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# Role of plant growth hormones on economic yield, andrographolide and active ingredient content in Kalmegh (*Andrographis peniculata* Burn F. Ex)

**Raidas DK, Upadhayaya SD, Sharma A and Choudhary AK**

**Abstract**
Kalmegh is known as green Chiretta or King of bitters. Investigations undertaken aiming to increase the growth and yield traits and biochemical constitute of Kalmegh. The investigations were carried out at the Farmer field, Village Badiyakhedi, District Sehore, (Madhya Pradesh) during Kharif season 2015-16 to study the influence of plant growth hormones viz., Cycocel (100, 150 and 200ppm), $GA_3$ (100, 150 and 200ppm), NAA (100, 150ppm) and control (water sprayed) at different concentrations on morpho-physiological traits and economic yield of Kalmegh (*Andrographis peniculata* Burn F. Ex) exhibited maximum plant height, number of branches, fresh weight of leaves, dry weight of leaves, fresh weight of plant, dry weight of plant, chlorophyll content, photosynthesis rate, $CO_2$ and $H_2O$ utilization, seed yield, dry herbage yield, andrographolide and active ingredient content. Significantly higher Seed yield (621.78 Kg/ha), dry herbage yield (46.61 q/ha), andrographolide (2.59%) and active ingredient content (105.66 Kg/ha) was obtained by treated with $GA_3$ @100ppm as compare to other treatments at harvest.

**Keywords:** Growth hormones, GA3, ppm, andrographolide, harbage yield, active ingredient

## Introduction
Kalmegh (*Andrographis peniculata* Burn F. Ex) is a genus of herbs and shrubs, distributed mostly in the tropical and moist regions. It comprises of about 19 plant species found in India and Sri Lanka, certain parts of Thailand and Bangladesh. In India it is grown in Assam, Bihar, Karnataka, Karla, Madhya Pradesh, Andhra Pradesh and West Bengal. Kalmegh, also known as "King of bitter" is one among the prioritized medicinal plants in India, and this herb is being used mainly for treating fever, liver disease, diabetes, snake bite etc. The leaf and the whole herb contain the medicinal properties and is useful in treatment of diabetes, influenza, bronchitis, hepatomegaly, skin disorder and many such diseases (Patra *et al.* 2004) [8]. The plant contains Andrographolides, neo-Andrographolides, Deoxy-Andrographolides. The leaves of Kalmegh contain maximum active principle Andrographolides, Homo-Andrographolides, Andrographesterol and Andrographone. Andrographolides the major constituent in leaves which is bitter substance. The leaves contain much more of Andrographolides then seed The average Andrographolides content varied from 12.44 to 33.52 mg/g in dried leaves which is found maximum at 90-120 days. Andrographolides is colorless, bitter crystalline compound. The term plant growth regulators however applied in phyto hormone as well as synthetic compound (Nickell, 1978) [6]. Plant growth regulators are organic compound, other than nutrients, that modify plant physiology processes. Plant growth regulator called bio stimulants or bio inhibitors, act side plant cell to stimulate or inhibit specific enzyme or enzyme system and help regulate plant metabolism. They are normally active at very low concentration in plant. The specific plant growth hormones are used to modify crop growth rate and pattern during the various stages of development, from germination to harvest and post harvest preservation. Growth hormone chemicals that have positive influences on major medicinal plant can be of value for higher economic yield and quality of medicinal content.

## Material and Methods
The experiment was conducted at Farmer field, Village Badiyakhedi, District Sehore, (Madhya Pradesh) during Kharif season 2015-16. Nine treatments (Cycocyl @100, 150 and 200ppm), (Gibberellic acid @100, 150 and 200ppm), (NAA @100 and 150ppm) and control (water spray). Treatments were evaluated in RBD with three replications. The seeds were sown on June 15th, 2015 and in nursery beds in lines of 10 cm apart and 1 cm deep and covered with fine sand. Seed germination was noticed after 7 days of sowing which continued till another week. A seed rate of 400 g per hectare was used. After sowing the seeds in the nursery, watering was applied daily by using rose can.

