

**Studies on the influence of varieties and spacing on  
growth, yield and quality traits of sprouting broccoli  
(*Brassica oleracea* L. var. *italica* Plenck)**

**SUMMARY  
of  
THESIS**

Submitted To  
Babasaheb Bhimrao Ambedkar University  
(A Central University)  
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## SUMMARY of THESIS

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The present investigation entitled “**Studies on the influence of varieties and spacing on growth, yield and quality traits of sprouting broccoli (*Brassica oleracea* L. var. *italica* Plenck)**” was carried out at Horticulture Research Farm, Department of Applied Plant Science (Horticulture), School for Bio-sciences and Biotechnology, Babasaheb Bhimrao Ambedkar University (A Central University), Vidya Vihar, Raebareli Road, Lucknow (U.P.), India, during rabi season of (2017-18 & 2018-19). The experimental material consisted of 16 treatments with 3 replication of four varieties viz. V<sub>1</sub>-(Pusa Broccoli KTS-1), V<sub>2</sub>-(Palam Kanchan), V<sub>3</sub>-(Palam Vichitra), V<sub>4</sub>-(Palam Samridhi), Four plant spacing viz.- S<sub>1</sub>- (60x45 cm), S<sub>2</sub>- (60x30 cm), S<sub>3</sub>- (45x45 cm), S<sub>4</sub>- (45x30 cm) and combined influence of varieties and spacing interaction in factorial Randomized Block Design. The salient features of the experiment are summarized below:

1. The highest plant height was measured in variety V<sub>1</sub> Pusa Broccoli KTS-1 was recorded (66.78, 67.21 and 67.00 cm, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data. Lowest in V<sub>3</sub> Palam Vichitra in 1<sup>st</sup> year (66.08 cm), 2<sup>nd</sup> year (66.01 cm) and united (66.05cm) respectively. Maximum plant height (67.37, 68.44 and 67.91 cm, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data was measured in spacing S<sub>1</sub> (60x45cm) and lowest in S<sub>4</sub> (45x30cm) in 1<sup>st</sup> year (64.63 cm), 2<sup>nd</sup> year (65.12 cm) and pooled data (64.88 cm). The highest plant height (68.37, 68.85 and 68.61 cm, respectively) was estimated in correlation V<sub>1</sub>S<sub>1</sub> and least in V<sub>3</sub>S<sub>4</sub> in 1<sup>st</sup> year (64.35 cm), 2<sup>nd</sup> year (64.49 cm) and pooled (64.42 cm).
2. The topmost stem diameter in variety V<sub>1</sub> Pusa Broccoli KTS-1 was recorded (3.52, 3.55 and 3.53 cm, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data. Lowest in V<sub>3</sub> Palam Vichitra in 1<sup>st</sup> year (3.16 cm), 2<sup>nd</sup> year (3.17 cm) and pooled (3.16 cm) respectively. The highest stem diameter was measured in spacing S<sub>1</sub> (60x45cm) (3.40, 3.46 and 3.43 cm, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), pooled data and lowest in S<sub>4</sub> (45x30cm) in 1<sup>st</sup> year (3.26 cm), 2<sup>nd</sup> year (3.27 cm) and pooled value in (3.27 cm), consequently. The uppermost stem diameter (3.57, 3.64 and 3.61 cm,

