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Influence of different plant growth hormones on morpho-physiological attributing characteristics in Kalmegh (Andrographis paniculata Burn F. Ex)

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ABSTRACT

Andrographis paniculata, commonly known as Kalmegh, is used both in Ayurvedic and Unani system of medicines because of its immunological, antibacterial and hepatoprotective properties. It is an annual herb has a high-value compound used in the treatment of various diseases. A field experiment was conducted at the research farm of RAK College of Agriculture, Sehore (Madhya Pradesh) during Kharif 2015-16 and 2016-17. Investigations were undertaken to aim to increase the growth and yield parameters of Kalmegh. Using different Plant Growth Hormones Cycocel (100, 150 and 200ppm), GA3 (100, 150 and 200ppm) and NAA (100 and 150ppm) and water spray as control to study the effect of plant growth hormones on Growth viz plant height (cm), leaf area (cm2), chlorophyll content (SPAD), photosynthesis rate (µmol CO2 m⁻ ² s-¬¹) at 90 DAS and yield viz test weight (g), seed yield (kg ha-1), herbage yield(q ha-1) and leaf alkaloid content (%) of kalmegh at harvesting. The foliar spray of GA3 @ 150ppm, GA3 @ 100ppm, Cycocel @100ppm and GA3 100ppm significantly maximum plant height (47.33), leaf area (420.82), chlorophyll content (57.78) photosynthesis rate (24.78) during 2015-16 and spray with GA3 @ 100 ppm, applies the maximum plant height (46.20), leaf area (426.41) and photosynthesis rate (22.88) significantly differed from other treatments during 2016-17 respectively. The average plant height, chlorophyll content and photosynthesis rate were higher during 2015-16 (39.57), (51.01) and (22.75) than 2016-17 (39.41), (46.71) and (21.07) except leaf area.

Keywords— *Cycocel, GA3, NAA spray, PPM, Photosynthesis rate, Chlorophyll content*

1. INTRODUCTION

Kalmegh (*Andrographis paniculata* Burn F. Ex) important medicinal plant belonging to the family Acanthaceae. Which is indigenous to India and has been used in Indian systems of medicines since time immemorial. The plant is also known as Rice bitters in West Indies and the king of bitters or Chiretta in England. It is an erect or recumbent, annual herbaceous plant. The branches are quadrangular, leaves simple petiolate, lanceolate with acute base and apex. Flowers are small, solitary and panicles with externally hairy rose or purple colored corolla, calyx-lobes glandular, pubescent, anther bearded at the base, fruits 20 mm long linear-oblong capsules acute at both ends. Seeds are numerous (i.e. containing 8-12 seeds per plant) yellowish-brown. 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. The 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). 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 and prevent the common cold. This also possesses anti diabetes, anti-jaundice, anti-inflammatory anti-ulcer genic, anti-typhoid, anti HIV, and antimalarial, antifertility, anticancer, and antiviral properties. (Joseph and Solomon, 2014). 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 the plant and it helps to increase the growth and yield of the kalmegh. So to know the potential of the plant hormones like Cycocel, GA_3, and NAA the present study was undertaken with the objective to maximize growth and yield of kalmegh. It also helped to find out the different concentration of the plant hormone which increases the yield. Further, the study was taken for higher production at a lower cost.

2. MATERIALS AND METHODS

This study was conducted at A field experiment was carried out in the research farm of RAK College of Agriculture, Sehore (Madhya Pradesh) during *Kharif* (2015-16 and 2016-17). There were eight treatments Cycocyl @100, 150 and 200ppm, GA_3 @100, 150 and 200ppm and NAA@100 and 150ppm and the water being the control. This study was done on the base of a randomized complete block design. The treatment was replicated 3 times. The plant growth regulators were sprayed in three stages viz seedling stage, vegetative stages, and reproductive stage. The local kalmegh variety seeds were sown in the main field at 30 x 15 cm spacing. The whole plot was divided into 3 blocks each representing the replication. Each block was then divided into the unit plot of 2 x 3 m size. The experiment plot fertilized with urea, single super phosphate and murate of potash @ of NPK 75 kg, 75 kg and 50 kg ha^{-1} respectively. All the operations are done regularly during the growing season. The growth and yield parameter observations were recorded at 90 DAS on five randomly selected plants from every treatment. The collected data include plant height, Leaf area will be determined by leaf area meter with conveyer attachment, chlorophyll content will be determined by using Minolata SPAD 502 plus Chlorophyll. The instrument measuring the relative amount of chlorophyll present in plant leaves in a unit of SPAD (Soil Plant Analysis Development). Photosynthesis rate using IRGA (Licor instruments, the USA as per method). Finally, mean data of all characters were computed for statistical analysis as per standard procedure is given by (Panse and Sukhtme 1989).

