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Effect of Gibberellic Acid on Phenological Behavior of Abelmoschus Moschatus Medik

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ABSTRACT: Phenology is the science of recurring events in nature and is the study of the timing of recurrent, biological events, the causes of their timing with regards to abiotic and biotic factors. Phenological events have been greatly influenced by growth hormones in a number of species. Abelmoschus moschatus Medik. Commonly known as Kasturibhendi (Hindi), Musk mallow (English) belongs to family Malvaceae and is medicinally important oil yielding plant. The phenology of the species is greatly influenced by a number of factors like bio and chemical fertilizers. The present paper deals with the effect of GA3 on phonological behavior of the selected species.

Key words: Abelmoschus Moschatus, Phenology, Gibberellic Acid

ORIGINAL ARTICLE

INTRODUCTIN

India has a rich treasure of medicinal plants due to the diversity of agro-climatic conditions spread over the country from tropical to temperate zones, coastal plains to high attitudes and semi-arid to highly humid evergreen forests, therefore, it is an advantageous position to produce a number of crude drugs.

Although India is a leading exporter of medicinal plants in the world, the rate of growth of these plants in relation to their economic prospects is not at all satisfactory. Medicinal plant sector is facing many constrains. So far, there has been no organized research set up to continually recharge scientific inputs in order to make their cultivation not only economically viable but also more profitable, so that they can claim their due share in the cropping systems of the country (Verma et al., 2007; Balakrishnan et al., 2001).

The seeds of Abelmoschus moschatus have been extensively used in traditional medicine as well as perfume industries. So, in order to get more quantity and better quality of volatile oil from the seeds an attempt has to be made to get better quality seeds by using plant growth regulators (Alakrishnan et al., 2001; Zodape et al., 2008; Kurumkar et al., 2005; Shakila et al., 2008). Abelmoschus moschatus Medik, commonly known as Kasturibhendi (Hindi), Musk mallow (English) belongs to family Malvaceae and is medicinally important oil yielding plant.

The phenology of the species is greatly influenced by a number of factors like bio and chemical fertilizers. So far, no work has been carried out on its growth profile as influenced by plant growth regulators. Hence, the present work was undertaken.

METHODS AND MATERIALS

Selection of plant:

Abelmoschus moschatus Medik, commonly known as Kasturibhendi (Hindi), Musk mallow (English) belongs to family Malvaceae and is medicinally important oil yielding plant commonly grown in some parts of our country in July and harvested in October-November. The plant have short life cycle and so, far no any systematic work was carried out to study the phenological behaviour of the plant as affected by the pre-sowing seed treatment with gibberellic acid, therefore, the plant was selected for present investigation.

Collection and authentication of plant material:

The seeds of the selected plant (Abelmoschus moschatus Medik.) were collected from Jawaharlal Nehru Agriculture University (JNKVV) Jabalpur, Madhya Pradesh and were identified and authenticated by Dr. J. L. Shrivastava, Scientist & Head, Biodiversity and Medicinal Plant, State Forest Research Institute, Jabalpur, (M.P.).

Experimental area:

The present work was carried out at State Forest Research Institute, Jabalpur, (M.P.). The experiment was conducted during July- 2009 to Jan-2010. The material used and the methodology adopted to carry out this

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research, and the periodical observations recorded are being presented.

Soil analysis:

The soils samples were collected from the study sites located in State Forest Research Institute, Jabalpur, (M.P.) and their physical and chemical characters were analyzed (Black, 1965; Mishra, 1968).

CR_1	CR_2	CR_3
T_1R_1	T_1R_2	T_1R_3
T_2R_1	T_2R_2	T_2R_3
T_3R_1	T_3R_2	T_3R_3
T_4R_1	T_4R_2	T_4R_3

Figure 1. Field showing layout of Plot

Abbr. C = Control, T1 = GA3 Conc. (10-6 M), T2 = GA3 Conc. (10-5M), T3 = GA3 Conc. (10-4M), T4 = GA3 Conc. (10-3M), R1 = Replicate 1; R2 = Replicate 2; R3 = Replicate 3

Sowing of seeds:

The seeds of the selected plant were surface sterilized by soaking in 0.01 % mercuric chloride solution for 3 minutes, washed thoroughly with double distilled water and divided into fifteen sets which were soaked in different concentration of gibberellic acid (GA3) along with control treatment with distilled water (GA3 conc. 10-6M, 10-5M, 10-4M and10-3 M) for 12 hours. The seeds were then sown (20 per plot) in a field (3 X 2 feet) in three replicates of five sets. The field was then irrigated with water as required and after germination of seeds, germination percentage were recorded. Other phenological parameters were recorded by selecting three plants from each section randomly (Laddha et al., 2008).

