**Effect of cutting on growth and yield of green leaves of spinach (*Beta vulgaris var. Bengalensis*) ev. All Green**

**Abstract**

The present study aim to study “Effect of cutting on growth and yield of green leaves of spinach” The present experiment was carried out at the Horticultural Research Farm, Department of Horticulture, Babasaheb Bhimrao Ambedkar University (A Central University), Vidya Vihar, Rae Bareli Road, Lucknow, U.P., India during the year 2019- 21. The field experiment was laid out in simple randomized block design comprising of eight treatments combinations with three replication son quality and yield parameters of palak. The result reveled that the interaction effect showed that there was significant effect of organic fertilizer and cutting. Clearly showed the application of Azotobactor with two cutting (M1C3) observed maximum highest of plant (20.94cm). that three cutting(C3), produced the highest number of leaves per plant (11.7cm)

**Keywords-:** ~~Effect, Cutting, Growth, Yield, Green Leaves, Spinach And~~*~~Beta vulgaris var. Bengalensis~~* ***key words should be specific***

**Introduction**

Palakor spinach beet *(Beta vulgaris var. bengalensis)* is cool season leafy vegetable, generally cultivated in the sub tropical and temperate conditions. Amongst all the vegetables, the leafy vegetables have a very high protective value(Zhou et al., 2024). They are rich in mineral and hence can be called as “Mines of minerals”. Beside this, soft fibrous matter is specially in providing necessary roughage in diet. It is rich and cheap source of Vitamin A, iron, essential amino acids and ascorbic acid etc(Kumar et al., 2023).

The spinach has great important among all leafy vegetables due to its shortest span of life , many farmers are attracted towards this leafy vegetable and demand of quality seed is raising rapidly(Panghal et al., 2024). The use of fertilizers, ~~no~~ (number) of leaves cutting and sowing days also effects the leaf and seed production potential. The edible portion of spinach consists of compact rosette of leaves prior to the stock formation (Hafez et al., 2015). It is cultivated for its fresh and green leaves which became ready for harvest (cutting) in about 30-35 days from sowing(Shukla et al., 2023).

In case of seed production, the interval may be more. The well grown but not over mature leaves are cut along with petiole at an interval of about 15-18 days. Indian spinach is one of the worth considering leafy vegetables for development. It is fairly tolerant and can be grown successfully in saline and sodic soils (**Mishra *et al*., 1973).** It is grown in almost all districts of Awadh region. Many cultivators are attracted towards this vegetable due to its shortest span of life of course day by day requirement of quality seed is raising rapidly. The yield of seed and green yield in particular area depends on constitution of cultivar. Favorable environmental conditions and adopting improved agro-techniques(Abed & Shebl, 2016; Saba, 2021).

# MaterialsandMethods

# 1. Experimental site

# The present field experiment was conducted at the Horticultural Research Farm, Department of Horticulture, Babasaheb Bhimrao Ambedkar University (A Central University), Vidya- Vihar, Rae Bareli Road, Lucknow, U.P., India during the year 2020-21 in winter season. The selection of site was done on the basis of suitability of land for the cultivation of Palak.

# 2. Climate and weather

# The experimental site is situated at an elevation of 123 meter above Mean Sea Level (MSL) in Central Uttar Pradesh at 26° 55` North latitude and 80° 59` East longitude. The average annual rainfall is 1001 mm precipitating mostly in between middle of July to end of September. The climate of this region is Sub-tropical with maximum temperature ranging from 22-40°C in summer, minimum temperature ranging from 5.5-23.5°C in winter. The climate is hot and relative humidity ranging from 70-95% in different season of the year. The weather data recorded at Indian Institute of Sugarcane Research, Lucknow from November 2019 to April 2020) with respect to total rainfall, maximum and minimum temperature, highest and lowest relative humidity

# 3. Details of the Experiment

# The field experiment was laid out in simple randomized block design comprising of eight treatments combinations with three replications. Plan of layout of the experiment are depicted below -

