

Original Research Article

<https://doi.org/10.20546/ijcmas.2018.706.255>

Effect of Spacing, Nitrogen and Boron on Yield and Yield Attributing Traits of Broccoli

Amarjeet Sheokand*, Monisha Rawat, Savita, Jasbir Khatkar,
Naresh Sheokand and Amit Khatkar

Department of Horticulture, School of Agriculture, Lovely Professional University,
Phagwara, Punjab-144411, India

*Corresponding author

ABSTRACT

The present study was planned with the objectives to evaluate the effect of different plant spacings and doses of nitrogen and boron on head size, head yield and quality. The investigation was conducted at the Agricultural Research Field, School of Agriculture, Lovely Professional University, Phagwara, Punjab during September 2017 to January 2018. The experimental material for the present investigation comprised one variety of broccoli viz. PalamSamridhi with nine different treatment combinations including two different spacings (60 x 60 cm and 60 x 30 cm), two levels of nitrogen (180 kg/ha and 120 kg/ha), two levels of boron (20 kg/ha and 10 kg/ha) and one control (60 x 45 + 150 kg N/ha + 15 kg B/ha). The evaluation was done in a randomized block design with nine different treatments and three replications. The observations were recorded for eighteen quantitative traits. The treatment T5 (60 x 30 cm + 180 kg N/ha + 20 kg B/ha) was found to be the optimum treatment combination which resulted in higher yield of broccoli (8.54 t/ha).

Keywords

Boron, broccoli,
nitrogen, plant
spacing, yield

Article Info

Accepted:

20 May 2018

Available Online:

10 June 2018

Introduction

Broccoli (*Brassica oleracea* var. *italica* L., 2n=18) is a major and highly nutritive exotic vegetable crop belonging to the family brassicaceae. From the ancient times, it has great economic significance because of its medicinal and dietetic properties. It is an excellent source of vitamin A and C and also a good source of folate. According to Thompson and Kelly (1985), broccoli is more nutritious than any other cole crops. Enriched in antioxidants, it can reduce the risk of some forms of cancer and heart diseases. Thus,

broccoli can play a vital role in improving the nutritional status of the people. The stem of broccoli plant, whose core is soft and sweet, may also be eaten like vegetable (Sazzad, 1996). Plant density is a concerned factor to maximize the yield and to obtain uniform plant maturity. It has significant effect on canopy development, soil moisture loss, ability to control emerging weeds, light interception and crop growth rate. It depends upon root system of the crop, plant spread, vegetative growth, planting time and variety. It helps in efficient utilization of field by covering the whole field for productive

purpose. Generally, it is directly proportional to the production. The recommended plant spacing i.e. 60 cm x 45 cm for the production of broccoli gives high returns. It is directly related to spacing. With more spacing, the number of plants per unit area decrease. So, it provides more area for plant establishment. Fertilizers also have an important role for crop growth and yield. The balanced proportion of fertilizers should be applied especially nitrogen because it is the major fertilizer which is responsible for the vegetative growth of plants, constituent of protein and protoplasm of chlorophyll and enzymes. It is essential for photosynthesis. It is a part of protein and improves the photosynthetic efficiency of plants and ultimately the yield. Boron also an important micronutrient for the growth and development of plants is required in minute quantities as compared to nitrogen. High doses of nitrogen may reduce the effect of boron. It controls transportation of sugar in plants. Its deficiency effects vegetative and reproductive growth of plants. Therefore, the present investigation was carried out to observe the effect of plant spacing, nitrogen and boron on yield and yield contributing characters of broccoli.

Materials and Methods

The present investigation was conducted during September 2017 to January 2018, at the Agriculture Farm, LPU, Phagwara. One variety of Broccoli PalamSamridhi was taken with nine different treatment combinations including two different spacings (60 x 60 cm and 60 x 30 cm), two levels of nitrogen (180 kg/ha and 120 kg/ha) and two levels of boron (20 kg/ha and 10 kg/ha) including one control (60 x 45 + 150 kg N/ha + 15 kg B/ha). The evaluation was done in a randomized block design with three replications. The observations were recorded on the yield and yield related traits. The data were analyzed statistically according to the procedure

described by Snedecor and Cochran (1989) to work out the effects of spacing, nitrogen and boron on the growth, yield and yield attributes of broccoli.