Growth hormones (GA3) treatment:

Gibberellic acid (GA3) of conc. 10-6M, 10-5M, 10-4M and10-3 M was used at pre-sowing stage and were treated with seeds for 12 hours (Shah et al., 2008).

Phenological Parameter studied:

After the treatment of seeds with gibberellic acid (GA3) for 12 hours with different concentration the seeds were sown and the various parameters were periodically recorded (Mishra, 1968; Sera, 1995).

RESULTS

Abelmoschus moschatus Medik (Kasturi bhendi), belongs to the family Malvaceae is volatile oil yielding medicinal and aromatic plant widely used as perfumery, was selected for present investigation. The scanty availability of information on this plant facilitates to study the phenological behaviour of the plant as influenced by different concentration of gibberellic acid during pre-sowing seed treatment.

Soil analysis of experimental soil:

The soil was analyzed for the physical and chemical parameters before starting up the field experiment. The various parameters were determined. The soil of experimental area is black having sand and loam, pH was 7.8 i.e, slightly alkaline. All the obtained results are presented in Table 1.

Phenological behavior:

Phenology is the science of recurring events in nature and is the study of the timing of recurrent, biological events, the causes of their timing with regards to abiotic and biotic factors. Phenological events have been greatly influenced by growth hormones (gibberlic acid) in a number of species. In majority of medicinally important plants growth hormones plays a significant role on their growth and yield. In the present study pre-sowing seed treatment of the selected plant Abelmoschus moschatus Medik with gibberellic acid (GA3) was found to produce significant results in all the considered parameters and appreciably enhance all parameters studied, especially at the rate of 10-5 M concentration. However, a higher concentration failed to bring about any significant effects. The seeds before sowing were tested for its viability in order to check the quality of the seeds. The seeds pass the viability test.

Germination percentage:

In the present study pre-sowing seed treatment of Abelmoschus moschatus Medik with different concentration of gibberellic acid were studied (Table 2 & Graph 1). It was found that there is significant and higher percentage of germination in GA3concentration at the rate of 10-5 M as compared to control treatment as well as other applied concentration. Germination percentage was recorded as 65.00+2.35 % in control, 71.66+1.35 % in 10-6 M, 83.33+1.35 % in 10-5 M, 66.66+1.35 % in 10-4 M and 63.33+1.35 % in 10-3 M concentration of GA3 applied at pre-sowing stage of seed germination. Therefore, it was concluded from the present investigation

that 10-5 M concentration of GA3 is very well suitable for better germination of the selected plant.

Shoot Length:

The data so obtained is presented and compared with control (Table 2 & Graph 2). The plant height was found to be maximum in 10-5 M concentration i.e, 62.76+0.13 cm and minimum in 10-3 M concentration i.e., 55.86+0.25 cm, which is even less than that of control treatment, indicating that increasing the concentration did not able to increase the shoot length. Hence, it was concluded that 10-5 M concentration of GA3 is suitable for the overall and maximum growth of shoot length of the selected plant.

Days required for anthesis:

Effect of pre-sowing seed treatment with GA3 on days required for anthesis of Abelmoschus moschatus Medik, were present and compared (Table 4 & Graph 3). The day required for anthesis of the plant varies from 18.33+0.47 to 23.00+0.00. The minimum required days for anthesis is 18.33+ 0.27 in 10-5 M concentration.

Number of Branches/plant:

During the course of present investigation only the primary branches was counted and it was found that the number of branches (Table 5 & Graph 4) was in range of 14.33+0.97 to 21.00+0.94.

Number of Flowers/plant: There is very much variability in the flowers of the species and it was observed during the course of present investigation that the number of flowers/plant varies from 91.33+0.90 to 111.33+1.89 (Table 6 & Graph 5), having the highest number of flowers/plant (111.33+1.89) in 10-5 M.

Number of Capsule/plant:

The maximum number of capsule/plant i.e., 102.33+1.52 was recorded in 10-5 M concentration while the minimum number i.e., 82.33+1.51 was recorded in 10-3 M concentration (Table 7 & Graph 6). The data obtained suggest that the maximum capsule/plant were obtained from the GA3 concentration 10-5 M which is far more than that of control treatment as well as other applied concentration.

