

MORPHOLOGICAL GROWTH PARAMETERS OF *ANDROGRAPHIS PANICULATA* WALL EX. NEES

Anil Kushram, S. K. Masih and R. P. Mishra*

State Forest Research Institute, Polipathar, Jabalpur (M.P.)

*Department of Post-Graduate Studies & Research in Biological Sciences,
Rani Durgavati University, Jabalpur (M.P.)

ABSTRACT: - Present study has been carried out from 2013-2016 at State Forest Research Institute during the detailed field survey from different forest divisions of Madhya Pradesh a total 89 samples of *Andrographis paniculata* were collected. These samples are a representing to different forest types of 10 districts, 6 forest circle, 13 forest divisions, 30 forest ranges and 63 forest beats of Madhya Pradesh. The collected seeds of 89 samples were cultivated for assessment of growth parameters such as Height of plant (cm.), Number of branches/plant, Number of leaves/plant and their Green/fresh and Dry weight (gm). The observations were recorded from 15th day to 165th days. The maximum height of plants has been recorded on 15th day as 0.10 cm and 77.00 cm at 165th day. Other parameters namely Number of branches/plant ranges from 3 to 33, Number of leaves/plant 2 to 406, green biomass 70gms to 350gms and dry biomass 40gms to 197gms respectively on 15th and 165th days.

KEYWORDS: *Andrographis paniculata*, Growth parameter, Height of plant, Number of branches/plant, Number of leaves/plant, Green/fresh weight, Dry weight.

INTRODUCTION

Andrographis paniculata (Burm. F.) Wall. Ex Ness is an important medicinal plant and widely used around the world. It belongs to the family Acanthaceae. It is erect, much branched, glabrous, 40-90 cm high. Leaves linear-obovate or lanceolate, 5-8 x 1-2 cm, acute at apex, tapering at base, glabrous, shortly petiolate. Flowers in terminal, axillary, paniculate racemes, solitary: bracts opposite, lanceolate. Bracteoles 2 small or absent. Calyx lobes pubescent. Corolla white or purplish, glandular pubescent; lower lip with deep pink or purple markings inside at base. Capsules linear-oblong, ca 1.5 cm long. Seeds subquadrate, brown or yellow, rugose (Mudgal *et al.*, 1997).

It is grows mainly as under shrub in tropical, moist deciduous forest. The habitat of *A. paniculata* is in the forest, along roadside, plains, coastline, hills, farm and wastelands. It can grow in all types of soil. The worldwide distribution reported from countries like Sri Lanka, Malaysia, Taiwan, Bangladesh, Nepal, Indonesia, China, Thailand, East and West Indies and Mauritius

(Niranjan *et al.*, 2010, Katakya & Handique, 2010). In India it is found especially in Tamil Nadu, Karla, Andhra Pradesh, Karnataka, Maharashtra, Uttarakhand, Chhatisgarh, West Bengal, Tripura, Jharkhand, Orissa, Bihar, Himachal Pradesh and Arunachal Pradesh (Pandey & Mandal, 2010). In Madhya Pradesh it is found naturally in forest area of Balaghat, Chhindwara, Dindori, Hosangabad, Jabalpur, Katni, Mandla, Narsinghpur, Seoni and Umariya districts.

It is also known as king of bitters due to its bitter taste and weak odor. The reason of bitterness, Andrographolide was isolated in pure form by Gorter (1911). The aerial parts, roots and whole plant of *A. paniculata* have been used for centuries in Asia as traditional medicine for the treatment of various ailments. As a whole plant it is used as Snakebite and insect sting treatment, dyspepsia, influenza, dysentery, malaria, respiratory infections (Chopra *et al.*, 1980, Jarukamjorn *et al.*, 2010). The fresh and dried leaves of *A. paniculata* and extracted juice are the official drugs of Indian pharmacopoeia and used as ulcers, chronic fever, malarial and intermittent fevers, inflammations, cough, bronchitis, skin diseases, colic, diarrhoea, dysentery, haemorrhoids etc. (Kumar & Kumar, 2013). The primary medicinal constituent of *A. paniculata* is Andrographolide used as antimalarial (Mishra *et al.*, 1992), anti-diarrhoeal (Gupta *et al.*, 1993), hepatoprotective (Handa *et al.*, 1990) and anti-inflammatory (Shen *et al.*, 2002) activities.

The major bioactive constituents are a group of diterpene lactones (Wongkittipong, *et al.*, 2000). Leaves of the plant contain several derivatives of diterpene lactones out of which andrographolide (bitter constituent) and neoandrographolide (non-bitter constituent) are important one (Akowuah, *et al.*, 2006). The leaves contain maximum active morphopinciples like andrographolide, homo-andrographolide, andrographesterol and andrographone carried out by Gorter (1911).

METHODS AND MATERIALS

The cultivation trail of 89 germplasm accessions were carried out in the State Forest Research Institute, Jabalpur. Seeds of 89 samples were sown during July 2014, by spreading methods. The growth parameters such as Height of plant (cm.), Number of branches/plant,

Number of leaves/plant, Green/fresh weight (10 plants/sample in gm) and Dry weight (10 plants/sample in gm) were recorded at an interval of 15 days i.e. at 15, 30, 45, 60, 75, 90, 105, 120, 150 and 165 days after sowing. The whole parameter wise data are analyzed and their results discussed in this paper in details.