- respectively) was estimated in interaction  $V_1S_1$  and lowest in  $V_3S_4$  in 1<sup>st</sup> year value in (3.11 cm), 2<sup>nd</sup> year value in (3.11 cm) and pooled data measured in (3.11 cm) respectively.
3. The maximum plant spreading (E-W) direction in variety  $V_1$  Pusa Broccoli KTS-1 was recorded (61.38, 62.50 and 61.94 cm, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data. Minimum observation was taken in  $V_3$  Palam Vichitra, 1<sup>st</sup> year (58.44 cm), 2<sup>nd</sup> year (56.94 cm) and pooled (57.69 cm) respectively. The highest plant spreading (E-W) direction was measured in spacing  $S_1$  (60x45cm) (62.54, 64.01 and 63.28 cm, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), pooled data and lowest in  $S_4$  (45x30cm) in 1<sup>st</sup> year (57.38 cm), 2<sup>nd</sup> year (54.56 cm) and pooled value in (55.97 cm), consequently. The maximum plant spreading (E-W) direction (64.12, 68.13 and 66.13 cm, respectively) was estimated in interaction  $V_1S_1$  and minimum in  $V_3S_4$  in 1<sup>st</sup> year value in (55.94 cm), 2<sup>nd</sup> year value in (51.06 cm) and pooled data measured in (53.50 cm) respectively.
  4. The maximum plant spreading (N-S) direction in variety  $V_1$  Pusa Broccoli KTS-1 was recorded (54.27, 55.38 and 54.82 cm, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data. Minimum observation was taken in  $V_3$  Palam Vichitra, 1<sup>st</sup> year (50.35 cm), 2<sup>nd</sup> year (49.42 cm) and pooled (49.93 cm) respectively. The highest plant spreading (N-S) direction was measured in spacing  $S_1$  (60x45cm) (52.88, 53.24 and 53.06 cm, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), pooled data and lowest in  $S_4$  (45x30cm) in 1<sup>st</sup> year (51.79 cm), 2<sup>nd</sup> year (50.73 cm) and pooled value in (51.26 cm), consequently. The maximum plant spreading (N-S) direction (54.57, 55.67 and 55.12 cm, respectively) was estimated in interaction  $V_1S_1$  and minimum in  $V_3S_4$  in 1<sup>st</sup> year value in (48.52 cm), 2<sup>nd</sup> year value in (48.44 cm) and pooled data measured in (48.48 cm) respectively.
  5. The highest number of leaves per plant was observed in variety  $V_1$  Pusa Broccoli KTS-1 was recorded (23.79, 23.93 and 23.86, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data. The lowest observation was taken in  $V_3$  Palam Vichitra, 1<sup>st</sup> year (23.26), 2<sup>nd</sup> year (23.25) and pooled (23.26) respectively. The maximum number of leaves per plant was measured in spacing

S<sub>1</sub> (60x45cm) (24.33, 24.54 and 24.44, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), pooled data and minimum in S<sub>4</sub> (45x30cm) in 1<sup>st</sup> year (22.81), 2<sup>nd</sup> year (22.86) and pooled value in (22.84), consequently. The maximum number of leaves per plant (24.72, 24.92 and 24.82, respectively) was estimated in interaction V<sub>1</sub>S<sub>1</sub> and minimum in V<sub>3</sub>S<sub>4</sub> in 1<sup>st</sup> year value in (22.19), 2<sup>nd</sup> year value in (22.44 cm) and pooled data measured in (22.32) respectively.