Number of Seeds/capsule:

The maximum number of seeds/capsule i.e., 198.00+1.32 was recorded in 10-5 M concentration while the minimum number of seeds/capitulum i.e., 96.66+2.36 was recorded in 10-3 M concentration (Table 8 & Graph 7). The data present shows that there is great variation in the seed yield of the species as influenced by the GA3 treatment.

Reproductive capacity:

Table 9 & Graph 8 showed the effect of pre-sowing seed treatment with GA3 on reproductive capacity of Abelmoschus moschatus Medik and it was recorded that the reproductive capacity with concentration of 10-5 M was maximum (165.00+2.80) and lowest of 61.13+0.61 in 10-3 M concentration.

Table 1: Physico-chemical analysis of experimental soil

S/No.	Parameter	Results
1.	Physical characters	Soil is black having sand and loam.
2.	Soil pH	7.9
4.	Electrical conductivity	0.89 mmhos/cm
5.	Organic carbon	0.77%
6.	Available nitrogen	280.2 kg/ha
7.	Available phosphorus	23.8 kg/ha
8.	Available potassium	137 kg/ha

Table 2: Effect of pre-sowing seed treatment with GA3 on germination (%) of Abelmoschus moschatus Medik

Treatments	Germination (%)					
	R_1	R_2	R_3	X	SD	X+SEM
C	70	60	65	65.00	4.08	65.00±2.35
T_1 (10^{-6} M)	70	75	70	71.66	2.35	71.66±1.35[a]
T_2 (10^{-5} M)	85	85	80	83.33	2.35	83.33±1.35[b]
T_3 (10^{-4} M)	70	65	65	66.66	2.35	66.66±1.35[a]
T_4 (10^{-3} M)	65	65	60	63.33	2.35	63.33±1.35[d]

Table 3: Effect of pre-sowing seed treatment with GA3 on shoot length of Abelmoschus moschatus Medik

Treatments	Shoot Length (cm)					
	R_1	R_2	R_3	X	SD	X+SEM
C	59.7	58.4	58.3	58.80	0.63	58.80±0.36
T_1(10^{-6} M)	60.4	59.9	61.0	60.43	0.44	60.43±0.25[a]
T_2 (10^{-5} M)	62.5	63.1	62.7	62.76	0.24	62.76±0.13[b]
T_3 (10^{-4} M)	58.6	59.8	59.2	59.20	0.48	59.20±0.27[b]
T_4 (10^{-3} M)	55.3	56.4	55.9	55.86	0.44	55.86±0.25[a]

Table 4: Effect of pre-sowing seed treatment with GA3 on days required for anthesis of Abelmoschus moschatus Medik

Treatments	Days required for anthesis					
	R_1	R_2	R_3	X	SD	X±SEM
C	21	21	20	20.66	0.47	20.66±0.27
T_1 (10^{-6} M)	20	20	20	20.00	.00	20.00±0.00[a]
T_2 (10^{-5} M)	18	19	18	18.33	0.47	18.33± 0.27[b]
T_3 (10^{-4} M)	22	21	22	21.66	0.47	21.66±0.27[a]
T_4 (10^{-3} M)	23	23	23	23.00	.00	23.00±0.00[b]

Table 5: Effect of pre-sowing seed treatment with GA3 on branches/plant of Abelmoschus moschatus Medik

Treatments	Branches/plant					
	R_1	R_2	R_3	X	SD	X±SEM
C	15	18	16	16.33	1.24	16.33±0.71
T_1 (10^{-6} M)	21	19	17	19.00	1.63	19.00±0.94[a]
T_2 (10^{-5} M)	19	21	23	21.00	1.63	21.00±0.94[a]
T_3 (10^{-4}M)	17	21	18	18.66	1.69	18.66±0.97[b]
T_4 (10^{-3} M)	12	16	15	14.33	1.69	14.33±0.97[a]

Table 6: Effect of pre-sowing seed treatment with GA3 on number of flowers/plant of Abelmoschus moschatus Medik