RESULTS AND DISCUSSION

A cooperative account of morphological parameters such as Height of plant (cm.), Number of branches/plant, Number of leaves/plant, Green/fresh weight (10 plants/sample in gm) and Dry weight (10 plants/sample in gm) were computerized and analysed. As a result the parameter wise maximum, minimum and average values are determined and results are discussed below as: -

1. Growth parameter - Height of plant (cm)

On an average of 10 plants of each samples considered and their height of plant (cm) is measured, recorded, analyzed and resulted below in table-1 with sample code number and height on 15th day of interval. Comparative analysis revealed that maximum height of the plants recorded in sample number SAP-3 (0.78), SAP-1 (1.13), SAP-3&10 (7.28), SAP-59 (14.00), SAP-10 (28.00), SAP-76 (37.80), SAP-76 (51.60), SAP-76 (63.20), SAP-77 (74.00), SAP-77 (76.00) and SAP-77 (77.20) after 15th, 30th, 45th, 60th, 75th, 90th, 105, 120th, 135th, 150th, 165 days. Whereas the minimum height of the plants of different samples were recorded in sample number SAP-1 (0.10), SAP-46 (0.43), SAP-15, 22, 32, 33, 34, 43, 69, 74 & 80 (3.00), SAP-2, 4, 5, 33, 40, 42, 43, 50, 63 & 80 (6.00), SAP-36, 44, 63 (11.00), SAP-44 (13.99), SAP-48 (23.18), SAP-63 (29.80), SAP-48 (36.70), SAP-45 (38.80) and SAP-45 (39.40).

2. Growth parameter - Number of branches/plant

The developments of number of branches in samples were started after 45th days and on 60th days the branches were recorded between 4-6 in numbers. The gradual development of branches initiated from 75th days to 165th day Table - 2. Maximum number of branches/plant of different samples was recorded in sample number SAP-3, 10, 14, 27, 31, 46, 54, 55, 57, 69, 76, 78, 83, 85, 86 & 89 (6), SAP-3, 10, 18, 22, 27, 39, 46, 54, 55, 57, 59, 76, 78, 79 & 84 (12), SAP-57, 76 & 78 (16), SAP-76 (23), SAP-76 (25), SAP-76 (32), SAP-76 (33) and SAP-76

(33) after 60th, 75th, 90th, 105, 120th, 135th, 150th and 165 days. Whereas the minimum branches/plant of different samples were recorded in sample number SAP-6, 7, 11, 17, 20, 24, 33, 35, 36, 39, 40, 42, 43, 47, 48, 49, 50, 58, 61, 63, 64, 68, 74, 80 & 81 (3), SAP-2, 4, 6, 7, 11, 15, 17, 19, 29, 33, 35, 36, 42, 43, 44, 48, 52, 56, 61, 63, 64, 68, 71, 74, 82 & 87 (8), SAP-6, 7, 12 & 19 (11), SAP-63 & 73 (14), SAP-44, 48, 63 & 64 (15), SAP-81 (16), SAP-81 (17) and SAP-81 (17).

3. Growth parameter - Number of leaves/plant

The numbers of leaves/plant were recorded first on main stem than it also developed on side branches. The numbers of leaves/plant were recorded branch wise than in whole plant. The gradual increase in sample from 2 to 406 at 15th and 165th days (Table - 3). Maximum numbers of leaves/plants of different samples were recorded in sample number SAP-55, 58, 64, 65, 70, 85 & 86 (6), SAP-84 & 88 (8), SAP-10 & 84 (13), SAP-57 (25), SAP-24, 25, 31 & 57 (40), SAP-85 (68.2), SAP-9 (134.4), SAP-54 (169), SAP-54 (233.00), SAP-54 (274) and SAP-54 (406.40) after 15th, 30th, 45th, 60th, 75th, 90th, 105, 120th, 135th, 150th and 165 days. Whereas the minimum number of leaves/plants of different samples were recorded in sample number SAP-1, 28, 30, 31, 33, 34, 37, 39, 41, 43, 44, 46, 47, 59, 60, 61, 66, 67, 68, 71, 72, 74, 75, 78, 79, 80, 87 & 89 (2), SAP-4 (4.40), SAP-26, 33 & 43 (6.00), SAP-5, 26, 34, 35, 42, 61 & 63 (15), SAP-37 (20.00), SAP-11 (29), SAP-63 (37.80), SAP-15 & 63 (47.20), SAP-15 (66.20), SAP-63 (79.00) and SAP-63 (76.20).

4. Growth parameter - Green/Fresh weight and Dry weight (gm)

After 165th days the samples were harvested and their green biomass recorded from 70gms to 350gms. Whereas the day of different samples recorded 40gms to 196gms @ 50% driage Table- 4. Maximum Green/Fresh weight (10 plants/sample in gm) of different samples were recorded in sample number SAP-25 (350) and Dry weight (10 plants/sample in gm) sample number SAP-60 (196) after 165 days. Whereas the minimum Green/Fresh weights (10 plants/sample in gm) of different samples were recorded in sample number SAP-27, 37 & 48 (70) and Dry weight (10 plants/sample in gm) sample number SAP-27 & 37 (40).