# Soil type : Sandy loam with slightly alkaline

# Season and year : Winter (2019-2020)

# Test Crop : Spinach beet

# Variety : All Green

# Number of treatments : 08

# Number of replications : 03

# Total number of plots : 24

# Design of experiment : R.B.D.(full form)

**4. Growthparameters**

Observationsweretakenatanintervalof15daysaftersowing.Fiveplantswereselectedatrandomlyfromeach plotas pertreatments forfollowingobservations*.\* mention whether randomly selected plants were tagged or not for observation recording*

**A. Plantheight(cm)**

The plant height was measured from ~~randomly selected~~ *tagged plants* plants from ground level to the largest leaftipwiththehelp of meter scale. *mean value was calculated ?*

**B. Numberofleaves**

Numbers of functional leaves werecountedperplant andmeanswerecalculated.

**C. Lengthofleaves(cm)**

The length of leaves was measured from the pointy part at one end of the leaf to the point where theleafjoinsthe stalkattheotherend with thehelp of ruler. *(mean value??)*

**D. Widthofleaves(cm)**

Thewidthofleaveswasmeasuredfromthecenterofthepintotheleaf’s outsideedge. *(mean value??)*

**E. Lengthofpetiole(cm)**

Meanlengthofpetiolewasmeasuredfromtheobservational plantsofeachtreatment. *(mean value??)*

**F. Leaf yield**

Green yield per plot was measured and further calculated on hectare basis.

**G. Germination count (%)**

Seed germination percentage was calculated by sowing the seeds in plots and by taking the germination count. ***(no table/ data found in this regard)***

**H. Statistically analysis**

The obtained data were subjected to statistical analysis by using the standard procedure pertinent to Randomized Block Design (RBD) given by Panse and Sukhatme (1985).

**Result and Discussion**

All investigation entitled on “Effect of cutting on growth and yield of green leaves of spinach. (*Beta vulgaris var.Bengalensis*) ev. All Green” was carried out during November 2020 ***(or 2019)*** to april 2021~~.~~ At Horticulture Research Farm, department of Horticulture under the school of agriculture science and technology Babasaheb Bhimrao Ambedkar university Lucknow -226025. The result obtained from this study on growth, yield and quality in spinach beet have been discussed in this chapter

**Table1.Effect of organic fertilizer (OF) and cutting (c) on height of palakev. All Green.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Height of Plant(cm)** | | | | |
| **Number of cutting** | | | | |
| Organic fertilizer | C0 | C1 | C2 | C3 | Mean |
| F0 N0 manuring | 19.31 | 16.86 | 17.06 | 14.68 | 19.24 |
| F1 Azotobacter | 19.53 | 17.72 | 18.98 | 20.94 | 17.49 |
| F2 Vermicompost | 18.79 | 17.35 | 19.01 | 20.85 | 18.36 |
| F3 FYM | 19.32 | 18.04 | 18.84 | 24.03 | 20.13 |
| Mean | 16.98 | 19.29 | 18.84 | 20.10 |  |
|  | M | C | M x C |  |  |
| SEm(+) | 0.29 | 0.15 | 0.59 |  | |
| CD(P=0.05) | 0.06 | 0.03 | 0.09 |  | |

**Table-2. Effect of organic fertilizer (OF) and cutting (C) on number of leaves of palakev. All Green.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **Number of leaves per plant** | | | | |
| **Number of cutting** | | | | |
| Organic fertilizer | C0 | C1 | C2 | C3 | mean |
| F0- No manuring | 10.60 | 9.64 | 10.17 | 9.25 | 9.91 |
| F1 Azotobacter | 10.53 | 10.32 | 9.09 | 11.23 | 10.49 |
| F2 Vermicompost | 10.36 | 10.20 | 10.29 | 11.52 | 10.54 |
| F3 FYM | 10.07 | 11.20 | 10.11 | 12.31 | 10.97 |
| Mean | 10.34 | 10.39 | 10.11 | 11.07 |  |
|  | M | C | M x C |  |  |
| SEm(+) | 0.015 | 0.007 | 0.022 |  |  |
| CD(P=0.05) | 0.044 | 0.022 | 0.066 |  |  |

