# Studies on effect of different cutting and varieties on growth parameter of spinach beet (*Beta vulgaris* var. *bengalensis* L.)


## Abstract

During the Rabi season, the Department of Horticulture at Babasaheb Bhimrao Ambedkar University Lucknow (U.P.) conducted research on the effect of different cuttings and varieties on the Horticulture Research Farm. The experiment is conducted in a RBD design with 16 treatments and two factor: varieties ($V_1$ Chandrika, $V_2$ Pusa Jyoti, $V_3$ All Green, and $V_4$ Palak Katadar) and cutting ($C_0$ no cutting, $C_1$ cutting 1, $C_2$ cutting 2, and $C_3$ cutting 3). We found that the effect of cutting on vegetative growth parameters, viz., plant height, number of leaves, leaf length, leaf width, leaf petiole length, and germination percentage, is significant. We found that cutting $C_0$ had a significant influence on the growth parameters (plant height, number of leaves, leaf length, leaf width, and petiole length), with the minimum observed at $C_3$, the maximum germination observed at $C_1$ as compared to $C_2$ treatment, and the least germination recorded at $C_0$ treatment. While plant height, number of leaves, leaf length, leaf width, petiole length, and germination percentage have a greater influence on Pusa jyoti ($V_2$) than on All Green ($V_3$), minimums are reported for Chandrika ($V_1$).



**Keywords:- Cutting, Varieties, spinach beet, Experiment, RBD.**


## Introduction

Spinach beet (*Beta vulgaris* var. *bengalensis* L.) is one of the most important leafy vegetables in the winter. Indian spinach belongs to the "Chenopodiaceae" family and originated in the Indo-Chinese region. The leafy vegetables have the highest nutritional value of other leafy vegetable **(Fageria et al. 2022).** They are rich in minerals and hence can be called "mines of minerals." It is one of the most nutritious leafy vegetable crops in tropical and sub-tropical regions. Spinach is a rich source of Vitamin A (9770 IU) and Vitamin C (70 mg/100 g). Spinach is high in nutrients. It has 3.4 g of protein, 0.8 g of fat, 380mg of calcium, 30 mg of potassium, and 16.2 mg of iron **(Singh 2019).**The oxalic acid content of spinach beet is low. Palak is closely related to beet root, Swiss chard (*Beta vulgaris var. cicla)*, and sugar beet. The popular spinach beet growing states include Uttar Pradesh, West Bengal, Maharashtra, and Gujarat. However, spinach beet is not very popular in south India. It is primarily used as a pot herb. Spinach leaves are valued for their medicinal properties. The leaves are used to treat inflammation, paralysis, headaches, and earaches, as well as spleen and liver diseases. Leaves of this crop might have been first used in Bengal, and hence it is known as *B. vulgaris var. bengalensis.* Indian spinach is one of the leafy vegetables that should be considered for future development. It is fairly tolerant and can be grown successfully on saline soil **(Mishra et al. 1973).**

It is cultivated for fresh, green leaves, which become ready to harvest (cut) in about 30 to 35 days from sowing. Because most leafy vegetables can be cut multiple times, they require a lot of fertilizer to keep up with their fast growth. To increase yield per unit area and per unit time, a farmer discovered maximum leaves by increasing cutting in a specific variety.

**Comment [I1]:** Did you mean spring?

**Comment [I2]:** Use past tense

**Comment [I3]:** Use the comparative form

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The goal of our research is to find the best combination of varieties that produce the most cutting in order to maximize yield.