Frequent weeding was done to keep the nursery free from weeds. The 30 days old seedlings were transplanted in the main field. The transplanting of seedlings, planting holes were made at 30×15 cm apart and one seedling was planted at each site. Seedlings were transplanted in the main field on July 15th, 2015. The crop was raised as per recommended package of practices and the plant growth hormones were sprayed in three stages viz., 20, 40 and 60 DAT. The primary observations of plant height, branches per plant, fresh weight of leaves per plant (g), dry weight of leaves per plant (g), fresh weight of plant (g), dry weight of plant (g), Chlorophyll index (SPAD), leaf area ($cm^2$ $plant^{-1}$), photosynthesis rate (µmol $m^{-2}$ $s^{-1}$), stomatal conductance (mmol $m^{-2}s^{-1}$), transpiration rate (mmol $m^{-2}s^{-1}$), $CO_2$ utilization (ppm) and $H_2O$ utilization (Kpa) at 30, 50, 70 and 90 DAT and yield parameter viz., number of seeds pod $^{-1}$, 1000-seed weight (g), pod weight (g $plant^{-1}$) seed yield (g $plant^{-1}$), seed yield (Kg $ha^{-1}$), herbage yield (g $plant^{-1}$), herbage yield (Kg $ha^{-1}$), and dry herbage yield (Kg $ha^{-1}$), andrographolide content (%) and active ingredient content (Kg $ha^{-1}$) at harvest. Finally mean data of the all characters were computed for statistical analysis as per standard procedure given by (Panse and Sukhtme, 1989) [7].

## Results and Discussions

### Seed yield (g) plant$^{-1}$ and seed yield (Kg ha$^{-1}$)

The present investigation revealed high significant variations existed among the impact of growth hormones on seed yield (g) $plant^{-1}$ and seed yield (Kg $ha^{-1}$) during the year presented in (Table-1 and Fig.1). The maximum seed yield (g) $plant^{-1}$ and seed yield (Kg $ha^{-1}$) of Kalmegh was obtained by sprays with $GA_3$ @100ppm (37.45 and 621.78) at harvest closely followed by Cycocel@ 100ppm (31.69 and 582.05) and Cycocel @ 150ppm (28.64, 560.46) with mean value of (23.82 and 494.76). Although it recorded the lowest value for control (14.20 and 380.62). The highest seed yield associated with the $GA_3$ application is due to accelerated photo-assimilate supply source to sink, which is in agreement with the results of (Gouping and Etmal (1992) [1]. Exogenous application of $GA_3$ evoke the intrinsic genetic potential of the plant causing increase in elongation of internodes as a consequence of cell division and cell wall extensibility (Moore, 1989). This is in close conformity with the findings of (Masroor *et al.*2014) [4] medicinal plant in fennel.

### Herbage yield (g) plant$^{-1}$, herbage yield and dry herbage yield (q ha$^{-1}$)

The present investigation revealed high significant variations existed among the impact of growth hormones on herbage yield (g) $plant^{-1}$, herbage yield ($qha^{-1}$) and dry herbage yield ($qha^{-1}$) during the year presented in (Table-1 and Fig.1). The maximum herbage yield (g) $plant^{-1}$, herbage yield (q $ha^{-1}$) and dry herbage yield (q $ha^{-1}$) of plant was attained by sprays with $GA_3$ @100ppm (73.17, 76.61 and 46.61) at harvest at par Cycocel@100ppm (68.05, 74.66 and 44.66) closely followed by Cycocel@150ppm (64.11, 70.35 and 42.68) and $GA_3$ @ 200ppm (57.17, 67.25 and 40.25) with mean value of (53.16, 64.08 and 38.64). While it recorded the lowest magnitude for control (34.56, 48.08 and 28.75). With regard to herbage and dry herbage yield in plant, application of $GA_3$ @100ppm proved superior than other treatments. However, it contributes towards enhancing the capacity of the treated plants increase biomass production as reflected in shoot and root dry mass of the plants. This enhancement could be the result of increased uptake of nutrients, enhanced chlorophyll content, photosynthesis rate and improved translocation of photo-assimilate source to sink part of plant and other metabolites ultimately increase biomass of plant (Miniraj and Shanmugavelu, 1987) [5]. The results are in accordance with the findings of (Panda *et al.*, 2007) in kalmegh, (Hassanpouraghdam *et al.*, 2011) [3] in lavender and (Singh *et al.*, 2012) [11] in coriander.

