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# Effect of plant growth regulators on yield parameters, yield and quality of black pepper (*Piper nigrum* L.) variety Panniyur - 1

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**Abstract**

Experiments conducted at Horticultural College and Research Institute, Periyakulam and Horticultural Research Station, Thadiankudisai (TNAU) to study the effect of different plant growth regulators (NAA, $GA_3$, BA and 2,4-D) indicated that spraying NAA (50 ppm) has improved many commercially desirable parameters like number of berries per spike, volume and weight of berries and yield in black pepper (*Piper nigrum* L.). Benefit cost ratio, however, was the highest in the treatment 2,4-D (10 ppm). The high cost of chemicals outweighed the yield except in the case of 2,4-D.

**Key words:** 2,4-D, benzyl adenine, black pepper, crop yield, gibberellic acid, NAA, *Piper nigrum*, yield components.

**Abbreviations:** NAA - Naphthalene Acetic Acid; GA - Gibberellic Acid; BA – Benzyl Adenine; 2,4-D - 2, 4-Dichloro phenoxy acetic acid

Black pepper, the 'king of spices' is the most ancient spice crop cultivated in India and has probably originated in the hills of the South Western Ghats of India. In India, it is cultivated in an area of 2.0 lakh ha with the production of 55,370 tonnes. The global demand is increasing sharply and is estimated to reach 1.85 lakh tonnes by 2005 (Peter 1998).

Plant growth regulators are organic compounds, which modify or regulate physiological processes in plants in appreciable measures when used in low concentrations. They are also known as 'magic chemicals' as they can exert miracle in the growth, development and yield of crop plants. Spike shedding is a disorder which threatens cultivation of black pepper. Factors such as climate, nutritional imbalance, pests, diseases etc. may intensify spike shedding. These factors may create a physiological imbalance within the plant, leading to shedding of spikes that adversely affects the productivity of the vines. Hence an investigation was carried out with different plant growth regulators to enhance the productivity of pepper vines.

An experiment was laid out at Horticultural College and Research Institute, Periyakulam and Horticultural Research Station Thadiankudisai (TNAU), using four growth regulators namely, NAA (50, 100 & 150 ppm), $GA_3$ (50, 100 & 150 ppm), BA (25, 50 & 75 ppm) and 2,4-D (5, 10 & 15 ppm) in a randomized block design with five replications. The control vines were sprayed with water. The number of vines per treatment was five. The growth regulators were applied as foliar spray twice, first during flowering and again 45 days later. The experiment was undertaken during 1998 and 1999. Observations were recorded on spike length, number of undeveloped and developed berries, total number of berries, percentage of berry set, diameter of berry, volume and weig-ht of 1000 green berries, yield of green berries per vine, oleoresin and piperine content (Table 1). Benefit-cost ratio was also worked out.

The highest spike length (20.30 cm) was recorded in $GA_3$ 150 ppm, which was on par with $GA_3$ 50 and $GA_3$ 100 ppm. The enhancement of spike length with $GA_3$ application might be due to the internodal elongation caused by cell enlargement, which could possibly be due to the increase in cell wall plasticity by $GA_3$ (Singh & Rajput 1991). The lowest number of undeveloped berries was recorded in NAA 50 ppm, which also recorded the highest number of developed berries and total number of berries per spike. This might have been due to the increase in endogenous level of auxin resulting in increased berry retention. The percentage of berry set was the highest in NAA 150 ppm. However, NAA 50 ppm can be considered better than NAA 150 ppm as the total number of berries per spike was more in NAA 50 ppm. This might be due to the reduction in berry drop at low concentrations while at higher concentration, it might have caused berry shedding. It is also reported that higher exogenous level of auxin increases endogenous levels of ethylene and abscisic acid resulting in fruit drop (Leopald 1964).

At higher concentrations of $GA_3$, the percentage of berry set was poor, which might be due to gametocidal effect. Further, $GA_3$ caused thickening and brittleness of pedicels and berries dropped easily from the pedicels. Such effect was also reported by Rana *et al.* (1968) in grapes. Application of BA 50 ppm resulted in higher berry diameter (6.01 mm). The increase in berry diameter might be due to the increased degree of cell division and differentiation of pericarp, the integument and the nucellus of the treated vines (Hariharan & Unnikrishnan 1985).

NAA 50 ppm registered the highest volume (172.30 ml) and weight (181.20 g) of 1000 green berries. Experiments conducted by Sukumarapillai *et al.* (1977) and Geetha & Sivaraman Nair (1990) in black pepper, supported the findings of the present study. The growth regulator treatments showed a significant effect on yield of green berries per vine. The highest yield of 3783.6 g was obtained in NAA (50 ppm). The increased yield can be attributed to the increase in total number of berries per spike, higher volume and weight of berries.