3. RESULTS AND DISCUSSIONS

3.1 Morpho-physiological Characteristics

3.1.1 Plant height (cm): The data on plant height per plant (cm) at 90 days as influenced by different plant growth hormones at harvesting was recorded during both the years and pooled data are presented in (Table -1). The impact of different concentration of plant growth hormones was significant of the crop on plant height on both the year and pooled analysis. The average plant height was higher during 2015-16 (39.57) than 2016-17 (39.41). The maximum plant height significantly during 2015-16 found was spray with GA_3 150ppm (47.33) and it was at par with all other treatments due to applying with GA_3 induces cell division, cell elongation, cell expansion, auxin metabolism, increase membrane permeability, photosynthesis, flowering in plants, stimulating rapid stem growth. Closely followed by spray with NAA @ 100ppm (44.68), GA_3 @ 200ppm (44.63) and GA3 @ 100ppm (43.93) as compare to control (34.74) respectively. Similar results reported on the medicinal plant *(Gloriosa Superba L.)* by K. Kannabiran and Padmanaban (2016). During 2016-17 significantly maximum plant height was recorded spray with GA_3 @100ppm (48.47) which was at par with all the treatments except spray with Cycocel @ 200ppm (31.19). Closely followed by spray with NAA @100ppm (43.30) and GA_3 @150ppm (42.32) respectively.

3.1.2 Leaf area (cm^2): The data on leaf area per plant at 90 days was recorded during both the years and pooled data are presented in (Table -1). The impact of different concentration of plant growth hormones was significantly at 90 days of the crop on leaf area (cm^2) per plant in both the year and pooled analysis. The average leaf area per plant was higher during 2016-17 (391.23) than 2015-16 (388.31). The maximum leaf area significantly during 2015-16 found was spray with GA_3 100ppm (420.82) and it was at par with all other treatments. Closely followed by spray with GA_3 @ 150ppm (415.89), GA_3 @ 200ppm (414.60) and NAA @ 100ppm (410.64) as compare to control (351.78) respectively. While leaf area (cm^2) was minimum (354.03) treated with Cycocel @ 200ppm respectively. During 2016-17 significantly maximum leaf area (cm^2) was recorded spray with GA_3 @100 ppm (426.41) which was at par with all the treatments. Closely followed by spray with GA_3 @ 150ppm (422.86), NAA @ 100ppm (413.30) and GA_3 @ 200ppm (411.13) as compare to control (353.50) respectively. While leaf area (cm^2) was minimum (358.14) treated with Cycocel @100ppm (358.14) due to exogenous application of GA_3 evokes the intrinsic genetic potential of the plant to cause increased cell division and cell wall extensibility, thereby resulting in higher leaf area. Similar observations have been made by Srivastava and Srivastava (2007) in medicinal plant of *Catharanthus roseus*.

3.1.3 Chlorophyll content (SPAD): The data on Chlorophyll content was recorded during both the years and pooled data are presented in (Table -1). The impact of different concentration of plant growth hormones was nonsignificant at 90 days of the crop during both the years and pooled analysis. It was observed that there was a continuous increase in the chlorophyll content at vegetative to reproductive stages of crop growth. The average Chlorophyll content was higher during 2015-16 (51.01) than 2016-17(46.71). The maximum chlorophyll content during 2015-16 found was spray with Cycocel 100ppm (57.78) and it was at par with all other treatments. Closely followed by spray with Cycocel @ 200ppm (55.59), Cycocel @ 150ppm (54.26) and NAA @ 100ppm (53.72) respectively. While chlorophyll content was minimum (45.62) treated with NAA @ 150ppm as compare to control (41.78) respectively. The maximum chlorophyll content during 2016-17 found was spray with GA_3 150ppm (49.35) and it was at par with all other treatments. Closely followed by spray with NAA @ 100ppm (49.13) and Cycocel @ 200ppm (48.93). The minimum chlorophyll was noted treated with GA_3 @ 200ppm (42.68) as compared to control (43.19) respectively.