Treatments	Number of Flowers/plant					
	R_1	R_2	R_3	X	SD	X±SEM
C	104	103	98	101.66	2.62	101.66±1.51
T_1 (10^{-6} M)	113	105	109	109.00	3.26	109.00±1.88[a]
T_2 (10^{-5} M)	115	112	107	111.33	3.28	111.33±1.89[c]
T_3 (10^{-4} M)	94	97	99	96.66	2.05	96.66±1.18[a]
T_4 (10^{-3} M)	89	95	90	91.33	1.56	91.33±0.90[b]

Table 7: Effect of pre-sowing seed treatment with GA3 on number of capsule/plant of Abelmoschus moschatus Medik

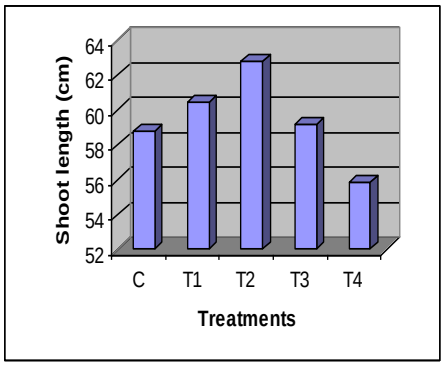
Treatments	Number of Capsule/plant					
	R_1	R_2	R_3	X	SD	X±SEM
C	95	94	89	92.66	2.62	92.66±1.51
T_1 (10^{-6} M)	101	96	94	97.00	2.94	97.00±1.69[a]
T_2 (10^{-5} M)	106	103	98	102.33	2.64	102.33±1.52[c]
T_3 (10^{-4} M)	85	88	90	87.66	2.05	87.66±1.18[a]
T_4 (10^{-3} M)	80	86	81	82.33	2.62	82.33±1.51[b]

Table 8: Effect of pre-sowing seed treatment with GA3 on number of seeds/capsule of Abelmoschus moschatus Medik

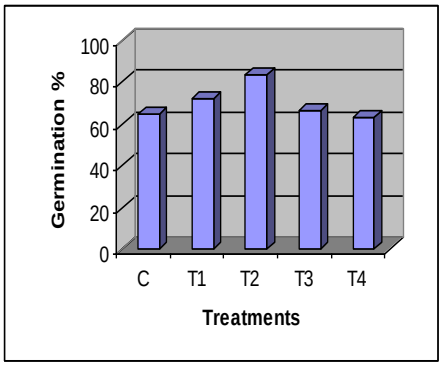
Treatments	Number of Seeds/capsule					
	R_1	R_2	R_3	X	SD	X±SEM
C	157	164	161	160.66	2.86	160.66±1.65
T_1 (10^{-6} M)	169	172	178	173.00	3.74	173.00±2.15[b]
T_2 (10^{-5} M)	200	196	198	198.00	2.30	198.00±1.32[c]
T_3 (10^{-4} M)	145	151	149	148.33	2.49	148.33±1.43[d]
T_4 (10^{-3} M)	92	96	102	96.66	4.10	96.66±2.36[c]

Table 9: Effect of pre-sowing seed treatment with GA3 on reproductive capacity of Abelmoschus moschatus Medik

Treatments	Reproductive capacity					
	R_1	R_2	R_3	X	SD	X±SEM
C	109.9	98.4	104.6	104.30	4.69	104.30±2.70
T_1 (10^{-6} M)	118.3	129.0	124.6	123.96	4.52	123.96±2.60[a]
T_2 (10^{-5} M)	170.0	166.6	158.4	165.00	4.86	165.00±2.80[c]
T_3 (10^{-4} M)	101.5	98.1	96.8	98.83	1.91	98.83±1.10[a]
T_4 (10^{-3} M)	59.8	62.4	61.2	61.13	1.06	61.13±0.61[c]



Graph1



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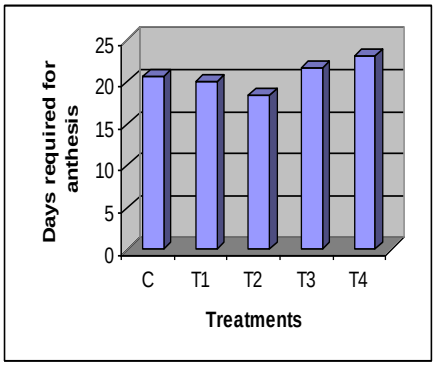