**Table-3 Effect of organic fertilizer (OF) and cutting (C) on length of leaves (cm) of palakev.All Green.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **Length of leaves (cm)** | | | | |
| **Number of cuttings** | | | | |
| Organic fertilizer | C0 | C1 | C2 | C3 | Mean |
| F0- No manuring | 8.80 | 8.83 | 8.75 | 7.37 | 8.44 |
| F1 Azotobacter | 9.05 | 8.99 | 9.15 | 10.06 | 9.31 |
| F2 Vermicompost | 10.17 | 9.33 | 9.95 | 10.14 | 9.44 |
| F3 FYM | 7.94 | 10.16 | 8.40 | 11.27 | 9.91 |
| Mean | 8.99 | 9.34 | 9.06 | 9.71 |  |
|  | M | C | M x C |  |  |
| SEm(+) | 0.07 | 0.04 | 0.11 |  |  |
| CD(P=0.05) | 0.2 | 0.11 | 0.31 |  |  |

**Table-4 Effect of organic fertilizer (OF) and cutting (C) on length of petiole (cm) of palakev. All Green.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **Length of petiole (cm)** | | | | |
| **Number of cuttings** | | | | |
| Organic fertilizer | C0 | C1 | C2 | C3 | Mean |
| F0- No manuring | 4.69 | 4.66 | 3.48 | 4.60 | 4.36 |
| F1 Azotobacter | 4.69 | 5.05 | 5.04 | 5.16 | 4.98 |
| F2 Vermicompost | 5.13 | 4.84 | 4.93 | 5.15 | 4.95 |
| F3 FYM | 5.13 | 5.10 | 4.86 | 5.48 | 5.01 |
| Mean | 4.72 | 4.91 | 4.58 | 5.10 |  |
|  | M | C | M x C |  |  |
| SEm(+) | 0.006 | 0.004 | 0.01 |  |  |
| CD(P=0.05) | 0.019 | 0.015 | 0.034 |  |  |

**Table-5 Effect of organic fertilizer (OF) and cutting (C) on width of leaves (cm) of palakev. All Green.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **Width of leaves (cm)** | | | | |
| **Number of cuttings** | | | | |
| Organic fertilizer | C0 | C1 | C2 | C3 | Mean |
| F0- No manuring | 3.81 | 3.69 | 4.09 | 3.63 | 3.80 |
| F1 Azotobacter | 4.11 | 4.08 | 4.02 | 5.08 | 4.32 |
| F2 Vermicompost | 4.20 | 4.18 | 4.16 | 5.16 | 4.42 |
| F3 FYM | 4.27 | 4.18 | 5.11 | 5.23 | 4.68 |
| Mean | 4.08 | 4.03 | 4.35 | 4.77 |  |
|  | M | C | M x C |  |  |
| SEm(+) | 0.004 | 0.002 | 0.006 |  |  |
| CD(P=0.05) | 0.012 | 0.007 | 0.019 |  |  |

**Table-6. Effect of organic fertilizer (OF) and cutting (C) on moisture content % of leaves of palakev. All Green.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **Moisture content (%)** | | | | |
| **Number of cuttings** | | | | |
| Organic fertilizer | C0 | C1 | C2 | C3 | Mean |
| F0- No manuring | 82.16 | 79.32 | 81.34 | 80.12 | 80.73 |
| F1 Azotobacter | 81.23 | 82.26 | 80.11 | 83.32 | 81.73 |
| F2 Vermicompost | 79.63 | 80.18 | 82.29 | 82.36 | 81.12 |
| F3 FYM | 81.33 | 79.78 | 82.32 | 84.11 | 81.88 |
| Mean | 81.09 | 80.38 | 81.51 | 82.48 |  |
|  | M | C | M x C |  |  |
| SEm(+) | 0.015 | 0.008 | 0.023 |  |  |
| CD(P=0.05) | 0.044 | 0.036 | 0.08 |  |  |