### Andrographolide (%) and active ingredient content (Kg ha$^{-1}$)

The present investigation revealed high significant variations existed among the impact of growth hormones at different concentration on andrographolide (%) and active ingredient content (Kg $ha^{-1}$) of plant in leaf at harvest during the year presented in (Table-1 and Fig.1). The application of $GA_3$@ 100ppm recorded maximumt andrographolide and active ingredient content (2.59 and 105.66) in leaves of plant as compare to other treatments and was found at par the application of Cycocel @100ppm (2.56 and 98.66) and followed by Cycocel@150ppm (2.47 and 91.54) and $GA_3$@150ppm (2.43 and 85.63) was recorded as compare to control (2.22 and 65.75) with mean value of (2.39 and 83.75) respectively. Andrographolide is an important biochemical constitute used for debility, fever, jaundice and skin diseases (Rawat and Vasistha, 2011) [9]. The andrographolide accumulated in plant leaves and the result revealed that the alkaloid content varied growth stage significantly a pattern of progressive increase in andrographolide content fresh as well as dry leaves was noted with increase in crop age. Minimum content of andrographolide was estimated at 30 DAT and maximum at 120 DAT. This result was accordance with several workers like Gowda and Krishnan, (1992) [2] and Savita Borse and Dhumal, (2001) [10] in medicinal *Solanum viarum* and Zenu *et al.* (2011) [12] in kalmegh plants (*Andrographis paniculata)* also support the present findings.

**Table 1:** Impact of growth hormones on seed yield (g) $plant^{-1}$, seed yield (Kg $ha^{-1}$) herbage yield (g) $plant^{-1}$, herbage yield (q $ha^{-1}$), dry herbage yield (q $ha^{1}$), andrographolide (%) and active ingredient content (Kg $ha^{-1}$) in Kalmegh at harvest

| Treatments symbols | Seed yield (g) plant$^{-1}$ | Seed yield (K ha$^{1}$) | Herbage yield (g) plant$^{-1}$ | Herbage yield (q ha$^{1}$) | Dry herbage yield (q ha$^{1}$) | Andrographolide (%) | Active ingredient content (Kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| $T_1$ | 31.69 | 582.05 | 68.05 | 74.66 | 44.66 | 2.56 | 98.66 |
| $T_2$ | 28.64 | 560.46 | 64.11 | 70.35 | 42.68 | 2.47 | 91.54 |
| $T_3$ | 16.15 | 411.61 | 37.70 | 55.22 | 33.88 | 2.26 | 70.33 |
| $T_4$ | 37.45 | 621.78 | 73.17 | 76.61 | 46.61 | 2.59 | 105.66 |
| $T_5$ | 26.14 | 532.05 | 57.17 | 67.25 | 40.25 | 2.43 | 85.63 |
| $T_6$ | 19.58 | 455.62 | 47.35 | 61.26 | 36.59 | 2.34 | 79.81 |
| $T_7$ | 16.84 | 428.81 | 44.82 | 57.80 | 35.47 | 2.30 | 74.37 |
| $T_8$ | 23.69 | 479.85 | 51.58 | 65.54 | 38.87 | 2.40 | 82.53 |
| $T_9$ | 14.20 | 380.62 | 34.56 | 48.08 | 28.75 | 2.22 | 65.27 |
| Mean | 23.82 | 494.76 | 53.16 | 64.08 | 38.64 | 2.39 | 83.75 |
| S.Em ± | 0.92 | 7.47 | 0.87 | 0.74 | 0.58 | 0.02 | 1.60 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CD at 5% | 2.77 | 22.40 | 2.60 | 2.21 | 1.75 | 0.03 | 4.81 |