Results and Discussion

The analysis of variance showed significant differences among the treatments for all the characters studied. There was an increasing trend in the values of plant spread, number of leaves/plant, leaf length, leaf width, fresh weight of leaves, stem, root and plant with an increased spacing and increasing dose of nitrogen and boron. Application of 180 kg N/ha and 20 kg B/ha gave significantly maximum values for most of the growth parameters viz. plant height (67.53 cm), number of leaves/plant (18.73), leaf length (61.43 cm) and leaf width (25.20 cm) of the biggest leaf and plant spread (81.33 cm).

The treatment T1 (60 x 60 cm + 180 kg N/ha + 20 kg B/ha) was found significantly superior over all the treatments as well as control T9 (60 x 45 cm + 150 kg N/ha + 15 kg B/ha) for all the growth characters viz. plant spread, leaf length, leaf width, number of leaves, stem stalk diameter, head diameter, head length, head weight and fresh weight of leaves, stem, root and plant.

It was observed that wider spacing and higher dose of nitrogen and boron resulted in increase in all these characters. This could be due to the positive effect of wider spacing where there is minimum competition for resources between plants as compared to the closer spacing. It facilitated more vegetative growth and increased leaf size, resulting in more spread of the plant. It may be due to the fact that plants grown under wider spacing received more nutrients, light, moisture leading to higher photosynthetic activity and thus increase in leaves, stem and root size as compared to plants grown at a closer spacing.

Table.1 Effect of plant spacing, nitrogen and boron on yield and yield parameters of broccoli

| Sl. No. | Treatments | Mean | | | | | | | |
|---------|------------|------------------------------|------------------------------|------------------|-----------------|------------------|--------------------------|------------------|--------------------|
| | | Plant height at harvest (cm) | Plant spread at harvest (cm) | Leaf length (cm) | Leaf width (cm) | Number of leaves | Stalk stem diameter (mm) | Head length (cm) | Head diameter (cm) |
| 1. | T1 | 67.53 | 81.33 | 61.43 | 25.20 | 18.73 | 34.82 | 17.43 | 13.27 |
| 2. | T2 | 65.60 | 80.93 | 58.66 | 23.46 | 16.30 | 33.54 | 16.53 | 13.20 |
| 3. | T3 | 67.00 | 78.63 | 59.16 | 24.20 | 17.47 | 34.61 | 16.93 | 12.93 |
| 4. | T4 | 64.20 | 77.13 | 56.46 | 21.73 | 15.73 | 32.91 | 15.73 | 11.93 |
| 5. | T5 | 74.00 | 78.53 | 59.33 | 23.06 | 15.47 | 33.24 | 16.47 | 12.80 |
| 6. | T6 | 71.93 | 75.93 | 57.33 | 22.73 | 15.07 | 32.96 | 15.60 | 11.33 |
| 7. | T7 | 71.07 | 74.63 | 57.80 | 22.86 | 15.33 | 33.11 | 15.80 | 11.40 |
| 8. | T8 | 69.87 | 73.87 | 55.53 | 21.13 | 14.93 | 32.70 | 14.80 | 11.27 |
| 9. | T9 | 67.67 | 77.07 | 58.10 | 22.93 | 16.03 | 33.01 | 15.93 | 11.87 |
| | S.Em.± | 1.57 | 1.27 | 0.65 | 0.69 | 0.26 | 0.40 | 0.46 | 0.39 |
| | CD at 5% | 4.76 | 3.85 | 1.97 | 2.09 | 0.78 | 0.21 | 1.39 | 1.18 |
| | CV (%) | 3.96 | 2.84 | 1.94 | 5.20 | 2.80 | 2.08 | 4.95 | 5.54 |

