

Effect of Spacing and Plant Growth Regulators on the Growth and Nutritional Value of Palak (*Beta vulgaris* var *bengalensis*)

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Abstract The experiment comprised of treatments with three spacing 15, 30 and 45 cm plant to plant and two plant growth regulators 50 ppm and 100 ppm each of indole acetic acid (IAA) and gibberellic acid (GA_3). A total of three foliar applications were made at two weeks interval commencing from two weeks after sowing. Spacing of 15 cm plant to plant gave the highest green yield per ha (108.07 q). Spacing 45 cm gave highest yield per plant (39.10 g) and seed yield spacing gave highest green seed yield per ha (19.10 q). All the spacings and treatments significantly increased plant height, stem girth, leaf development and chlorophyll content of the vegetable with higher values recorded in treatments with 100 ppm IAA and 100 ppm GA_3 . The study suggests that plant spacing 45 cm and 100 ppm GA_3 have poten-

tial to increase growth, nutritional value and yield parameters of Palak (*Beta vulgaris* var *bengalensis*).

Keywords Palak, Growth regulators, Spacing, Growth, Nutrition.

Introduction

Plant growth regulators are known to control plant's physiological and biochemical processes. These include, control of dormancy, organ size, crop development, flowering and fruit set, regulation of chemical composition of plants and control of mineral uptake from the soil [1]. The spacing and growth regulators influence plant growth and development at different spacing and at very low concentrations of growth regulator they inhibit the growth [2]. Indole acetic acid and gibberellic acid promote seedling growth in various concentrations [3]. Auxins are primary regulators of plant form while gibberellins and brassinosteroids stimulate elongation [4].

This study was carried out to evaluate the spac-

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Table 1. Effect of different concentrations of plant growth regulators on vegetative parameters and chlorophyll content of Palak (*Beta vulgaris* var *bengalensis*) at 2 weeks after sowing.

Treatments (ppm)	Plant height (cm)	Stem diameter (cm)	No. of leaves	Leaf area ratio	Chlorophyll content (mg/g)
IAA (50)	27.7	2.46	17.30	276.0	0.67
IAA (100)	28.3	2.48	11.30	288.2	0.70
GA ₃ (50)	34.2	2.13	20.30	171.0	0.79
GA ₃ (100)	36.2	2.04	20.70	189.5	0.93
Control	22.9	2.04	09.30	124.4	0.66
LSD _{5%}	5.45	0.33	12.21	28.94	0.09

ing and growth regulator responses of Palak (*Beta vulgaris* var *bengalensis*) to spacing and growth regulator treatments and to determine the optimum spacing and concentrations of the hormones that can be recommended on the vegetable for enhanced growth and quality.

Materials and Methods

Growth regulator treatments

The growth regulators employed in the experiment were indole 3 acetic acid (IAA), gibberellic acid (GA₃). The concentrations of the growth regulators treatment were IAA and GA₃ 50 ppm and 100 ppm. Thirty (30 ml) of the various concentrations were applied on the planted vegetables by foliar spraying of four doses at two week intervals commencing from two weeks after sowing. The control vegetable plants were foliar sprayed with 30 ml water also applied in four doses at two week interval starting from 2 weeks after sowing.

Effects of growth regulator treatments on vegetative growth and chlorophyll content

The treated and control vegetables were sampled at 2 weeks after planting. Plant heights and stem girth were measured using a meter rule with the aid of a thread. Number of leaves on each of the treated and control plants was counted and the leaves were subsequently detached and their outlines traced out on

Table 2. Effect of different spacing on vegetative parameters and seed yield of Palak (*Beta vulgaris* var *bengalensis*) at 45 days of sowing.

Spacing (cm)	Plant height (cm)	Stem diameter (cm)	No. of leaves	Seed yield per plant (g)	Seed yield per hectare (q)
15	29	0.9	15	4.9	17.56
30	31	1.7	16	5.2	18.87
45	34	2.1	18	5.7	19.10
Control	17	0.6	11	2.2	12.20
LSD _{5%}	5.24	0.45	13.54	0.87	8.79

a graph paper to measure the leaf area. The leaf area ratio was calculated using the formula :

$$\text{Leaf area ratio} = \frac{\text{Leaf area total}}{\text{Dry weight of whole plant}}$$

For all the parameters measured, three replications were taken and the means were recorded. The chlorophyll contents of the leaves were determined using the method of Witham et al. [5].

Results and Discussion

Significant ($p < 0.05$) increases in all the vegetative growth parameters monitored were observed in the treated vegetable compared with the control. Gibberellic acid (GA₃ 100 ppm) treatment resulted in greater plant height (36.2 cm) followed by GA₃ 50 ppm (34.2 cm) (Table 1). The IAA treatments (100 ppm and 50 ppm) stimulated greater leaf area ratio (288.2, 276.0 respectively). Similar results of plant height stimulation were observed upon application of 100 mg/L GA₃ on carrot [6]. Similarly, GA₃ spraying was found to stimulate production of flowers in lettuce [7]. GA₃ application increased the growth of bean and leaf length of lettuce [8]. Gibberellic acid was also reported to increase plant height, number of leaves and total plant weight of some cowpea cultivars [9]. The hormonal treatments stimulated significant increases in the total chlorophyll contents of the vegetable except IAA treatments. The highest total chlorophyll content (0.93 mg/g) at 2 weeks was obtained by 100 ppm GA₃.

It was also observed that all the spacing showed

significant increase in vegetative growth and yield parameters (Table 2). Among the three spacings used, 45cm plant to plant spacing showed good response towards all the vegetative and yield parameters and the reason quoted for this was because as the plants gets more space between them for vigorous growth of vegetative and yield parameter.

The growth regulator treatments and spacing resulted in significant increased growth and food quality and yield parameters of the Palak. Treatments with 100 ppm GA₃ induced the greatest increase in height, chlorophyll content whereas, 45 cm of spacings induced higher vegetative growth and yield parameters. These treatments could thus be used to enhance the growth and quality of this vegetable.

References

1. Nickell LG (1978) Plant growth regulators. Chem Engg News 56 : 18—34.
2. Jules J, Robert WS, Frank W, Varnon WR (1981) Plant science. An introduction to world crops. WH Freeman & Co, New York, pp 55-64, 162—192.
3. Mella RA, Dahal P, Yang H, Bradford KJ (1997) Quantification of GA₃ regulated in RNA abundance in tomato seeds using tissue printing. In : Ruthland (ed). Encyclopedia Plant Physiol, pp 292—295.
4. Dugardeyn J, Vandenbussche F, Van Derstraiten D (2008) To grow or not to grow : What we can learn on ethylene gibberellin cross-talk by in silico gene expression analysis. J Exptl Bot 59 : 1—16.
5. Witham FH, Blaydes DF, Devlin RN (1971) Experiments in plant physiology. D Van Nostrand Comp, New York, pp 55—56.
6. Santos P (2008) Influence of gibberellic acid on carrot growth and severity of alternaria leaf blight. Pl Dis 84 : 555—558.
7. Tanimoto E (2007) Regulation of root growth by plant hormones-Roles for auxin and gibberellin. Critical Rev in Pl Sci 24 : 249—265.
8. Abbas ED, Ibn al-haitham J (2011) Effect of GA₃ on growth and some physiological characterizes in carrot plant (*Daucus Carota* L.). Pure and Appl Sci 24 : 148—152.
9. Mukhtar FB (2004) Differential growth responses of photoperiod-sensitive and photoperiod-insensitive cowpea varieties to planting season and gibberellic acid treatment. Best J 1 : 73—78.