3.1.4 Photosynthesis rate (µmol CO_2 m^{-2} s^{-1}): The data on photosynthesis rate was recorded during both the years and pooled data are presented in (Table -1). The impact of different concentration of plant growth hormones was significant of the crop during both the year and pooled analysis. It was observed that there was a continuous increase in the photosynthesis rate at all the stages of crop growth. Significantly higher Photosynthesis rate was observed during 2015-16 by treatment GA_3 @ 100ppm (24.78) and it was at par with all other treatments. Closely followed by spray with GA_3 @ 150ppm (24.21), Cycocel @ 100ppm (23.40) and NAA @ 100ppm (23.12) respectively. While photosynthesis rate was minimum (21.55) treated with Cycocel @

200ppm as compare to control (19.90) respectively. The maximum photosynthesis rate during 2016-17 found was spray with GA_3 100ppm (22.88) and it was at par with all other treatments. Closely followed by spray with GA_3 @ 150ppm (22.24) and minimum photosynthesis rate observed treated with Cycocel @ 200ppm (19.19) as compared to control (18.91) respectively. The average photosynthesis rate was higher during 2015-16 (22.75) than 2016-17 (21.07).

4. CONCLUSION

From the present investigation, it can be foliar spray of growth hormones on vegetative stages and reproductive stage after seeds sown of kalmegh viz GA_3 @ 150ppm, GA_3 @ 100ppm and Cycocel @100ppm was most effective for realizing significantly maximum plant height leaf area, chlorophyll content and photosynthesis rate during 2015-16 and spray with GA_3 @ 100 ppm, the maximum plant height, leaf area, and photosynthesis rate was significantly differed from other treatments during 2016-17 to realize ultimately maximum profit correlated with herbage yield, alkaloid yield and seed yield of kalmegh.

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Table 1: Impact of Different Plant Growth Hormones on Morpho-physiological characteristics in Kalmegh (*Andrographis paniculata* Burn F. Ex)

Treatments	Plant height (cm) At 90 Days			Leaf area (cm^2 $Plant^{-1}$) At 90 Days			Chlorophyll content (SPAD) At 90 Days			Photosynthesis rate (µmol CO_2 m^{-2} s^{-1}) At 90 Days		
	2015	**2016**	**Pooled**	**2015**	**2016**	**Pooled**	**2015**	**2016**	**Pooled**	**2015**	**2016**	**Pooled**
Cycocel @100 ppm	33.30	35.99	34.64	367.82	358.14	362.98	57.78	46.14	51.96	23.4	21.24	22.32
Cycoce@l 150 ppm	33.42	35.68	34.55	360.73	372.58	366.65	54.26	48.22	51.24	22.78	20.99	21.88
Cycocel @200 ppm	32.92	31.19	32.05	354.03	364.01	359.02	55.59	48.93	52.26	21.55	19.19	20.37
GA_3 @100 ppm	43.93	48.47	46.20	420.82	426.41	423.61	50.8	48.15	49.47	24.78	22.88	23.83
$GA_{3@}$ 150 ppm	47.33	42.32	44.82	415.89	422.86	419.37	52.45	49.35	50.90	24.21	22.24	23.22
GA3 @200 ppm	44.63	41.83	43.23	414.60	411.13	412.86	47.11	42.68	44.89	22.22	20.73	21.47
NAA @100 ppm	44.68	43.30	43.99	410.64	413.30	411.97	53.72	49.13	51.42	23.12	22.06	22.59
NAA @150 ppm	41.20	39.78	40.49	398.50	399.22	398.86	45.62	44.61	45.11	22.83	21.39	22.11
Control	34.74	36.16	35.45	351.78	353.50	352.64	41.78	43.19	42.48	19.9	18.91	19.40
Mean	**39.57**	**39.41**	**39.49**	**388.31**	**391.23**	**389.77**	**51.01**	**46.71**	**48.85**	**22.75**	**21.07**	**21.91**
SE (m) ±	**2.33**	**3.00**	**2.66**	**11.76**	**14.04**	**12.90**	**0.98**	**2.64**	**1.81**	**0.38**	**0.79**	**0.58**
C D at 5%	**7.18**	**8.98**	**8.08**	**35.27**	**42.07**	**38.67**	**NS**	**NS**	**NS**	**1.16**	**2.38**	**1.77**

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