Table -1: Growth parameter - Height of plant (in cm.)

Sample Code	15 Days	30 Days	45 Days	60 Days	75 Days	90 Days	105 Days	120 Days	135 Days	150 Days	165 Days
SAP-1	0.10	1.13	4.46	7.00	17.00	21.90	32.90	48.50	57.80	61.70	63.30
SAP-2	0.40	1.10	3.33	6.00	15.00	21.70	26.50	36.10	45.80	48.79	50.80
SAP-3	0.78	1.11	7.28	11.00	21.00	33.20	46.60	50.50	59.30	63.50	64.30

SAP-4	0.66	0.88	3.72	<u>6.00</u>	16.00	19.86	33.81	41.00	47.60	50.40	51.90
SAP-5	0.41	0.95	4.00	<u>6.00</u>	15.00	21.90	30.73	42.90	48.30	50.40	51.40
SAP-6	0.40	1.07	4.16	8.00	14.00	19.82	33.40	38.80	47.20	50.60	52.60
SAP-7	0.65	0.91	3.05	7.00	14.00	18.41	32.88	36.40	43.50	46.80	47.60
SAP-8	0.66	0.88	4.16	9.00	15.00	19.00	31.32	40.20	50.00	52.50	54.90
SAP-9	0.41	0.88	4.34	9.00	19.00	24.50	39.70	45.80	53.00	56.10	57.80
SAP-10	0.41	0.90	7.28	13.00	28.00	34.20	47.10	53.15	63.00	67.80	69.60
SAP-11	0.40	0.91	4.00	8.00	16.00	21.30	36.80	39.70	47.00	51.80	53.10
SAP-12	0.32	1.07	3.05	8.00	13.00	17.60	30.46	44.80	56.00	59.30	61.90
SAP-14	0.42	0.90	4.30	9.00	16.00	21.50	28.56	31.60	41.90	44.20	45.20
SAP-15	0.35	1.05	<u>3.00</u>	7.00	15.00	22.60	30.29	35.70	43.70	46.00	46.80
SAP-16	0.37	0.86	5.20	8.00	16.00	20.30	38.97	47.20	53.20	56.20	57.90
SAP-17	0.33	0.88	4.00	7.00	15.00	18.00	28.00	40.38	56.00	58.90	60.20
SAP-18	0.37	0.83	4.00	9.00	20.00	27.00	38.30	41.80	51.60	54.40	55.20
SAP-19	0.38	0.87	4.00	7.00	16.00	23.10	36.30	39.50	48.10	51.70	53.50
SAP-20	0.35	0.80	5.00	11.00	20.00	28.40	40.50	45.10	53.30	56.00	56.60
SAP-21	0.36	0.90	4.11	9.00	14.00	20.70	34.35	38.40	47.30	49.00	49.70
SAP-22	0.40	0.93	<u>3.00</u>	7.00	17.00	25.10	34.78	42.13	47.30	49.10	50.10
SAP-24	0.35	0.86	3.50	8.00	15.00	22.20	31.37	35.60	42.80	44.70	46.60
SAP-25	0.37	0.90	4.25	8.00	20.00	25.10	38.29	42.90	47.50	50.90	52.70
SAP-26	0.38	0.82	3.50	7.00	12.00	17.80	26.30	38.80	48.50	50.00	50.70
SAP-27	0.36	0.91	4.00	12.00	27.00	34.60	40.00	56.50	64.60	69.00	69.70
SAP-28	0.30	0.87	5.00	10.00	20.00	26.90	40.07	46.88	57.04	61.60	63.00
SAP-29	0.33	0.78	4.00	9.00	16.00	21.70	28.87	37.70	43.50	46.40	47.50
SAP-30	0.30	0.86	4.00	8.00	18.00	25.50	31.15	36.70	46.00	47.00	47.90
SAP-31	0.20	0.83	5.00	10.00	20.00	31.30	37.35	40.50	46.70	49.40	50.70
SAP-32	0.30	0.84	<u>3.00</u>	7.00	17.00	24.70	38.92	47.40	57.20	59.10	60.20
SAP-33	0.20	0.85	<u>3.00</u>	<u>6.00</u>	15.00	21.10	30.91	36.70	46.30	48.00	48.70
SAP-34	0.20	0.84	<u>3.00</u>	8.00	18.00	25.40	30.57	36.40	46.20	48.00	48.70
SAP-35	0.38	0.85	4.00	7.00	14.00	17.80	25.40	36.90	43.40	45.20	46.20
SAP-36	0.36	0.85	3.26	8.00	<u>11.00</u>	16.30	27.00	35.80	42.60	44.40	45.10
SAP-37	0.30	0.86	4.00	9.00	15.00	19.30	26.40	32.70	45.80	47.20	48.20
SAP-38	0.35	0.79	4.00	8.00	18.00	24.50	28.00	37.80	41.80	44.30	45.10
SAP-39	0.20	0.77	4.00	10.00	20.00	27.20	35.00	40.90	45.10	47.40	48.40
SAP-40	0.30	0.86	4.00	<u>6.00</u>	14.00	18.20	26.30	32.71	37.70	39.70	40.70
SAP-41	0.15	0.91	5.00	8.00	11.10	15.20	24.80	34.50	37.10	39.00	40.90
SAP-42	0.60	0.95	3.35	<u>6.00</u>	13.00	17.80	25.00	33.30	42.40	44.00	45.30
SAP-43	0.20	0.93	<u>3.00</u>	<u>6.00</u>	11.50	15.00	24.75	38.60	42.70	44.80	45.50

