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# Influence of plant growth regulators on yield and economics of cultivation of Kalmegh (*Andrographis paniculata* Nees.)

**Sowmya Kumari and Umesha K**

**Abstract**
Kalmegh (*Andrographis paniculata* Nees.) is an annual herb know as king of bitter has high value compound used in the treatment of the various diseases. An investigation undertaken to know the growth regulators influence on the yield of the crops and economics of cultivation also workedout. Among the 10 treatment, 3 different growth regulators used at different concentration to identify the best growth regulators to maximize the yield of kalmegh. Foliar spray of NAA at 50 ppm significantly increased the dry yield and drying percentage of kalmegh (3662 kg/ha and 54.5%). The maximum net return and highest B:C ratio (1,67,307 Rs/ha and 3.19) was also obtained with NAA at 50 ppm treatment.

**Keywords:** *Andrographis paniculata* Nees. Plant growth regulators

## Introduction
Plants have been one of the important sources of medicines even since the dawn of human civilization. In spite of tremendous developments in the field of allopathy during the 20th century, plants still remain as one of the major sources of drugs in modern as well as traditional systems of medicine throughout the world. Approximately one third of all pharmaceuticals are of plant origin. The plants have been used for relieving suffering and curing ailments. Among these medicinal plants, kalmegh is getting importance in present day due to its medicinal and curative properties (Farooqi and Sreeramu, 2010) [3].

*Andrographis paniculata* Nees (Family- Acanthaceae) (English name-King of Bitters, Tamil name-Nilavempu) is an annual herbaceous plant and is extensively cultivated in Southern Asia, China and some parts of Europe. It is also known as Kalmegh or "King of Bitters" because of bitterness of plant. It is an herbaceous, erect growing, branched annual plant grow to a height of 30-110 cm in moist places with quadrangular stem. Leaves are simple, lanceolate, glabrous, opposite 2-12cm long. Inflorescence is 10-30 mm long, terminal and axillary panicle. The upper lip of flower is oblong, white with yellowish top, lower lip broadly cunneate, 3-lobed, white with violet markings; stamens 2, ovary is superior. Capsule of the plant is erect, 1-2 cm long and 2-5 mm wide, longitudinally furrowed on broad faces, acute at both ends. Seeds are very small, sub quadrate (Ankita and Handique, 2010) [1].

Whole part of the plant like leaves, stem and roots are used in different medicine. Four lactones, viz. deoxyandrographolide, andrographolide, neo andrographolide and deoxy didehydro andrographolide were found in *Andrographis paniculata* (Sangalungkarn *et al*., 1990) [8]. Kalmegh is used in 26 Ayurvedic formulations as evidenced from Indian Pharmacopoeia; while, in Chinese Medicine it is an important "cold property" herb and is used to release body heat in fever, prevent common cold, and dispel toxins from the body, upper respiratory tract infections including sinusitis and fever. It is well known for different the rapatic property viz., curing liver disorders, common cough and colds in human, respiratory tract infections, for asthma, loss of scalp hair, immune stimulant, gonorrhea, piles, dysentery, diarrhea, dyspepsia, curing liver disorders, blood purification, influenza, gastric complaints and as an antidote against poisons of snakes and insects. This is also possesses anti diabetes, anti-jaundice, anti-inflammatory anti-ulcer genic, anti-typhoid, anti HIV, and antimalarial, antifertility, anticancer, anti-hyperglycaemic, antibacterial and antiviral properties. (Joseph and Solomon, 2014, Ghosh *et al*., 2012) [4, 6].

Kalmegh has huge demand because of its pharmacological properties. Natural resource get declined because of indiscriminate collection of kalmegh from forest area.

There is more scope for the cultivation of the crop. Use of plant growth regulators has brought revolution in horticulture industry. Plant growth regulators that overcome the factors which limiting the plant growth and help to grow plant vigorously by this it increases the yield of the crop. In kalmegh major economic part of the plant is leaves. Growth regulators directly influence on the vegetative growth of the plant. Foliar application of the growth regulators directly enter plant and it help to increase the yield of the kalmegh.
So to know the potential of the plant harmone like NAA, $GA_3$ and Paclobutrazol the present study was undertaken with the objective to maximize yield and find out the benefit-cost ratio of kalmegh. It also helped to find out the concentration of the plant harmone which increase the yield. Further, study was taken for higher production at lower cost.

**Material and Methods**
The study was done in the Department of Plantation, Spice, Medicinal and Aromatic crops, College of Horticulture, Bengaluru. The field was divided into plot of 2.4 x 2 m size. The field experiment was laid out in to Randomized Complete Block Design (RCBD) with ten treatments and three replication. Land is ploughed well made into fine tilth, during the last plough recommended dose of FYM and fertilizers are applied to the soil i.e. 25 t/ha of FYM and 75:75:50 kg NPK/ ha. In this full dose of phosphrous and potash along with half dose of nitrogen applied as basal dose and remaining half dose applied 30 days after transplanting. The local variety seedlings are raised in nursery bed. Healthy and uniform height seedlings of 45 days old with 4-5 leaves are transplanted in the main field at a spacing of 30 cm between row and 20 cm between plants. Three growth regulators namely naphthalene acetic acid, gibberellic acid and paclobutrazol were used for the trail. The details of the treatment combination as below

$T_1$-Control
$T_2$-NAA 40 ppm
$T_3$-NAA 50 ppm
$T_4$-NAA 60 ppm
$T_5$-$GA_3$ 25 ppm
$T_6$-$GA_3$ 50 ppm
$T_7$-$GA_3$ 100 ppm
$T_8$-Paclobutrazol 100 ppm
$T_9$-Paclobutrazol 150 ppm
$T_{10}$-Paclobutrazol 200 ppm

All the growth regulators are given through foliar spray at 30 days after transplanting and second spray was taken 30 days after harvesting of main crop. All the cultural operation was taken place as per the package of practice. Data was recorded on all the aspect of the crop. Fresh weight of the crop was recorded immediately after harvest from main and ratoon crops. Herbage was dried at $60^0$ C and dry weight of the main and ratoon crops were recorded. Drying percentage was calculated by dividing the total dry weight of plant by respective total fresh weight of plant and multiplied by 100 and expressed as percentage. Economics of cultivation was calculated.