6. The maximum length of leaves was observed in variety V<sub>1</sub> Pusa Broccoli KTS-1 was recorded (51.16, 51.15 and 51.16 cm, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data. Minimum observation was taken in V<sub>3</sub> Palam Vichitra, 1<sup>st</sup> year (49.10 cm), 2<sup>nd</sup> year (49.04 cm) and pooled (49.70 cm) respectively. The highest length of leaves was measured in spacing S<sub>1</sub> (60x45cm) (51.95, 52.03 and 51.99 cm, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), pooled data and lowest in S<sub>4</sub> (45x30cm) in 1<sup>st</sup> year (48.77 cm), 2<sup>nd</sup> year (48.65 cm) and pooled value in (48.71 cm), consequently. The maximum length of leaves (52.79, 52.79 and 52.79 cm, respectively) was estimated in interaction V<sub>1</sub>S<sub>1</sub> and minimum length of leaves was taken in V<sub>3</sub>S<sub>4</sub> in 1<sup>st</sup> year value in (47.76 cm), 2<sup>nd</sup> year value in (47.32 cm) and pooled data measured in (47.54 cm) respectively.
7. The maximum width of leaves was observed in variety V<sub>1</sub> Pusa Broccoli KTS-1 was recorded (30.33, 30.69 and 30.51 cm, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data. Minimum observation was taken in V<sub>3</sub> Palam Vichitra, 1<sup>st</sup> year (29.49 cm), 2<sup>nd</sup> year (29.63 cm) and pooled (29.56 cm) respectively. The highest width of leaves was measured in spacing S<sub>1</sub> (60x45cm) (31.02, 31.20 and 31.11 cm, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), pooled data and lowest in S<sub>4</sub> (45x30cm) in 1<sup>st</sup> year (28.69 cm), 2<sup>nd</sup> year (28.59 cm) and pooled value in (28.64 cm), consequently. The maximum width of leaves (31.35, 31.36 and 31.36 cm, respectively) was estimated in interaction V<sub>1</sub>S<sub>1</sub> and minimum width of leaves was taken in V<sub>3</sub>S<sub>4</sub> in 1<sup>st</sup> year value in (28.02 cm), 2<sup>nd</sup> year value in (27.18 cm) and pooled data measured in (27.60 cm) respectively.
8. The highest dry weight of plant was measured in variety V<sub>2</sub> Palam Kanchan recorded (190.38, 198.02 and 194.20 g, respectively) in 1<sup>st</sup> year i.e. in (2017-18),

2<sup>nd</sup> year i.e. in (2018-19) and pooled data. Lowest in V<sub>3</sub> Palam Vichitra in 1<sup>st</sup> year (109.15 g), 2<sup>nd</sup> year (115.65 g) and united (112.40 g) respectively. Maximum dry weight of plant (164.85, 169.28 and 167.67 g, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data was measured in spacing S<sub>4</sub> (45x30 cm) and lowest dry weight of plant was taken in S<sub>1</sub> (60x45 cm) in 1<sup>st</sup> year (133.41 g), 2<sup>nd</sup> year (137.80 g) and pooled data (135.60 g). The highest dry weight of plant (201.34, 206.12 and 203.73 g, respectively) was estimated in correlation V<sub>2</sub>S<sub>4</sub> and least data was measured in V<sub>1</sub>S<sub>1</sub> in 1<sup>st</sup> year (99.48 g), 2<sup>nd</sup> year (101.74 g) and pooled value (100.61 g), consequently.

9. Varieties V<sub>1</sub> Pusa Broccoli KTS-1 showed in (47.57, 48.30 and 47.94 days, consequently) had taken earliest curd initiation 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled value. The highest curd initiation days measured in varieties V<sub>3</sub> PalamVichitra in 1<sup>st</sup> year (52.37), 2<sup>nd</sup> year (52.76) and pooled data (52.56). Plant spacing S<sub>1</sub> (60x45cm) as found (48.62, 49.31 and 48.97 days, respectively) had taken earliest curd initiation in 1<sup>st</sup> year i.e. in (2017-18), in 2<sup>nd</sup> year i.e. in (2018-19) and pooled data was measured earliest curd initiation days. The highest curd initiation days was measured in S<sub>4</sub> (45x30cm) in 1<sup>st</sup> year (54.80), 2<sup>nd</sup> year (51.24) and pooled value (51.02). The combined influence of varieties and spacing interaction V<sub>1</sub>S<sub>1</sub> was taken earliest curd initiation (46.02, 46.84 and 46.43 days, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and united value. The highest curd initiation days measured in V<sub>3</sub>S<sub>4</sub> in 1<sup>st</sup> year (53.12), 2<sup>nd</sup> year (53.20) and pooled data showed in (53.16), respectively.
10. Varieties V<sub>1</sub> Pusa Broccoli KTS-1 showed in (22.70, 22.43 and 22.58 days, consequently) had taken earliest curd initiation 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled value. The highest curd initiation days measured in varieties V<sub>3</sub> PalamVichitra in 1<sup>st</sup> year (24.87), 2<sup>nd</sup> year (23.56) and pooled data (24.21). Plant spacing S<sub>1</sub> (60x45cm) as found (22.98, 22.08 and 22.53 days, respectively) had taken earliest curd initiation in 1<sup>st</sup> year i.e. in (2017-18), in 2<sup>nd</sup> year i.e. in (2018-19) and pooled data was measured earliest curd initiation days. The highest curd initiation days was measured in S<sub>4</sub> (45x30cm) in 1<sup>st</sup> year (24.34), 2<sup>nd</sup> year (23.87) and pooled value (24.10). The combined influence of varieties and spacing interaction V<sub>1</sub>S<sub>1</sub> was taken earliest curd initiation (22.04,