SAP-44	0.20	0.86	4.00	7.00	<u>11.00</u>	<u>13.99</u>	25.80	32.10	37.40	39.90	41.10
SAP-45	0.40	0.86	5.00	8.00	14.00	19.10	26.70	31.60	37.00	<u>38.80</u>	<u>39.40</u>
SAP-46	<u>0.10</u>	<u>0.43</u>	4.20	10.00	20.00	27.20	32.77	37.10	44.80	46.80	47.90
SAP-47	0.20	0.49	5.00	8.00	18.00	22.40	27.80	37.50	43.50	45.40	46.30
SAP-48	0.35	0.85	4.00	7.00	13.00	17.00	<u>23.18</u>	30.80	<u>36.70</u>	39.30	40.40
SAP-49	0.32	0.88	3.65	8.00	17.00	22.70	31.96	35.90	41.40	43.00	44.00
SAP-50	0.40	0.74	3.05	<u>6.00</u>	13.00	19.42	31.56	36.50	42.80	45.90	46.70
SAP-51	0.41	0.88	3.27	7.00	17.00	24.50	32.46	38.50	44.90	47.20	48.20
SAP-52	0.33	0.88	4.20	8.00	12.00	16.11	25.30	33.10	37.20	39.30	40.60
SAP-53	0.38	0.88	5.00	9.00	19.00	24.80	34.01	49.70	57.30	59.50	60.30
SAP-54	0.42	0.90	6.00	12.00	22.00	27.80	35.20	38.30	47.70	50.20	52.00
SAP-55	0.60	0.88	5.00	10.00	22.00	29.30	37.20	51.57	64.00	66.40	67.00
SAP-56	0.45	0.89	4.20	9.00	19.00	24.30	36.70	49.70	54.40	57.50	58.60
SAP-57	0.33	0.87	4.20	11.00	25.00	35.00	40.20	46.30	53.70	56.00	56.60
SAP-58	0.60	0.96	4.20	8.00	22.00	28.10	40.70	46.90	54.80	57.10	58.20
SAP-59	0.20	0.91	6.00	14.00	24.00	32.00	39.70	45.50	57.10	59.10	60.90
SAP-60	0.20	0.82	4.20	9.00	19.00	26.80	39.26	53.95	64.30	66.00	67.10
SAP-61	0.22	0.77	4.00	7.00	15.00	21.87	34.20	41.50	47.60	50.70	52.90
SAP-62	0.30	0.82	4.20	9.00	20.00	33.70	40.70	55.45	62.40	65.00	66.10
SAP-63	0.42	0.82	3.05	<u>6.00</u>	<u>11.00</u>	16.40	23.40	<u>29.80</u>	37.10	40.10	41.30
SAP-64	0.60	0.83	5.00	7.00	16.00	21.68	27.40	37.80	42.80	44.80	45.70
SAP-65	0.60	0.84	4.20	8.00	18.00	24.60	35.30	45.10	48.00	50.00	51.20
SAP-66	0.20	0.91	5.00	9.00	15.00	22.10	28.40	38.00	54.40	56.10	57.30
SAP-67	0.20	0.76	4.00	8.00	20.00	30.00	40.09	44.60	53.20	55.30	55.90
SAP-68	0.30	0.77	<u>6.00</u>	10.00	19.00	25.10	32.90	37.70	43.40	44.80	45.60
SAP-69	0.42	0.84	<u>3.00</u>	9.00	20.00	30.60	38.76	42.00	46.10	48.60	49.90
SAP-70	0.60	0.80	5.00	10.00	16.00	22.33	28.12	36.60	43.90	45.70	46.90
SAP-71	0.20	0.86	5.00	8.00	20.00	27.40	40.27	49.20	56.60	58.50	59.40
SAP-72	0.20	0.90	4.10	9.00	14.00	20.09	29.70	37.90	46.70	49.40	50.60
SAP-73	0.30	0.84	4.10	8.00	17.00	24.50	38.00	42.40	47.10	49.40	50.60
SAP-74	0.20	0.77	<u>3.00</u>	7.00	16.00	21.74	29.77	38.60	43.60	46.50	47.40
SAP-75	0.20	0.86	3.51	8.00	18.00	25.70	32.41	39.00	42.70	45.40	46.00
SAP-76	0.30	0.86	5.00	9.00	21.00	37.80	51.60	63.20	67.50	71.70	73.00
SAP-77	0.30	0.82	4.00	8.00	20.00	31.50	47.30	62.50	74.00	76.20	77.20
SAP-78	0.20	0.82	5.00	10.00	21.00	30.00	40.86	46.50	52.90	54.30	55.80
SAP-79	0.20	0.85	4.10	8.00	18.00	25.90	40.45	48.10	54.70	58.00	59.20
SAP-80	0.20	0.81	<u>3.00</u>	<u>6.00</u>	15.00	22.85	33.40	38.70	45.00	47.00	48.00
SAP-81	0.35	0.86	4.00	7.00	17.00	23.61	31.20	36.60	40.20	42.20	43.00