No significant differences among the treatments were observed in respect of oleoresin and piperine contents. NAA 50 ppm however, had the highest oleoresin content (11.40 %) and BA 75 ppm had the highest piperine content (3.99%).

The highest benefit - cost ratio was obtained in 2,4-D 10 ppm (1 : 9.26) followed by 2,4-D 5 and 15 ppm. However, NAA 50 ppm recorded highest yield per vine, which was 12.97 per cent more than 2,4 - D 10 ppm, the ratio become low due to high cost of the chemical. Low cost of 2,4 –D has considerably improved the benefit-cost ratio. If the market price of pepper increases, the high yield obtained with NAA 50 ppm may have economical significance.

In conclusion, among the different growth regulators tried to improve black pepper yield, NAA 50 ppm was better than the other treatments. But in terms of benefit-cost ratio, 2,4-D (10 ppm) was effective.

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Table 1. Effect of plant growth regulators on yield and quality of black pepper variety Panniyur - 1

| Growth regulator (ppm) | Number of berries spike$^{-1}$ UB | DB | TB | Berry set (%) | Berry size (mm) | Spike length (cm) | Volume of 1000 green berries (ml) | Weight of 1000 green berries (g) | Yield of green berries (g plant$^{-1}$) | Oleoresin (%) | Piperine (%) | Benefit-cost ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NAA 50 | 11.9 | 102.0 | 113.9 | 83.60 | 5.87 | 16.55 | 172.3 | 181.2 | 3783.6 | 11.40 | 3.84 | 1:5.68 |
| NAA 100 | 12.1 | 99.2 | 111.3 | 84.00 | 5.82 | 16.46 | 166.4 | 173.4 | 3546.7 | 10.93 | 3.75 | 1:3.69 |
| NAA 150 | 12.7 | 99.2 | 111.9 | 85.42 | 5.79 | 15.72 | 163.7 | 169.6 | 3503.6 | 11.04 | 3.81 | 1:2.74 |
| $GA_3$ 50 | 14.6 | 78.4 | 93.0 | 73.00 | 5.21 | 19.20 | 131.4 | 136.6 | 3398.6 | 9.94 | 3.66 | 1:2.84 |
| $GA_3$ 100 | 14.0 | 78.0 | 92.0 | 71.54 | 5.18 | 19.40 | 129.6 | 134.3 | 3386.7 | 9.82 | 3.49 | 1:1.69 |
| $GA_3$ 150 | 14.3 | 75.1 | 89.4 | 68.67 | 5.19 | 20.30 | 126.4 | 131.1 | 3409.9 | 10.03 | 3.50 | 1:1.20 |
| BA 25 | 11.9 | 92.0 | 103.9 | 77.44 | 5.93 | 16.54 | 155.4 | 161.3 | 3446.7 | 11.30 | 3.90 | 1:3.04 |
| BA 50 | 12.4 | 89.8 | 102.2 | 78.32 | 6.01 | 16.25 | 159.4 | 163.4 | 3466.4 | 10.95 | 3.87 | 1:1.78 |
| BA 75 | 12.8 | 89.6 | 102.4 | 78.29 | 5.83 | 16.20 | 159.9 | 164.2 | 3499.4 | 11.15 | 3.99 | 1:1.28 |
| 2,4-D 5 | 12.0 | 94.7 | 106.7 | 81.27 | 5.53 | 15.44 | 166.2 | 172.5 | 3516.9 | 9.43 | 3.49 | 1:9.10 |
| 2,4-D 10 | 12.3 | 93.9 | 106.2 | 81.14 | 5.55 | 16.34 | 160.7 | 168.6 | 3566.8 | 9.83 | 3.30 | 1:9.26 |
| 2,4-D 15 | 12.4 | 91.5 | 103.9 | 80.05 | 5.52 | 16.03 | 161.6 | 164.3 | 3500.4 | 9.54 | 3.42 | 1:9.09 |
| Control | 14.9 | 64.5 | 79.4 | 63.62 | 4.90 | 14.18 | 118.3 | 123.6 | 3356.6 | 10.03 | 3.54 | 1:8.90 |
| SE(d) | 1.09 | 7.57 | 6.39 | 4.88 | 0.194 | 0.86 | 10.93 | 11.56 | 87.93 | — | — | — |
| CD at 5% | 2.20 | 15.24 | 12.87 | 9.83 | 0.390 | 1.73 | 21.99 | 23.24 | 176.82 | NS | NS | — |

UB- Undeveloped berries ; DB- Developed berries; TB- Total number of berries

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