**Materials and methods**

The experiment is conducted on Horticultural Research Farm-1, Babasaheb Bhimrao Ambedkar University, Lucknow, 226 025 (U.P.), during the Rabi season of 2019-20. The experimental site is located at 26° 50' N latitude, 80° 52' E longitude, and 123° MSL. Weather data are reported by the IISR. In general, the maximum temperature in the summer is ($43^0$C) and the minimum temperature in the winter is ($2^0$C). The soil at the experiment field is sandy loam that is slightly alkaline. Used four varieties ($V_1$ Chandrika, $V_2$ Pusa Jyoti, $V_3$ All Green, and $V_4$ Palak Katadar) and three cuttings ($C_0$ no cutting, $C_1$ cutting 1, $C_2$ cutting 2, and $C_3$ cutting 3) in a factorial RBD design with 16 treatments and 3 replications. We used that treatment combination: zero cutting + Chandrika, zero cutting + Pusa Jyoti, zero cutting + All Green, zero cutting + Palak Katadar, one cutting + Chandrika, one cutting + Pusa Jyoti, one cutting + All Green, one cutting + Palak Katadar, two cutting + Chandrika, two cutting + Pusa Jyoti, two cutting + All Green, two cutting + Palak Katadar, three cutting + Chandrika, three cutting + Pusa Jyoti Crops are sown on 10 November 2019 during the Rabi season. Data is recorded in growth attributes such as plant height (cm), number of leaves, leaf length (cm), leaf width (cm), leaf petiole length (cm), and germination percentage (%). A statistical analysis of data obtained in different sets of experiments was calculated following the standard procedure of **Panse and Sukhatme (1985)**.

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**Result and discussion**

Effect of cutting on varieties considering in following group.

**Effect of cutting:**

**On growth parameter**

Data recorded for growth attributes at regular intervals of 30, 50, and 70 DAS are shown in Table-1. Growth attributes that significantly influence cutting at 70 DAS, viz., plant height, number of leaves, leaf length, width of leaves, and length of petiole. maximums recorded (plant height, number of leaves, leaf length, width of leaves, and length of petiole) in the control (no cutting) $C_o$ respectively (49.11 cm), (24.33), (12.49 cm), (7.09 cm), (7.09 cm), and minimum data reported at growth attributes (plant height, number of leaves, leaf length, width of leaves, and length of petiole) $C_3$ (three cutting) respectively (18.29 cm), (14.17 cm), (8.78 cm), (4.99 cm), and (4.99 cm) its result is due to maximum $C_0$ allowed to thought out the life period undisturbed without cutting but $C_3$ treatment plot has to faced three cutting conformed **Singh et al. (2015) Dadiga et al. (2015), Naik et al. (2010).** While in case of germination (%) maximum germination is observed $C_1$ (78.87 %) treatment followed by the $C_2$ (78.04 %) treatment and minimum germination reported $C_0$ (74.96%) treatment similar result are reported by **Bhore et al (2000).**

Comment [I6]: reformulate the sentence

**Effect of varieties**

Data recorded for growth attributes at regular intervals of 30, 50, and 70 DAS are shown in Table -1.varieties also significantly influence growth attributes viz., plant height, number of leaves, leaf length, width of leaves, and length of petiole, showed that $V_2$ (32.17 cm) recorded maximum height and minimum height was recorded in variety $V_1$ (29.13 cm) at 70DAS, where in number of leaves per plant maximum $V_2$ (19.58) and followed by $V_3$ (18.33) and

minimum are reported in $V_1$ (16.83) at 70 DAS, in case of length of leaves $V_2$ ( Pusa joyti) (11.31 cm) is maximum as compare to $V_3$ (10.71 cm) and minimum recorded $V_1$ (9.75 cm) at 70DAS, width of leaves highest recorded in variety $V_2$ (6.51 cm) followed by $V_3$ (6.05 cm) and minimum reported in $V_1$ (5.49 cm) at 70DAS, while in case of length of petioles $V_2$ (Pusa Jyoti) are recorded in maximum length of petiole 6.51 cm and minimum recorded in $V_1$ (Chandrika) 5.49 cm result corroborate the finding of **Thakral et al. (1991) Waseem et al. (2000)**. While in germination (%) Pusa Jyoti $V_2$ (78.49%) having highest germination and Chandrika $V_1$ (75.86%) least germination percentage was recorded closely result reported by **Singh et al. (2013) and Waseem et al. (2000)**.