SAP-82	0.30	0.84	3.30	8.00	14.00	20.41	38.40	44.50	49.10	51.60	53.20
SAP-83	0.30	0.86	5.00	10.00	20.00	28.00	29.40	36.30	43.00	45.10	46.20
SAP-84	0.42	0.82	5.00	11.00	26.00	33.70	43.40	57.00	61.90	64.90	66.00
SAP-85	0.60	0.72	5.00	10.00	21.00	30.61	36.70	46.40	53.90	56.00	57.00
SAP-86	0.50	0.85	4.00	11.00	23.00	29.50	39.60	46.90	52.30	54.10	55.10
SAP-87	0.20	0.82	4.00	9.00	20.00	29.13	34.90	41.30	48.00	51.70	53.90
SAP-88	0.30	0.91	5.00	9.00	19.00	26.80	34.20	38.70	46.50	48.30	49.80
SAP-89	0.20	0.78	4.00	10.00	21.00	35.40	43.60	47.60	53.40	55.00	56.30
Average	0.35	0.86	4.20	8.43	17.42	24.27	33.95	41.65	49.00	51.48	52.67
Maximum	0.78	1.13	7.28	14.00	28.00	37.80	51.60	63.20	74.00	76.20	77.20
Minimum	0.10	0.43	3.00	6.00	11.00	13.99	23.18	29.80	36.70	38.80	39.40

Table -2: Number of branches/plant

Sample Code	15 Days	30 Days	45 Days	60 Days	75 Days	90 Days	105 Days	120 Days	135 Days	150 Days	165 Days
SAP-1				4	10	12	16	17	18	19	19
SAP-2				4	8	12	16	18	19	21	21
SAP-3				6	12	13	18	20	23	24	24
SAP-4				4	<u>8</u>	12	16	20	21	22	22
SAP-5				4	10	12	15	20	21	21	21
SAP-6				<u>3</u>	<u>8</u>	<u>11</u>	16	19	19	20	20
SAP-7				<u>3</u>	<u>8</u>	<u>11</u>	16	18	19	19	19
SAP-8				4	10	13	16	19	21	21	21
SAP-9				4	11	13	17	18	19	20	20
SAP-10				6	12	14	17	19	20	22	22
SAP-11				<u>3</u>	<u>8</u>	12	18	18	20	20	20
SAP-12				4	10	<u>11</u>	18	19	20	21	21
SAP-14				6	11	13	17	20	22	23	19
SAP-15				4	<u>8</u>	14	17	18	19	21	21
SAP-16				4	10	13	17	17	17	19	19
SAP-17				<u>3</u>	8	12	18	19	21	21	20
SAP-18				4	12	15	18	18	18	19	19
SAP-19				4	<u>8</u>	<u>11</u>	18	18	19	19	19
SAP-20				<u>3</u>	10	14	17	17	18	19	19
SAP-21				4	11	14	17	17	18	18	18
SAP-22				4	12	13	17	17	17	18	18
SAP-24				<u>3</u>	10	13	16	16	17	18	18
SAP-25				4	11	14	18	19	19	19	19
SAP-26				4	10	13	18	19	19	19	19

SAP-27				6	12	14	18	19	23	23	24
SAP-28				4	10	14	17	21	21	21	21
SAP-29				4	<u>8</u>	14	17	17	17	19	19
SAP-30				4	11	14	17	18	19	19	19
SAP-31				6	10	14	17	18	19	20	20
SAP-32				4	10	14	18	18	20	21	21
SAP-33				<u>3</u>	<u>8</u>	12	17	17	18	19	19
SAP-34				4	11	14	15	17	17	19	19
SAP-35				<u>3</u>	<u>8</u>	12	15	18	18	19	19
SAP-36				<u>3</u>	<u>8</u>	12	16	17	17	20	20
SAP-37				4	10	12	16	17	19	20	20
SAP-38				4	11	13	17	18	18	19	19
SAP-39				<u>3</u>	12	15	17	22	22	24	25
SAP-40				<u>3</u>	10	13	16	17	18	18	18
SAP-41				4	9	12	15	16	17	19	19
SAP-42				<u>3</u>	<u>8</u>	12	16	17	19	21	21
SAP-43				<u>3</u>	<u>8</u>	12	18	18	19	20	20
SAP-44				4	<u>8</u>	12	15	<u>15</u>	17	19	19
SAP-45				4	10	13	15	16	17	19	19
SAP-46				6	12	15	16	17	20	21	21
SAP-47				<u>3</u>	10	14	16	17	19	20	20
SAP-48				<u>3</u>	<u>8</u>	13	15	<u>15</u>	18	19	19
SAP-49				<u>3</u>	10	14	17	17	18	18	18
SAP-50				<u>3</u>	10	14	16	17	18	19	19
SAP-51				4	11	14	17	18	20	21	21
SAP-52				4	<u>8</u>	12	15	16	18	19	19
SAP-53				4	10	14	19	19	19	21	21
SAP-54				6	12	15	15	18	20	21	21
SAP-55				6	12	15	18	23	24	27	27
SAP-56				4	<u>8</u>	14	17	21	24	26	26
SAP-57				6	12	16	19	19	21	22	22
SAP-58				<u>3</u>	10	15	20	22	23	23	23
SAP-59				4	12	16	21	23	23	24	24
SAP-60				5	10	15	18	23	25	27	27
SAP-61				<u>3</u>	<u>8</u>	12	17	18	22	22	22
SAP-62				4	10	15	18	23	26	27	27
SAP-63				<u>3</u>	<u>8</u>	12	<u>14</u>	<u>15</u>	20	21	21
SAP-64				<u>3</u>	<u>8</u>	14	15	<u>15</u>	17	19	19