21.08 and 21.56 days, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and united value. The highest curd initiation days measured in V<sub>3</sub>S<sub>4</sub> in 1<sup>st</sup> year (25.98), 2<sup>nd</sup> year (24.56) and pooled data showed in (25.27), respectively.

11. The recorded data revealed that maximum curd diameter was found in varieties V<sub>1</sub> Pusa Broccoli KTS-1 showed in (117.38, 120.45 and 118.92 mm, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>st</sup> year i.e. in (2018-19) and pooled data. Minimum curd diameter measured in varieties V<sub>4</sub> Palam Samridhi in 1<sup>st</sup> year (108.66 mm), 2<sup>nd</sup> year (109.72 mm) and pooled data (109.19 mm). Plant spacing S<sub>1</sub> (60x45mm) as found (116.42, 117.34 and 116.88 mm, consequently) had taken maximum curd diameter in 1<sup>st</sup> year, 2<sup>nd</sup> year and collective value and minimum curd diameter was measured in S<sub>4</sub> (45x30cm) in 1<sup>st</sup> year (111.14 mm), 2<sup>nd</sup> year (111.61 mm) and pooled data (111.38 mm). The combined influence of varieties and spacing interaction had taken maximum curd diameter in V<sub>1</sub>S<sub>1</sub> showed in (120.84, 121.34 and 121.10 mm, respectively) in 1<sup>st</sup> year, 2<sup>nd</sup> year and pooled value. Interaction V<sub>4</sub>S<sub>4</sub> showed minimum curd diameter was measured 1<sup>st</sup> year (107.34 mm), 2<sup>nd</sup> year (108.84 mm) and pooled data showed in (108.09 mm), respectively.
12. The recorded data revealed that maximum weight of curd with guard leaves in varieties V<sub>1</sub> Pusa Broccoli KTS-1 showed in (944.55, 951.07 and 947.81 g, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data. Minimum weight of curd with guard leaves was taken in varieties V<sub>4</sub> Palam Samridhi in 1<sup>st</sup> year (891.86 g), 2<sup>nd</sup> year (898.74 g) and pooled data (895.30 g). Plant spacing S<sub>1</sub> (60x45mm) as found (995.31, 999.31 and 997.31 g, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data. Minimum was weight of curd with guard leaves measured in S<sub>4</sub> (45x30cm) in 1<sup>st</sup> year (843.41 g), 2<sup>nd</sup> year (856.75 g) and pooled (850.08 g) respectively. The combined influence of varieties and spacing interaction had taken maximum weight of curd with guard leaves in V<sub>1</sub>S<sub>1</sub> showed in (1000.72, 1002.73 and 1001.73 g, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), united value and minimum weight of curd with guard leaves was measured in V<sub>4</sub>S<sub>4</sub> in 1<sup>st</sup> year (800.17 g), 2<sup>nd</sup> year (803.14 g) and in pooled data showed in (801.66 g), consequently.