**Comment [17]:** use past participle

**Comment [18]:** we must use short and clear sentences

**Comment [19]:** reformulate the sentence and avoid repitition

**Interaction**

Plant height effects of combination maximum plant height (52.14 cm) at 70 DAS with $C_0V_2$ minimum plant height $C_2V_1$ (17.70 cm). Combination $C_0V_2$ had the highest number of leaves per plant (27.67), while combinations $C_2V_1$ and $C_3V_1$ had the lowest number of leaves (14.00 leaves per plant) at 70 DAS. The maximum length of leaves (14.68 cm) with $C_0V_2$ and minimum length of leaves (8.58cm) of the combination $C_3V_1$ were reported in length of leaves 70DAS. $C_0V_2$ (8.03 cm) is the maximum width of leaves, followed by $C_0V_3$ (7.22 cm), and the minimum width of leaves is recorded in conjunction with $C_3V_1$ (4.80 cm). In 70 DAS, combination $C_0V_2$ had the longest petiole at 8.03 cm, and combination $C_3V_1$ had the shortest at 4.80 cm. The $C_1V_2$ (80.04 cm) combination recorded the maximum germination percentage, while the minimum germination percentage was recorded in the $C_0V_1$ (72.71 cm) combination Similar result were also reported by **Bradely et al. (1971) and Singh et al. (2015).**

**Comment [110]:** use short and clear sentences

**Table-1Effect of different cutting and varieties on growth parameter.**

| Treatments | Plant height (cm) | | | Number of leaves | | | Length of leaves (cm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 30DAS | 50DAS | 70DAS | 30DAS | 50DAS | 70DAS | 30DAS | 50DAS | 70DAS |
| $V_1$ | 17.28 | 22.32 | 29.13 | 10.50 | 14.17 | 16.83 | 7.66 | 10.59 | 9.57 |
| $V_2$ | 20.78 | 25.29 | 32.17 | 12.17 | 17.25 | 19.58 | 8.42 | 11.99 | 11.31 |
| $V_3$ | 19.85 | 23.86 | 31.44 | 11.58 | 16.00 | 18.33 | 8.09 | 11.54 | 10.71 |
| $V_4$ | 19.14 | 23.42 | 30.46 | 11.00 | 15.67 | 17.83 | 7.99 | 11.13 | 10.49 |
| SEm± | 0.23 | 0.16 | 0.19 | 0.25 | 0.19 | 0.21 | 0.14 | 0.19 | 0.19 |
| CD at 5% | 0.68 | 0.46 | 0.54 | 0.73 | 0.56 | 0.60 | 0.42 | 0.55 | 0.56 |
| **Cutting** | | | | | | | | | |
| $C_O$ | 18.25 | 35.30 | 49.11 | 10.67 | 18.92 | 24.33 | 7.39 | 12.13 | 12.49 |
| $C_1$ | 19.84 | 19.95 | 37.41 | 11.83 | 14.33 | 19.83 | 8.68 | 10.83 | 11.16 |
| $C_2$ | 19.45 | 20.05 | 18.38 | 11.67 | 15.00 | 14.25 | 8.43 | 11.38 | 9.82 |
| $C_3$ | 19.48 | 19.60 | 18.29 | 11.08 | 14.83 | 14.17 | 7.65 | 10.83 | 8.78 |
| SEm± | 0.23 | 0.16 | 0.19 | 0.25 | 0.19 | 0.21 | 0.14 | 0.19 | 0.19 |
| CD at 5% | 0.68 | 0.46 | 0.54 | 0.73 | 0.56 | 0.60 | 0.42 | 0.55 | 0.56 |