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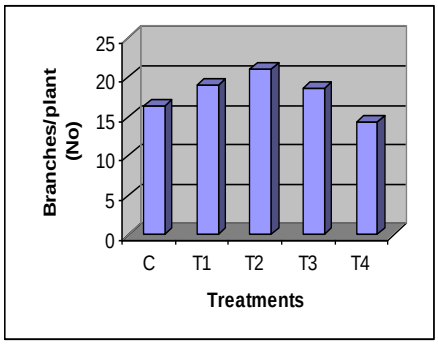
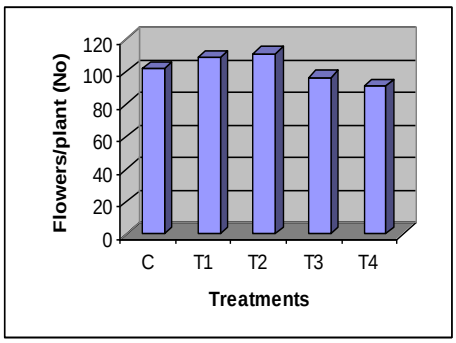


Graph4



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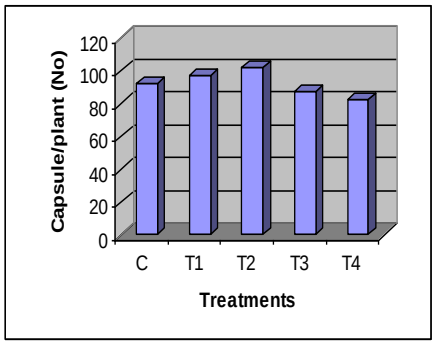

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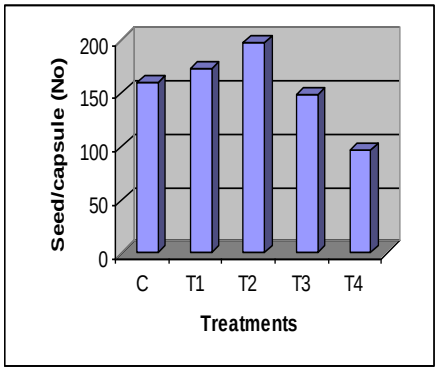
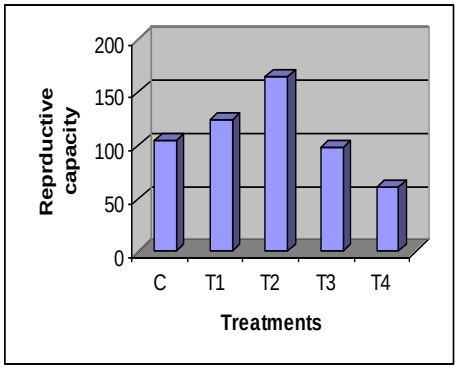


Graph7



Graph8

Graph 1: Effect of pre-sowing seed treatment with GA3 on **germination (%)** of Abelmoschus moschatus Medik
Graph 2: Effect of pre-sowing seed treatment with GA3 on **shoot length** of Abelmoschus moschatus Medik
Graph 3: Effect of pre-sowing seed treatment with GA3 on **days required for anthesis** of Abelmoschus moschatus Medik
Graph 4: Effect of pre-sowing seed treatment with GA3 on **branches/plant** of Abelmoschus moschatus Medik
Graph 5: Effect of pre-sowing seed treatment with GA3 on **number of flowers/plant** of Abelmoschus moschatus Medik
Graph 6: Effect of pre-sowing seed treatment with GA3 on **number of capsule/plant** of Abelmoschus moschatus Medik
Graph 7: Effect of pre-sowing seed treatment with GA3 on **number of seeds/capsule** of Abelmoschus moschatus Medik
Graph 8: Effect of pre-sowing seed treatment with GA3 on **reproductive capacity** of Abelmoschus moschatus Medik
Note: All Values are expressed as X (Mean) +SEM, n=3. (One way ANOVA followed by Student t-test). Statistically significance of aP < 0.05, bP<0.01, cP<0.001 and dNS in comparison to respective control.

CONCLUSION

Thus, these experimental studies provide a scientific support to the selected medicinal plant by which the various phenological behaviour was studied to improve the agrotechniques of the species resulting in the growth and

yield of the selected plant. Hence, it was concluded from the present investigation that the gibberellic acid concentration 10-5 M was very well suitable for the phenological behaviour of the species and also, the seed yield as well as oil content was found to be maximum in this range of concentration.

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