SAP-65				5	11	14	15	19	21	21	21
SAP-66				4	10	13	17	18	22	23	23
SAP-67				4	10	15	17	17	18	19	19
SAP-68				<u>3</u>	<u>8</u>	13	15	17	19	20	20
SAP-69				6	11	15	16	17	18	19	19
SAP-70				4	10	14	15	17	19	20	20
SAP-71				4	<u>8</u>	14	19	19	20	20	21
SAP-72				5	10	12	16	17	17	21	21
SAP-73				4	10	13	<u>14</u>	19	19	21	21
SAP-74				<u>3</u>	<u>8</u>	13	15	17	17	19	19
SAP-75				4	10	13	17	19	19	19	19
SAP-76				6	12	16	23	25	32	33	33
SAP-77				4	10	15	18	21	24	25	25
SAP-78				6	12	16	17	19	20	21	21
SAP-79				4	12	15	17	22	22	24	24
SAP-80				<u>3</u>	10	14	17	19	19	19	19
SAP-81				<u>3</u>	10	14	15	16	<u>16</u>	<u>17</u>	<u>17</u>
SAP-82				4	<u>8</u>	13	17	17	19	21	21
SAP-83				6	11	15	16	17	19	19	19
SAP-84				5	12	14	17	18	21	23	23
SAP-85				6	11	14	18	21	23	24	24
SAP-86				6	11	14	16	19	19	21	21
SAP-87				4	<u>8</u>	14	17	19	19	20	20
SAP-88				<u>3</u>	10	15	17	19	19	19	19
SAP-89				6	10	13	17	19	20	21	21
Average				4	10	14	17	18	20	21	21
Maximum				6	12	16	23	25	32	33	33
Minimum				3	8	11	14	15	16	17	17

Table-3: Number of leaves/plant

Sample Code	15 Days	30 Days	45 Days	60 Days	75 Days	90 Days	105 Days	120 Days	135 Days	150 Days	165 Days
SAP-1	<u>2.00</u>	6.00	8.40	16.00	31.00	40.20	57.40	74.00	84.60	112.40	114.00
SAP-2	4.00	6.00	9.20	18.00	28.00	41.20	52.60	71.00	125.60	131.80	134.20
SAP-3	4.00	6.00	11.80	20.00	34.00	40.00	117.60	135.60	159.20	163.20	160.60
SAP-4	4.66	<u>4.40</u>	10.40	16.00	30.00	33.60	92.00	120.80	164.60	169.80	168.40
SAP-5	3.71	5.80	9.60	<u>15.00</u>	28.20	33.00	105.20	126.20	164.00	173.60	170.00
SAP-6	4.00	6.00	7.00	<u>17.00</u>	26.00	39.20	123.20	145.40	180.80	204.80	205.60
SAP-7	4.00	6.00	9.00	16.00	26.00	33.40	116.60	132.40	168.40	186.40	183.60