**Table-2Effect of different cutting and varieties on growth parameter.**

**Comment [111]:** you should incorporate the name of this table, the other tables and also figures in the result part

| Treatments | Width of leaves (cm) | | | leaf petiole length (cm) | | | Germination (%) |
|---|---|---|---|---|---|---|---|
| | 30DAS | 50DAS | 70DAS | 30DAS | 50DAS | 70DAS | |
| $V_1$ | **5.16** | **5.50** | 5.49 | 5.30 | 6.24 | 5.49 | 75.86 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **$V_2$** | 5.82 | 6.57 | 6.51 | 6.38 | 7.30 | 6.51 | 78.49 |
| **$V_3$** | 5.47 | 6.32 | 6.05 | 6.03 | 6.83 | 6.05 | 77.41 |
| **$V_4$** | 5.35 | 6.16 | 5.85 | 5.72 | 6.54 | 5.85 | 76.73 |
| **SEm±** | 0.14 | 0.19 | 0.18 | 0.15 | 0.16 | 0.36 | 0.17 |
| **CD at 5%** | 0.40 | 0.54 | 0.52 | 0.42 | 0.45 | 0.53 | 0.50 |
| **Cutting** | | | | | | | |
| **$C_O$** | 4.70 | 6.61 | 7.09 | 4.67 | 7.40 | 7.09 | 74.96 |
| **$C_1$** | 5.81 | 5.76 | 6.21 | 6.84 | 6.16 | 6.21 | 78.87 |
| **$C_2$** | 5.73 | 6.53 | 5.59 | 6.12 | 7.20 | 5.59 | 78.04 |
| **$C_3$** | 5.57 | 5.64 | 4.99 | 5.80 | 6.15 | 4.99 | 76.62 |
| **SEm±** | 0.14 | 0.19 | 0.18 | 0.15 | 0.16 | 0.36 | 0.17 |
| **CD at 5%** | 0.40 | 0.54 | 0.52 | 0.42 | 0.45 | 0.53 | 0.50 |

**Table-3 Interaction effect different cutting and varieties on growth of palak.**

| **Treatments** | **Plant height (cm)** | | | **Number of leaves** | | | **Length of leaves (cm)** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **30DAS** | **50DAS** | **70DAS** | **30DAS** | **50DAS** | **70DAS** | **30DAS** | **50DAS** | **70DAS** |
| $C_0V_1$ | 14.04 | 32.29 | 44.09 | 8.67 | 14.33 | 19.33 | 6.83 | 10.86 | 9.89 |
| $C_0V_2$ | 21.39 | 37.77 | 52.14 | 11.67 | 22.67 | 27.67 | 7.75 | 13.01 | 14.68 |
| $C_0V_3$ | 19.60 | 36.02 | 51.71 | 11.33 | 19.67 | 25.33 | 7.53 | 12.35 | 13.06 |
| $C_0V_4$ | 17.98 | 35.12 | 48.51 | 11.00 | 19.00 | 25.00 | 7.46 | 12.30 | 12.34 |
| $C_1V_1$ | 17.97 | 19.03 | 36.84 | 11.67 | 14.00 | 20.00 | 8.26 | 10.06 | 10.83 |
| $C_1V_2$ | 21.28 | 21.01 | 38.25 | 12.33 | 14.67 | 20.33 | 9.23 | 11.69 | 11.58 |
| $C_1V_3$ | 20.33 | 20.10 | 37.56 | 12.00 | 14.33 | 19.67 | 8.68 | 11.39 | 11.15 |
| $C_1V_4$ | 19.78 | 19.65 | 37.01 | 11.33 | 14.33 | 19.33 | 8.57 | 10.19 | 11.09 |
| $C_2V_1$ | 18.29 | 19.12 | 17.70 | 10.67 | 14.33 | 14.00 | 8.24 | 10.93 | 9.68 |
| $C_2V_2$ | 20.38 | 21.39 | 19.13 | 12.67 | 16.00 | 15.33 | 8.85 | 11.78 | 9.92 |
| $C_2V_3$ | 19.85 | 20.03 | 18.37 | 12.00 | 15.00 | 14.00 | 8.34 | 11.60 | 9.82 |
| $C_2V_4$ | 19.29 | 19.64 | 18.33 | 11.33 | 14.67 | 13.67 | 8.29 | 11.22 | 9.87 |
| $C_3V_1$ | 18.85 | 18.85 | 17.88 | 11.00 | 14.00 | 14.00 | 7.31 | 10.49 | 8.58 |
| $C_3V_2$ | 20.06 | 21.00 | 19.16 | 12.00 | 15.67 | 15.00 | 7.86 | 11.18 | 9.06 |
| $C_3V_3$ | 19.61 | 19.29 | 18.13 | 11.00 | 15.00 | 14.33 | 7.76 | 10.84 | 8.82 |
| $C_3V_4$ | 19.41 | 19.26 | 18.00 | 10.33 | 14.67 | 13.33 | 7.66 | 10.80 | 8.65 |
| **SEm±** | 0.46 | 0.32 | 0.37 | 0.50 | 0.39 | 0.42 | 0.29 | 0.38 | 0.39 |
| **CD at 5%** | 1.35 | 0.93 | 1.08 | NS | 1.12 | NS | NS | NS | 1.12 |