Treatments, $T_1$ = Cycocel @100ppm, $T_2$ = Cycocel @150ppm, $T_3$ = Cycocel@200ppm, $T_4$ =$GA_3$ @100ppm, $T_6$ = $GA_3$@150ppm, $T_7$ = $GA_3$@200ppm, $T_8$ = NAA@100ppm, $T_9$ = NAA@150ppm, $T_9$ = Control (water spray)

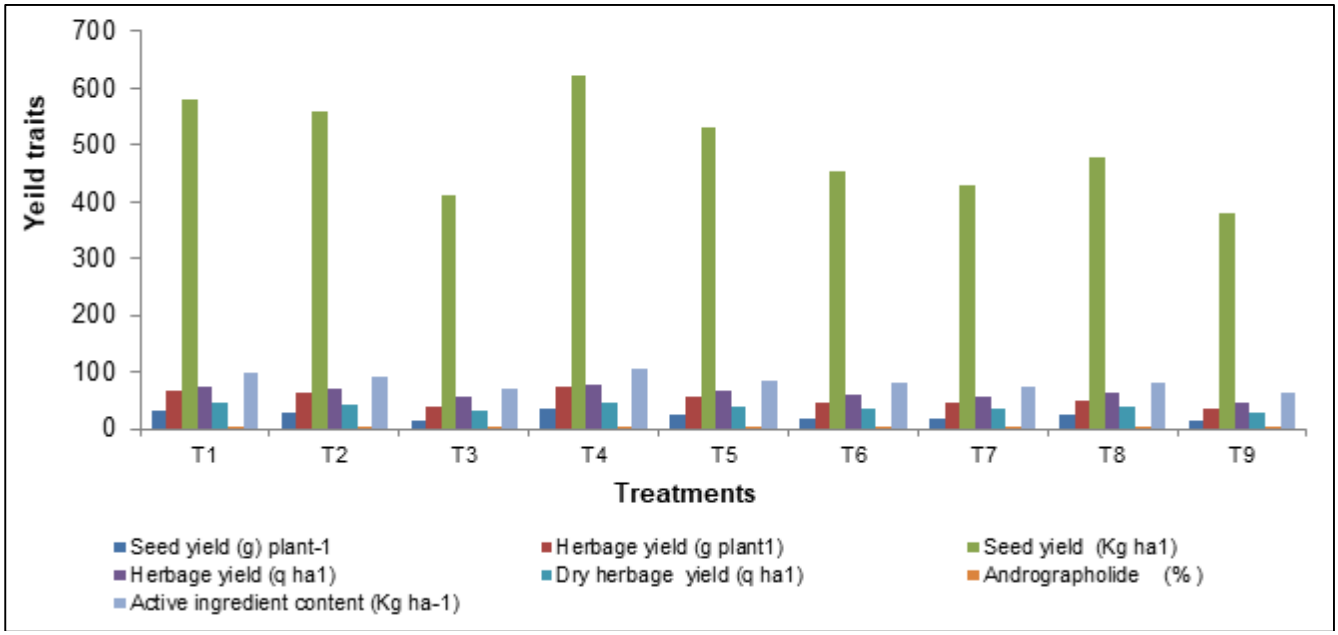


**Fig 1:** Impact of growth hormones on seed yield (g) plant$^{-1}$, seed yield (q ha$^{-1}$) herbage yield (g) plant$^{-1}$, herbage yield (q ha$^{-1}$), dry herbage yield (q ha1), andrographolide (%) and active ingredient content (Kg ha$^{-1}$) in Kalmegh at harvest

## Conclusion

It may be concluded from the present investigation tha plant hormone especially $GA_3$ @100ppm was able to enhance the different yield attributing traits and seed yield, herbage yield, dry herbage yield, alkaloid and active ingredient content was significantly differed from other treatments to be better partitioning and efficient translocation of photo-assimilates towards the economic sink, To realize ultimately maximum profit correlated with seed yield, dry herbage yield, alkaloid and active ingredient content of Kalmegh.

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