**Result and Discussion**
The data on yield parameter is represented in the table 1. The fresh herbage yield was recored after harvesting of main as well as ratoon crop. The herbage yield is significantly influenced by the spraying of growth regulators. The maximum fresh herbage yield and dry herbage yield of 8105 kg/ha and 3662 kg/ ha was obtained by spraying $GA_3$ at 100 ppm and NAA 50 ppm. Highest drying percentage (on shade dry basis) of 54.5 obtained by spraying NAA 50 ppm. The difference in the yield parameter is mainly due to the interaction between season and growth regulators. Increase in the yield mainly due to the fact that the growth regulators increase the number of leaves production which results in the production and accumulation of more photosynthates. The report from the Channakesava *et al.* (2007) [2]. indicated that yield obtained from the control showed significantly lower yields than growth regulator spray which indirectly increase the morphological, physiological and growth parameters of the plants.

**Economics:** Variation in cost of cultivation is due to difference in the price of chemicals used. Maximum expenditure (Rs. 65,697 per ha) has been incurred due to the use of paclobutrazol at 200 ppm due its higher price and higher concentration of the chemical used. Maximum gross returns of Rs. 2,19,720 per ha was realised from the crop sprayed with NAA at 50 ppm which is due to highest cumulative dry herb yield obtained from two crops of kalmegh. The net returns, was maximum from the crop applied with NAA at 50 ppm (Rs. 1,67,307 per ha) which can be attributed to highest cumulative dry herb yield, higher gross returns, lower concentration and lower price of the chemical. Whereas, $GA_3$ application at 50 ppm resulted in lowest net returns (Rs. 57,207 per ha) owing to lowest cumulative dry herb yield coupled with higher price of the chemical as compare to control. Similar results have been recorded by Shivran and Jat (2013) [9]. in cumin and Godara *et al.* (2013) in fenugreek.
With regard to B: C ratio, the maximum returns per rupee invested was from NAA at 50 ppm (3.19) spray which is clearly due to higher gross returns and lower expenditure incurred in imposing the treatment in kalmegh. The B:C ratio indicating the returns per rupee invested was least from kalmegh crop applied with $GA_3$ at 50 ppm (1.02) due to lowest dry herb yield, yielding minimum gross returns and high price of chemical adding to the cost of cultivation as compared to other treatments tried during the course of present investigation. Similar observations have been made by Ruchita *et al.* (2009) [7]. and Gour *et al.* (2010) [5]. in fenugreek, Shivran and Jat (2013) [9]. in cumin, Singh *et al.* (2012) [11]. in coriander.

**Table 1:** Fresh and dry herb yield (kg/ha) of kalmegh as influenced by growth regulators

| Treatments | Fresh herb yield of main and ratoon crop | Dry herb yield of main and ratoon crop | Drying percentage (on shade dry basis) |
|---|---|---|---|
| Control | 4924 | 2171 | 44.1 |
| NAA 40 ppm | 5760 | 2824 | 49.1 |
| NAA 50 ppm | 6728 | 3662 | 54.5 |
| NAA 60 ppm | 5592 | 2081 | 37.2 |
| $GA_3$ 25 ppm | 6285 | 2487 | 39.5 |
| $GA_3$ 50 ppm | 5673 | 1890 | 33.4 |
| $GA_3$ 100 ppm | 8105 | 3248 | 40.1 |
| Paclobutrazol100 ppm | 6391 | 2529 | 39.7 |
| Paclobutrazol150 ppm | 5277 | 2496 | 47.4 |
| Paclobutrazol200ppm | 5262 | 2569 | 48.8 |
| Mean | 5999 | 2596 | 43.4 |
| S.Em ± | 120 | 83 | 1.6 |
| CD at 5% | 361 | 248 | 5.0 |

**Table 2:** Economics of cultivation of kalmegh under Bangalore condition as influenced by growth regulators

| Treatments | Cost of cultivation (Rs. ha$^{-1}$) | Gross returns (Rs. ha$^{-1}$) | Net returns (Rs. ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|
| Control | 51873 | 1,30,260 | 78,387 | 1.51 |
| NAA 40 ppm | 52305 | 1,69,440 | 1,17,135 | 2.24 |
| NAA 50 ppm | 52413 | 2,19,720 | 1,67,307 | 3.19 |
| NAA 60 ppm | 52521 | 1,24,860 | 72,339 | 1.38 |
| $GA_3$ 25 ppm | 54033 | 1,49,220 | 95,187 | 1.76 |
| $GA_3$ 50 ppm | 56193 | 1,13,400 | 57,207 | 1.02 |
| $GA_3$ 100 ppm | 60513 | 1,94,880 | 1,34,367 | 2.22 |
| Paclobutrazol 100 ppm | 58785 | 1,51,740 | 92,955 | 1.58 |
| Paclobutrazol 150 ppm | 62241 | 1,49,760 | 87,519 | 1.41 |
| Paclobutrazol 200 ppm | 65697 | 1,54,140 | 88,443 | 1.35 |

## Conclusion

Based on the above discussion, it can be concluded that the plant growth regulators has significant effect on yield of kalmegh. It increases the yield of both main and ratoon crops and also highest B: C ratio obtained by spraying of this growth regulator.

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