**Table-4 Interaction effect different cutting and varieties on growth of palak.**

| **Treatments** | **Width of leaves (cm)** | | | **leaf petiole length (cm)** | | | **Germination** |
|---|---|---|---|---|---|---|---|
| | **30DAS** | **50DAS** | **70DAS** | **30DAS** | **50DAS** | **70DAS** | **(%)** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $C_0V_1$ | 4.32 | 5.81 | 6.28 | 3.71 | 6.59 | 6.28 | 72.71 |
| $C_0V_2$ | 4.95 | 7.06 | 8.03 | 5.24 | 8.19 | 8.03 | 72.27 |
| $C_0V_3$ | 4.81 | 6.89 | 7.22 | 5.18 | 7.52 | 7.22 | 75.45 |
| $C_0V_4$ | 4.72 | 6.68 | 6.83 | 4.56 | 7.29 | 6.83 | 75.41 |
| $C_1V_1$ | 5.62 | 5.23 | 5.55 | 6.09 | 5.92 | 5.55 | 78.14 |
| $C_1V_2$ | 6.41 | 6.15 | 6.82 | 7.38 | 6.46 | 6.82 | 80.04 |
| $C_1V_3$ | 5.67 | 5.95 | 6.32 | 7.06 | 6.22 | 6.32 | 79.04 |
| $C_1V_4$ | 5.55 | 5.72 | 6.16 | 6.85 | 6.03 | 6.16 | 78.23 |
| $C_2V_1$ | 5.25 | 5.78 | 5.31 | 5.67 | 6.69 | 5.31 | 77.06 |
| $C_2V_2$ | 6.25 | 7.08 | 5.93 | 6.66 | 7.98 | 5.93 | 79.31 |
| $C_2V_3$ | 5.79 | 6.66 | 5.59 | 6.26 | 7.22 | 5.59 | 78.15 |
| $C_2V_4$ | 5.61 | 6.61 | 5.54 | 5.88 | 6.90 | 5.54 | 77.64 |
| $C_3V_1$ | 5.47 | 5.15 | 4.80 | 5.74 | 5.76 | 4.80 | 75.53 |
| $C_3V_2$ | 5.68 | 5.98 | 5.25 | 6.25 | 6.56 | 5.25 | 78.32 |
| $C_3V_3$ | 5.62 | 5.78 | 5.05 | 5.62 | 6.37 | 5.05 | 77.01 |
| $C_3V_4$ | 5.51 | 5.63 | 4.87 | 5.57 | 5.92 | 4.87 | 75.64 |
| **SEm±** | 0.28 | 0.38 | 0.36 | 0.29 | 0.31 | 0.36 | 0.35 |
| **CD at 5%** | NS | NS | NS | NS | NS | NS | 1.01 |