SAP-8	4.66	6.00	7.00	17.00	27.00	32.80	99.40	105.20	166.00	172.20	171.60
SAP-9	3.71	6.00	10.00	20.00	31.00	38.40	134.40	152.40	173.40	187.40	186.40
SAP-10	3.60	6.00	13.00	20.00	30.00	41.80	127.00	143.20	181.40	190.40	195.20
SAP-11	4.00	6.00	7.00	16.00	24.00	<u>29.00</u>	86.60	135.40	165.80	187.40	188.80
SAP-12	2.50	6.00	8.00	18.00	26.00	32.80	87.00	135.60	181.60	197.80	206.60
SAP-14	3.55	6.00	10.00	18.00	26.00	33.40	68.40	105.00	154.80	162.00	163.40
SAP-15	3.00	6.00	8.00	16.00	26.00	29.20	39.40	<u>47.20</u>	<u>66.20</u>	122.20	119.80
SAP-16	3.42	6.00	12.20	20.00	30.00	34.80	79.00	123.80	158.60	170.60	171.80
SAP-17	2.66	6.00	9.00	17.00	28.00	31.80	42.40	48.20	79.00	137.20	135.80
SAP-18	3.00	6.00	9.00	19.00	26.00	32.80	84.20	133.60	159.40	187.60	189.20
SAP-19	3.33	6.00	10.00	20.00	31.00	38.60	75.40	81.00	138.40	155.40	158.40
SAP-20	3.42	6.00	7.20	17.00	36.00	43.20	83.40	112.00	166.00	188.40	189.00
SAP-21	4.00	6.00	8.00	20.00	30.20	38.40	83.20	100.20	165.60	183.00	185.80
SAP-22	4.00	6.00	8.00	16.00	29.00	40.20	73.20	81.00	152.60	165.40	163.40
SAP-24	3.50	6.00	8.00	18.00	40.00	43.60	98.40	106.00	142.20	151.80	156.00
SAP-25	3.50	6.00	9.00	18.00	40.00	48.80	81.80	105.60	170.20	185.40	189.40
SAP-26	3.62	6.00	6.60	<u>15.00</u>	27.00	32.80	65.20	85.00	148.60	157.80	159.00
SAP-27	3.33	6.00	8.00	18.00	24.00	30.20	44.20	57.40	76.20	84.20	108.00
SAP-28	<u>2.00</u>	6.00	10.00	19.00	30.00	36.60	127.40	164.80	186.40	210.60	218.00
SAP-29	2.66	6.00	8.00	16.00	33.00	39.00	90.00	131.80	178.00	180.80	184.40
SAP-30	<u>2.00</u>	6.00	8.00	20.00	36.00	42.40	82.60	113.20	175.40	184.40	187.00
SAP-31	<u>2.00</u>	6.00	12.00	24.00	40.00	48.60	100.20	129.00	170.40	185.80	193.40
SAP-32	3.33	6.00	8.00	17.00	31.00	37.60	114.40	122.60	175.80	191.80	195.80
SAP-33	<u>2.00</u>	6.00	<u>6.00</u>	16.00	28.00	34.60	67.60	76.60	161.60	181.40	188.40
SAP-34	<u>2.00</u>	6.00	7.00	<u>15.00</u>	26.00	30.40	87.40	131.20	165.20	175.20	178.40
SAP-35	3.62	6.00	8.00	<u>15.00</u>	22.00	29.60	55.60	70.20	150.00	176.40	178.60
SAP-36	3.33	6.00	7.00	17.00	21.00	33.00	71.80	87.00	139.80	158.80	162.40
SAP-37	<u>2.00</u>	6.00	9.00	18.00	<u>20.00</u>	30.60	46.40	63.00	149.60	163.20	161.20
SAP-38	3.50	6.00	8.00	16.00	23.00	31.60	40.40	50.20	84.40	106.80	106.80
SAP-39	<u>2.00</u>	6.00	7.00	17.00	27.20	34.00	60.40	70.00	130.20	148.40	174.00
SAP-40	4.00	6.00	8.00	16.00	25.00	31.80	48.40	55.40	159.00	173.60	176.60
SAP-41	<u>2.00</u>	6.00	10.00	19.00	24.40	30.80	58.80	77.20	159.00	177.20	176.40
SAP-42	6.00	6.00	8.00	<u>15.00</u>	27.00	33.60	50.00	60.80	82.20	92.80	106.00
SAP-43	<u>2.00</u>	6.00	<u>6.00</u>	16.00	23.00	32.40	56.80	59.80	83.80	92.80	89.20
SAP-44	<u>2.00</u>	6.00	7.00	17.00	25.00	32.80	56.40	83.60	129.60	137.40	132.60
SAP-45	4.00	6.00	10.00	16.00	28.00	33.60	45.00	54.00	72.60	83.60	82.40
SAP-46	<u>2.00</u>	6.00	10.00	20.00	26.00	36.80	67.40	101.80	172.00	179.80	174.80
SAP-47	<u>2.00</u>	6.00	8.00	16.00	24.00	35.00	79.40	130.60	174.00	186.40	183.20
SAP-48	4.00	6.20	7.00	17.00	22.00	34.20	68.40	82.80	153.00	165.20	159.60