13. The recorded data revealed that maximum weight of curd without guard leaves in varieties V<sub>1</sub> Pusa Broccoli KTS-1 showed in (458.74, 465.89 and 462.32 g, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data. Minimum weight of curd without guard leaves was taken in varieties V<sub>4</sub> Palam Samridhi in 1<sup>st</sup> year (435.36 g), 2<sup>nd</sup> year (438.62 g) and pooled data (436.99 g). Plant spacing S<sub>1</sub> (60x45mm) as found (481.21, 486.18 and 483.70 g, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled data. Minimum was weight of curd without guard leaves measured in S<sub>4</sub> (45x30cm) in 1<sup>st</sup> year (428.55 g), 2<sup>nd</sup> year (404.14 g) and pooled data (416.35 g) respectively. The combined influence of varieties and spacing interaction had taken maximum weight of curd without guard leaves in V<sub>1</sub>S<sub>1</sub> showed in (499.80, 501.12 and 500.46 g, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), united value and minimum weight of curd without guard leaves was measured in V<sub>4</sub>S<sub>4</sub> in 1<sup>st</sup> year (384.92 g), 2<sup>nd</sup> year (390.14 g) and in pooled data showed in (387.53 g), consequently.
14. The recorded data revealed that the maximum yield was found in varieties V<sub>1</sub> Pusa Broccoli KTS-1 showed value in (7.90, 8.02 and 7.96 kg/plot, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), collective data and minimum yield measured in varieties V<sub>4</sub> Palam Samridhi in 1<sup>st</sup> year (7.50 kg/plot), 2<sup>nd</sup> year (7.56 kg/plot) and pooled data (7.53 kg/plot). Plant spacing S<sub>4</sub> (45x30mm) as found (9.59, 9.69 and 9.64 kg/plot, respectively) had taken in 1<sup>st</sup> year, 2<sup>nd</sup> year and pooled value was measured maximum yield. Minimum yield was measured in S<sub>1</sub> (60x45cm) in 1<sup>st</sup> year (5.78 kg/plot), 2<sup>nd</sup> year (5.84 kg/plot) and pooled data (5.81 kg/plot) respectively. The combined influence of varieties and spacing interaction had taken maximum yield in V<sub>1</sub>S<sub>4</sub> showed in (9.80, 9.89 and 9.84 kg/plot, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and collective value. Minimum yield was measured in V<sub>4</sub>S<sub>1</sub> in 1<sup>st</sup> year (5.60 kg/plot), 2<sup>nd</sup> year (5.67 kg/plot) and pooled data showed in (5.63 kg/plot), respectively.
15. The recorded data revealed that the maximum yield was found in varieties V<sub>1</sub> Pusa Broccoli KTS-1 showed value in (243.90, 247.61 and 245.75 q/ha, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), collective

data and minimum yield measured in varieties V<sub>4</sub> Palam Samridhi in 1<sup>st</sup> year (231.48 q/ha), 2<sup>nd</sup> year (233.26 q/ha) and pooled data (232.37 q/ha). Plant spacing S<sub>4</sub> (45x30mm) as found (295.83, 299.23 and 297.53 q/ha, respectively) had taken in 1<sup>st</sup> year, 2<sup>nd</sup> year and pooled value was measured maximum yield. Minimum yield was measured in S<sub>1</sub> (60x45cm) in 1<sup>st</sup> year (178.32 q/ha), 2<sup>nd</sup> year (180.09 q/ha) and pooled data (179.21 q/ha) respectively. The combined influence of varieties and spacing interaction had taken maximum yield in V<sub>1</sub>S<sub>4</sub> showed in (302.46, 305.24 and 303.85 q/ha, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and collective value. Minimum yield was measured in V<sub>4</sub>S<sub>1</sub> in 1<sup>st</sup> year (172.83 q/ha), 2<sup>nd</sup> year (175.00 q/ha) and pooled data showed in (173.91 q/ha), respectively.