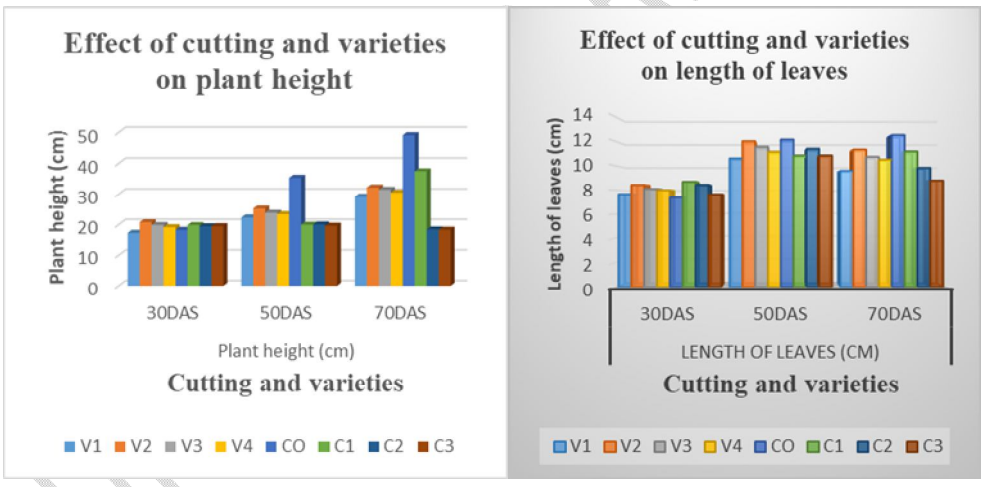


**Figure-1.** Showed effect of cutting and varieties on plant height and length of leaves.

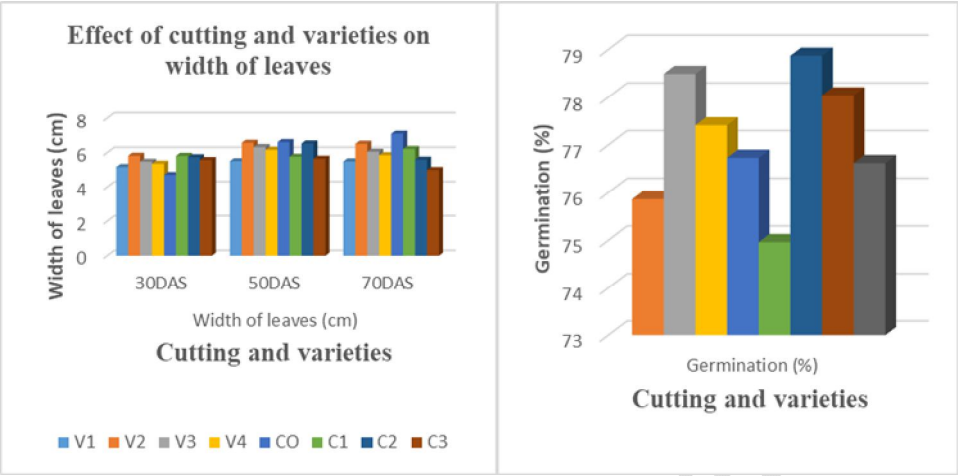


**Figure-2.** Showed effect of cutting and varieties on width of leaves and germination (%).

**Conclusion:**

For the result of experiment it can be concluded that for getting maximum green yield of Palak var. Pusa Jyoti at three leaf cutting is better means $V_2C_3$ combination is best for production per unit area and per unit time.

**Comment [I12]:** reformulate the sentence

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**Comment [I13]:** you should use a standard form for all the references

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