Table.2 Effect of plant spacing, nitrogen and boron on yield and yield parameters of broccoli

| Sl. No. | Treatments | Mean | | | | | |
|---------|------------|-----------------------------|---------------------------|---------------------------|----------------------------|----------------------|--------------|
| | | Fresh weight of leaves (kg) | Fresh weight of root (kg) | Fresh weight of stem (kg) | Fresh weight of plant (kg) | Head yield (gm/head) | Yield (t/ha) |
| 1. | T1 | 0.883 | 0.107 | 0.304 | 1.463 | 171.20 | 4.75 |
| 2. | T2 | 0.714 | 0.097 | 0.262 | 1.237 | 162.47 | 4.51 |
| 3. | T3 | 0.849 | 0.103 | 0.300 | 1.407 | 155.00 | 4.31 |
| 4. | T4 | 0.674 | 0.095 | 0.270 | 1.173 | 136.07 | 3.78 |
| 5. | T5 | 0.802 | 0.102 | 0.300 | 1.353 | 153.80 | 8.54 |
| 6. | T6 | 0.558 | 0.074 | 0.219 | 0.980 | 131.00 | 7.28 |
| 7. | T7 | 0.605 | 0.097 | 0.211 | 1.053 | 140.60 | 7.81 |
| 8. | T8 | 0.554 | 0.061 | 0.215 | 0.953 | 123.20 | 6.84 |
| 9. | T9 | 0.709 | 0.083 | 0.245 | 1.187 | 149.13 | 5.52 |
| | S.Em.± | 0.05 | 0.01 | 0.01 | 0.06 | 4.01 | 0.16 |
| | CD at 5% | 0.15 | 0.02 | 0.04 | 0.18 | 12.14 | 0.47 |
| | CV (%) | 11.97 | 12.82 | 8.99 | 8.47 | 4.73 | 4.58 |

T1 (60 x 60 cm + 180 kg N/ha + 20 kg B/ha), T2 (60 x 60 cm + 120 kg N/ha + 20 kg B/ha), T3 (60 x 60 cm + 180 kg N/ha + 10 kg B/ha), T4 (60 x 60 cm + 120 kg N/ha + 10 kg B/ha), T5 (60 x 30 cm + 180 kg N/ha + 20 kg B/ha), T6 (60 x 30 cm + 120 kg N/ha + 20 kg B/ha), T7 (60 x 30 cm + 180 kg N/ha + 10 kg B/ha), T8 (60 x 30 cm + 120 kg N/ha + 10 kg B/ha), T9 (60 x 45 cm + 150 kg N/ha + 15 kg B/ha)

Similarly, Haque *et al.*, (1996) reported higher leaf length at 180 kg N/ha than 120 kg N/ha; Kumar *et al.*, (2007) and Saikia *et al.*, (2010) reported that the plant spread increased when plant spacing was increased from 50 x 30 cm to 60 x 45 cm. The results are in conformity with the findings of El-Behcidi and El- Mansi (1973) in cabbage and Saikia *et al.*, (2010) in broccoli. Katiyar *et al.*, (2011) also found an increase in plant spread with increase in nitrogen doses and Hossain *et al.*, (2011) also reported maximum number of leaves at 60 × 60 cm spacing. Similarly, in cabbage maximum leaf length (35.28 cm) and leaf width (32.98 cm) were recorded when planted at a spacing of 60 x 45 cm and minimum leaf length (34.84cm) and leaf width (31.68 cm) from 60 x 40 cm spacing (Moniruzzaman, 2011). Singhal *et al.*, (2009) also recorded maximum fresh weight of plant in broccoli at a spacing of 45 x 60 cm followed by 45 x 45 cm.

But in case of plant height and total yield per hectare T5 (60 x 30 cm + 180 kg N/ha + 20 kg B/ha) was found significant over control and all other treatments. Plant height was found to be higher at a narrower spacing of 60 x 30 cm. The cause of the increase in plant height could be the competition for light. It was observed that closely spaced plants grew very fast as compared to wider spaced plants. This may be because of competition for photosynthetic active radiation which stimulates growth. Yield may have increased due to the increase in plant population per hectare as a result of decrease in plant spacing. Similar results were also obtained by Haque *et al.*, (1996) who reported higher plant height at 180 kg N/ha than 120 kg N/ha. Similarly, Giri *et al.*, (2013) and El-Shikha *et al.*, (2007) also reported increase in plant height with increased application of nitrogen. Saikia *et al.*, (2010) also noticed maximum plant height when plants were sown at a narrow spacing of 30 × 30 cm.