16. The maximum ascorbic acid was observed in varieties V<sub>1</sub> Pusa Broccoli KTS-1 showed value in (79.12, 79.15 and 79.14 mg/100g, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), collective data and minimum ascorbic acid measured in varieties V<sub>3</sub> Palam Vichitra in 1<sup>st</sup> year (78.08 mg/100g), 2<sup>nd</sup> year (78.09 mg/100g) and pooled data (78.09 mg/100g). Plant spacing S<sub>2</sub> (60x30 cm) had taken (79.19, 79.09 and 79.10 mg/100g, consequently) had taken maximum ascorbic acid in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled value. Minimum ascorbic acid was measured in S<sub>4</sub> (45x30 cm) in 1<sup>st</sup> year (77.58 mg/100g), 2<sup>nd</sup> year (77.53 mg/100g) and pooled data (77.56 mg/100g) respectively. The combined influence of varieties and spacing interaction had taken maximum ascorbic acid in V<sub>1</sub>S<sub>1</sub> showed in (79.93, 79.96 and 79.95 mg/100g, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), collective data and minimum was measured in V<sub>3</sub>S<sub>4</sub> in 1<sup>st</sup> year (77.04 mg/100g), 2<sup>nd</sup> year (77.36 mg/100g) and pooled data showed in (77.20 mg/100g) respectively in our study.
17. The highest total soluble solid content was recorded in varieties V<sub>1</sub> Pusa Broccoli KTS-1 showed in (8.57, 8.47 and 8.52 °Brix, respectively) 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and collective data. Minimum was measured in varieties V<sub>3</sub> Palam Vichitra in 1<sup>st</sup> year (7.92 °Brix), 2<sup>nd</sup> year (7.90 °Brix) and pooled data (7.91 °Brix). Plant spacing S<sub>1</sub> (60x45 cm) had taken maximum total soluble solid (8.49, 8.28 and 8.39 °Brix, consequently) in 1<sup>st</sup> year i.e. in (2017-18),

2<sup>nd</sup> year i.e. in (2018-19), mutual value and minimum total soluble solid was measured in S<sub>4</sub> (45x30 cm) in 1<sup>st</sup> year (8.00 <sup>0</sup>Brix), 2<sup>nd</sup> year (7.92 <sup>0</sup>Brix) and pooled data (7.99 <sup>0</sup>Brix), respectively. The combined influence of varieties and spacing interaction had taken maximum total soluble solid in V<sub>1</sub>S<sub>1</sub> showed in (8.88, 8.76 and 8.82 <sup>0</sup>Brix, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled value. Minimum total soluble solid was measured in V<sub>3</sub>S<sub>4</sub> in 1<sup>st</sup> year (7.42 <sup>0</sup>Brix), 2<sup>nd</sup> year (7.56 <sup>0</sup>Brix) and pooled data showed in (7.49 <sup>0</sup>Brix) respectively.

18. The pertaining data was revealed that the maximum total sugar was found in varieties V<sub>3</sub> Palam Vichitra showed in (3.98, 3.98 and 3.98 %, respectively) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and collective value. Minimum total sugar was measured in varieties V<sub>2</sub> Palam Kanchan in 1<sup>st</sup> year (3.73 %), 2<sup>nd</sup> year (3.72 %) and pooled data (3.73 %). The highest total sugar had taken in spacing S<sub>2</sub> (60x30 cm) as found (3.91, 3.85 and 3.88 %, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), pooled value and minimum total sugar was measured in S<sub>1</sub> (60x45 cm) in 1<sup>st</sup> year (3.83 %), 2<sup>nd</sup> year (3.83 %) and pooled (3.83 %) respectively. The combined influence of varieties and spacing interaction had taken maximum total sugar in V<sub>3</sub>S<sub>2</sub>, (4.08, 4.06 and 4.07 %, respectively) in 1<sup>st</sup> year, 2<sup>nd</sup> year and pooled value. Minimum total sugar (%) was measured in V<sub>2</sub>S<sub>1</sub> in 1<sup>st</sup> year (3.54 %), in 2<sup>nd</sup> year (3.58 %) and pooled data showed in (3.56 %) respectively.

