05	84.90	1.75	9.16	0.38	4.49	48.31	12.90	5.41	3.43

**Table 2: Head colour and leaf shape of the genotypes of broccoli understudy**

<b>S. No.</b>	<b>Genotype</b>	<b>Colour of Head</b>	<b>Leaf shape</b>
1.	Atlantic	Green	Lanceolate
2.	BI 5297	Purple	Oblong
3.	Broccoli No. 1	Green	Elliptic
4.	Broccoli Di Minestra Sptilata	Green	Lanceolate
5.	DPG- B-12	Green	Elliptic
6.	Di Nataala Fugia Ricia	Green	Elliptic
7.	Convolo Broccolo	Purple	Elliptic
8.	Early white Sprouting	Green	Lanceolate
9.	Frualora	Purple	Lanceolate
10.	G-9	Green	oblong
11.	G-7	Green	oblong
12.	Palam Haritika	Green	oblong
13.	PK-1	Light Green	Oblong
14.	Palam Smridhi	Green	Lanceolate
15.	Green Head	Green	Oblong
16.	Lawanaya	Green	Oblong
17.	Verde Calbrese	Green	Lanceolate