It can be interpreted from the results that the yield was higher when plants were grown at a narrow spacing of 60 x 30 cm, rather than a wider spacing of 60 x 60 cm and 60 x 45 cm, as wider spacing led to decrease in plant population per hectare and resulted in lower yield. Higher dose of nitrogen @ 180 kg/ha and boron @ 20 kg/ha led to highest yield. Thus, it can be concluded that for maximising the productivity of broccoli per unit area, the plants should be grown at a narrow spacing of 60 x 30 cm with nitrogen and boron applications @ 180 kg/ha and 20 kg/ha respectively.

References

- Ei-Behcidi, M. and Ei-Mansi, A.A. 1973. Effect of nitrogen level and spacing on cabbage yield. *BertragaZurPropisehen Land wirtschaft and VeterinarMedizin*. 11(3): 291-297.
- El-Shikha, D.M., P. Waller, D. Hunsaker, T. Clarke and Barnes, E. 2007. Ground-based remote sensing for assessing water and nitrogen status of broccoli. *Agricultural Water Management*. 92(3), pp.183-193.
- Giri, R. K., M. D. Sharma, S. M., G. C. Y. D. Shakya and Kandel, T. P. 2013. Growth and yield responses of broccoli cultivars to different rates of nitrogen in western Chitwan, Nepal. *Agric Sci*.4:8-12.
- Haque, M. E., A. J. M. S. Karim, J. Haider and Hosain, T. 1996. Effect of irrigation and nitrogen on the growth and yield of broccoli. *Bangladesh Hort*. 24:53-57.
- Hossain, M.F., N. Ara, M.R. Uddin, S. Dey and Islam, M.R. 2011. Effect of time of sowing and plant spacing on broccoli production. *Tropical Agricultural Research and Extension*. 14(4).
- Katiyar, D., S.M. Tripathi, A.K. Dwivedi, and Pandey, V. 2011. Studied Kumar, N, Kumar, N., Prakash, V. and Srivastva, A.K., 2007. Effect of transplanting

- dates and geometries on broccoli (*Brassica oleracea* cv. *italica*) under mid-hills conditions of north-west Himalaya. *Indian Journal of Agricultural Science*. 77(7), pp.448-450.
- Kumar, N.N. Kumar, V. Prakash and Srivastva, A.K. 2007. Studies on the Interaction and Economics of Nitrogen and Phosphorus on Crop Growth, Relating Traits of Broccoli (*Brassica oleracea* L. var. *italica*). *Annals of Horticulture*. 4(2), pp.176-180.
- Moniruzzaman, M. 2011. Effect of plant spacings on the performance of hybrid cabbage (*Brassica oleracea* var. *capitata*) varieties. *Bangladesh Journal of Agricultural Research*. 36(3), pp.495-506.
- Saikia, B. R., D. B. Phookan and Brahma, S. 2010. Effect of time of planting and planting densities on growth, yield and economics production of broccoli (*Brassica oleracea* L. var. *italic Plenck*) cv. Pusa broccoli KTS-1. *J Hill Agric*.1:135-139.
- Sazzad, M. 1996. Optimizing fertilizer requirement for broccoli cultivation. M.S. Thesis. Dept. Soil Science. Bangababdhusheik Mujibur Rahman Agricultural University, Gazipur, Bangladesh.
- Snedecor, G. W. and Cochran, W. G. 1989, *Statistical Methods*, Eighth Edition, Iowa State University Press
- Thompson, H. C. and Kelly, W. C. 1985. *Vegetable Crops*. Fifth edition, McGraw Hill. Book Co. New York, Toronto, London, P. 307.

How to cite this article:

Amarjeet Sheokand, Monisha Rawat, Savita, Jasbir Khatkar, Naresh Sheokand and Amit Khatkar. 2018. Effect of Spacing, Nitrogen and Boron on Yield and Yield Attributing Traits of Broccoli. *Int.J.Curr.Microbiol.App.Sci*. 7(06): 2156-2160.
doi: <https://doi.org/10.20546/ijemas.2018.706.255>