19. The maximum reducing sugar was observed in varieties V<sub>3</sub> Palam Vichitra showed in (3.38, 3.38 and 3.38 %, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), united value and minimum data was measured in varieties V<sub>1</sub> Pusa Broccoli KTS-1 in 1<sup>st</sup> year (3.28 %), 2<sup>nd</sup> year (3.25 %) and pooled data ( 3.28 %). Spacing S<sub>2</sub> (60x30 cm) as found (3.30, 3.32 and 3.31 %, respectively) had taken maximum reducing sugar in 1<sup>st</sup> year, 2<sup>nd</sup> year and pooled value. Minimum reducing sugar was measured in S<sub>1</sub> (60x45 cm) in 1<sup>st</sup> year (3.27 %), 2<sup>nd</sup> year (3.26 %) and pooled (3.27 %), respectively. The combined influence of varieties and spacing interaction had taken maximum reducing sugar in V<sub>3</sub>S<sub>2</sub> showed in (3.58, 3.52 and 3.55 %, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), collective value and minimum reducing sugar was measured in V<sub>2</sub>S<sub>2</sub> in 1<sup>st</sup>

year (3.19 %), 2<sup>nd</sup> year (3.18 %) and pooled data (3.19 %) respectively in our study.

20. It is clear from the result that maximum non-reducing sugar in varieties V<sub>3</sub> Palam Vichitra showed in (0.72, 0.68 and 0.70 %, consequently) in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19) and pooled value and minimum non-reducing sugar was measured in varieties V<sub>2</sub> Palam Kanchan in 1<sup>st</sup> year (0.52 %), 2<sup>nd</sup> year (0.52 %) and pooled data (0.52 %). Spacing S<sub>2</sub> (60x30 cm) as found (0.64, 0.65 and 0.65 %, respectively) had taken maximum non-reducing sugar in 1<sup>st</sup> year i.e. in (2017-18), 2<sup>nd</sup> year i.e. in (2018-19), joint value and minimum non-reducing sugar was measured in S<sub>4</sub> (45x30cm) in 1<sup>st</sup> year (0.56 %), S<sub>1</sub> (60x45cm), 2<sup>nd</sup> year (0.50 %) and S<sub>1</sub> (60x45 cm) pooled (0.56 %) respectively. The combined influence of varieties and spacing interaction had taken maximum non-reducing sugar in V<sub>3</sub>S<sub>2</sub> showed in (0.88, 0.82 and 0.85 %, consequently) in 1<sup>st</sup> year, 2<sup>nd</sup> year, pooled value and minimum non-reducing sugar (%) was measured in V<sub>2</sub>S<sub>1</sub> in 1<sup>st</sup> year (0.44 %), 2<sup>nd</sup> year (0.42 %) and pooled data (0.43 %) respectively in our study.

## **CONCLUSION**

The varieties and spacing showed significant variation among the different treatments. When the distance between plants increased the growth related parameters were increased. Generally, the wider the plant spacing the better is the performance of the broccoli. On the basis of above result obtained in the present investigation. Hence, it can be concluded from the study that variety V<sub>1</sub> Pusa Broccoli KTS-1, spacing S<sub>1</sub> (60x45 cm) and interaction (variety x spacing) V<sub>1</sub>S<sub>1</sub> significantly affected that maximum plant height (cm), stem diameter (cm), plant canopy spreading (E-W) (cm), Plant canopy spreading (N-S)(cm), number of leaves per plant, length of leaves (cm), width of leaves (cm), early days of curd initiation, early days taken to curd harvest and maximum curd diameter (mm), weight of curd with gourd leaf (kg), weight of curd without gourd leaf (kg) and total soluble solids (<sup>0</sup>Brix). Therefore, it may be recommended that variety V<sub>1</sub> Pusa Broccoli KTS-1, spacing S<sub>1</sub> (60x45cm) and interaction (variety x spacing) V<sub>1</sub>S<sub>1</sub> for maximum growth and better quality characters under Lucknow condition.