**Table-7. Effect of organic fertilizer (OF) and cutting (C) on green yield of leaves (g) on basis of single cutting of palakev. All Green.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **Green yield of leaves per plot (g)** | | | | |
| **Number of cuttings** | | | | |
| Organic fertilizer | C0 | C1 | C2 | C3 | Mean |
| F0- No manuring | 805.89 | 790.60 | 801.25 | 770.84 | 792.14 |
| F1 Azotobacter | 829.76 | 817.12 | 832.33 | 879.06 | 839.56 |
| F2 Vermicompost | 823.75 | 819.90 | 811.82 | **889.81** | 836.18 |
| F3 FYM | 853.50 | 840.90 | 856.04 | ~~800.93~~ | 860.73 |
| Mean | 828.50 | 816.96 | 825.22 | 858.21 |  |
|  | M | C | M x C |  |  |
| SEm(+) | 2.026 | 1.078 | 3.114 |  |  |
| CD(P=0.05) | 5.909 | 3.098 | 9.007 |  |  |

# The maximum plant height was observed in the treatment ~~(M~~~~3~~~~)~~ (F3)FYM and three times cutting (C3) value???? but, after second cutting plant height reduced due to minimum moisture and less nutrient uptake and increase of temperature. Similar result by Dadiga*et al.* and Bahavand*et al.(year mention)* also found similar result when they experimented on coriander and Indian spinach, with use of FYM, vermicompost and compost mixtures. They reported that use vermicompost along with RDF 50 kg/ha increased vegetative growth of palak coriander respectively.

# The maximum number of leaves under the treatment FYM (M3) +three time of cutting (C3) value???? were rewarded due to reason that in number of cutting (C3) were three. Therefore, in three cutting the number of leaves will increase because of addition of leaves number for each cutting. This result corroborated the finding of by Naik *etal.(2010)* When they did experiment on spinach beet. With use FYM and vermicompost mixtures.

# Dadiga *et al.* (2015), Bharad*et al.* (2013).and Baharvand*et al.* (2014). also found Similar results when they carried out on experiment on coriander. Indian spinach, and With use FYM, and vermicompost. They reported that use of FYM along with RDF 50Kg/ha increased vegetative growth of palak and coriander.

# This result is quite similar with results of by Dange*et al.* (2011). When they experimented on spinach beet. With use of treatment of 50 % RDF + 50 % N though poultry manure gave the best resut of growth in terms of plant, number of leaves area per plants, length of petiole at all stage of growth.

# The maximum green leaf yield/ha was calculated under the treatment (M3). kindly check??? Third time cutting (C3). But after second cutting reduced green leaf yield because of decrese in vegetative part due to low moisture and less nutrient up take and increase of temperature. This finding is conformity the finding. Sarkar *et al*.(2013)*check year in refernce* and Rajendra (2013). Who conducted and experiment on spinach with use of organic manure mixture. They reported that FYM highest nutrient available in fertilizer and proper aeration increased yield.

# Conclusion

# All the vegetative growth of parameters spinach ev. All Green in respect of plant height. Number of leaf, width of leaf and length of petiole were significantly influenced by the variation in maturing ‘s levels and number of cutting frequency. Better vegetative growth was observed in the treatment FVM (M3). Among all other manures used. All the quality parameters of spinach i.e. ~~chlorophyll content, ascorbic acid~~, leaf moisture and ~~dry weight~~ (no table mentioned) were significantly improved by FYM (M3) and application and third time cutting (C3). Maximum green leaf yield/ha was reported under this treatment has significantly affect treatment (M3) FYM manure applied and three time cutting.

# *\* Kindly mention explanation of all remaining tables i.e. table 3, 4,5,6 mentioned here.*

**Reference**

1. Abed, M. Y., **&** Shebl, E. F. (2016). Effect of sowing dates and number of cuttings on yield and quality of spinach (Spinacia oleraceae L.). *Journal of Plant Production*, *7*(12), 1437–1442.
2. Baharvand, Z. A., Hossian, Z, and masoud, R.(2014). Effect of vermicompost and chemical fertilizer on growth parameters of three coriander cultivars*. J. Applied Sci. Agri*., ***volume???page??***
3. Bharad ,S.G ., Korde , S.D., Satpute, P. and Baviskar , M.N. (2013). Effect of organic manure and number of growth yield and quality of Indian spinach. *Asian* ***j.*** *of Horti*., 8(1): 60 – 64
4. Dadiga, A., kadwey , S. and Prajapati , S. (2015). Influences of organic and inorganic source of nutrients on growth, yield attributed trials and yield economic of coriander. (*Coriandrum sativam* L.) CVJD-1. *J* . *Ag. Res.,* 46 (6): 577 – 580.
5. ~~Dadiga, A., kadwey , S. and Prajapati , S. (2015). Influences of organic and inorganic source of nutrients on growth, yield attributed trials and yield economic of coriander. (~~*~~Coriandrum sativam~~* ~~L.) CVJD-1.~~ *~~J~~* ~~.~~ *~~Ag. Res.,~~* ~~46 (6): 577 – 580.~~ *R****epetatitve***
6. Hafez, M. M., Shafeek, M. R., Mahmoud, A. R., **~~&~~(and)** Ali, A. H. (2015). Beneficial effects of nitrogen fertilizer and humic acid on growth, yield and nutritive values of spinach (Spinacia olivera L.). *Journal of Applied Sciences*, *5*(02), :597–603.
7. Kumar, S., Ram, R. B., Verma, S., Verma, R. S., Kishor, B., **&** Kumar, L. (2023). Studies on Effect of Different Cutting and Varieties on Growth Parameter of Spinach Beet (Beta vulgaris var. Bengalensis L.). *International Journal of Plant & Soil Science*, *35*(4), 8–15.
8. Naik, D.M., Patil, S.B. Jature and Shinde. S.J.(2010). Effect of sowing dates number of leaf cuttings on growth and yield of palak (*Beta vulgaris* L.). The *Asian J. Hort.,* 4(2): 377-379. Vegetable for the tropical region ICAR, NEW Delhi, low priced book series No. 2
9. Panghal, V. P. S., Lal, M., Duhan, D. S., **&** Bhuker, A. (2024). Optimizing sowing time and leaf cuttings for seed yield and quality of palak (Beta vulgaris var. Bengalensis L.). *Vegetable Science*, *51*(02), 361–366.
10. Panse, V.G. and Sukhatme, P.V. (1985) Statistical Methods for Agricultural Workers. *Indian Council of Agricultural Research Publication, 87-89. - References—Scientific Research Publishing*. (n.d.). Retrieved February 15, 2025, from https://www.scirp.org/reference/referencespapers?referenceid=1814819
11. Rajender, S., Geeta, B. and Dilbag, S.(2013). Influence of sowing time and leaf cutting on the seed yield and quality compound palal (*Beta vulgaris var.bengalensis*) Indian*. J*. *Agri. Sci*., 83(4): 410-414.
12. Saba, S. N. (2021). *Effect of spacings and number of leaf cutting on green yield and seed yield of spinach (Beta vulgaris L.) var, all green* [PhD Thesis, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani]. https://krishikosh.egranth.ac.in/items/2dc41aba-1fcd-4c32-a79e-71aabb775936
13. Sarkar, R. K., Jana J. C. and Datta. S. (2014). Effect of cutting frequencies and nitrogen leve on growth, green and seed yield and quality of water spinach.  *J.Applied natural Sci. 6(2): 545-551.*
14. Shukla, M. K., Pandey, R., Singh, R., **&** Prajapati, N. K. (2023). Effect of Organic Manures and Leaf Cuttings on Growth, Yield and Quality of Palak (Beta vulgaris var. Bengalensis). *International Journal of Plant & Soil Science*, *35*(19), 871–875.
15. Zhou, L., Mubeen, M., Iftikhar, Y., Zheng, H., Zhang, Z., Wen, J., Khan, R. A. A., Sajid, A., Solanki, M. K., Sohail, M. A., Kumar, A., Massoud, E. E. S., & Chen, L. (2024). Rice false smut pathogen: Implications for mycotoxin contamination, current status, and future perspectives. *Frontiers in Microbiology*, *15*, 1344831. https://doi.org/10.3389/fmicb.2024.1344831
16. Panse, V.G. and Sukhatme, P.V. (1985) *Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research Publication, 87-89. - References - Scientific Research Publishing*, n.d.).

* ***16th literature cited should be arranged accordingly***
* ***references should be checked once as many mistakes are noticed.***
* ***reference missing: Mishra et al., 1973; Dangeet al. (2011)***
* ***scientific name should be italics***
* ***follow the same format for each reference***