SAP-49	2.50	6.20	10.00	20.00	30.00	40.20	78.40	100.00	171.60	189.80	188.40
SAP-50	4.00	6.20	9.00	18.00	35.00	45.80	120.20	140.80	171.60	180.20	179.40
SAP-51	4.00	6.20	7.20	16.00	30.00	35.20	67.80	114.00	166.80	179.60	174.40
SAP-52	2.66	6.20	10.00	20.00	30.00	39.40	76.00	90.60	161.20	166.00	163.00
SAP-53	4.00	6.60	10.00	22.00	32.00	41.00	47.20	56.00	80.20	110.00	116.60
SAP-54	4.00	6.60	10.00	20.00	30.00	43.40	113.40	169.60	233.00	274.00	406.40
SAP-55	6.00	6.40	11.00	24.00	36.00	44.60	95.20	116.00	155.60	187.20	192.00
SAP-56	4.00	6.60	10.00	20.00	38.00	61.60	106.20	139.80	173.60	192.60	191.00
SAP-57	2.66	6.60	9.00	25.00	40.00	53.80	129.20	136.00	168.20	180.60	177.00
SAP-58	6.00	6.60	10.00	17.00	37.00	46.40	107.00	124.00	174.00	193.40	189.80
SAP-59	<u>2.00</u>	6.80	10.00	21.00	30.00	42.00	92.60	118.40	176.00	191.00	188.80
SAP-60	<u>2.00</u>	6.40	9.00	17.00	37.00	54.60	107.80	138.80	191.40	209.40	210.80
SAP-61	<u>2.00</u>	6.20	8.00	<u>15.00</u>	26.00	35.80	92.20	119.60	175.20	188.80	186.00
SAP-62	3.00	6.40	9.00	19.00	30.00	43.40	125.40	144.40	183.80	207.80	215.00
SAP-63	4.00	6.40	9.00	<u>15.00</u>	25.00	33.20	<u>37.80</u>	<u>47.20</u>	73.20	<u>79.00</u>	<u>76.20</u>
SAP-64	6.00	6.40	10.00	20.00	35.00	46.40	63.20	80.60	168.20	175.60	174.40
SAP-65	6.00	6.80	10.00	20.00	30.00	37.80	72.20	96.80	138.40	141.60	138.20
SAP-66	<u>2.00</u>	6.20	8.60	18.00	28.00	37.40	65.00	70.80	139.20	176.60	173.80
SAP-67	<u>2.00</u>	6.00	7.20	16.00	34.00	45.40	72.60	78.60	141.80	146.20	140.60
SAP-68	<u>2.00</u>	6.00	11.00	17.00	27.00	36.80	58.60	62.20	149.40	156.80	159.80
SAP-69	4.00	7.20	8.00	20.00	34.00	41.80	75.80	93.60	163.20	168.60	166.40
SAP-70	6.00	6.20	10.00	18.00	30.00	43.40	69.20	74.40	165.20	180.40	184.00
SAP-71	<u>2.00</u>	6.40	7.20	16.00	32.00	52.00	109.60	144.20	180.60	204.20	201.60
SAP-72	<u>2.00</u>	7.20	10.00	18.00	27.00	42.40	80.20	82.20	154.40	177.80	175.40
SAP-73	3.00	7.40	9.00	17.00	26.00	33.80	59.00	89.60	151.00	161.80	165.00
SAP-74	<u>2.00</u>	7.00	6.00	16.00	30.00	39.00	70.00	103.80	145.60	159.40	160.60
SAP-75	2.00	6.60	8.80	19.00	36.00	50.20	80.60	96.20	158.40	168.20	172.00
SAP-76	3.00	7.00	10.00	22.00	36.00	51.20	116.00	144.80	203.00	224.20	221.20
SAP-77	4.00	6.80	9.00	19.00	29.00	44.40	55.20	69.80	89.40	120.20	123.00
SAP-78	<u>2.00</u>	7.40	11.00	20.00	36.00	48.00	102.80	120.00	179.60	191.00	188.80
SAP-79	<u>2.00</u>	7.20	10.00	24.00	32.00	50.00	128.40	141.40	179.40	208.80	206.00
SAP-80	<u>2.00</u>	7.40	7.00	16.00	30.00	42.40	70.40	87.20	153.40	175.60	175.20
SAP-81	4.00	7.00	8.20	20.00	33.00	55.20	44.40	55.40	95.60	117.00	112.80
SAP-82	4.00	6.40	10.00	17.00	27.00	46.00	63.00	76.20	145.00	179.60	189.20
SAP-83	2.40	7.40	12.00	20.00	30.00	54.80	53.80	61.00	136.00	161.20	157.60
SAP-84	4.00	8.00	13.00	17.00	37.00	50.60	132.60	145.80	180.60	211.60	208.00
SAP-85	6.00	7.20	10.00	21.00	38.00	68.20	95.40	132.20	193.80	208.00	205.20
SAP-86	6.00	7.20	12.00	24.00	35.00	55.80	67.60	77.40	139.20	149.00	145.00

SAP-87	<u>2.00</u>	7.80	8.20	20.00	30.00	55.60	70.60	83.60	142.00	163.80	160.40
SAP-88	4.00	8.00	12.00	19.00	31.00	43.80	69.20	73.20	137.80	158.20	156.80
SAP-89	<u>2.00</u>	7.20	9.00	20.00	27.00	41.20	89.20	103.40	160.40	178.20	182.00
Average	3.30	6.35	9.01	18.23	29.91	40.42	80.72	100.90	151.62	168.66	171.05
Maximum	6.00	8.00	13.00	25.00	40.00	68.00	134.40	169.00	233.00	274.00	406.40
Minimum	2.00	4.40	6.00	15.00	20.00	29.00	37.80	47.20	66.20	79.00	76.20

Table - 4: Green/Fresh weight and Dry weight (gm)

Sample Code	Green/fresh weight (10 plants/sample in gm)	Dry weight (10 plants/sample in gm)	Sample Code	Green/fresh weight (10 plants/sample in gm)	Dry weight (10 plants/sample in gm)
SAP-1	147	60	SAP-48	<u>70</u>	50
SAP-2	190	70	SAP-49	210	110
SAP-3	230	100	SAP-50	130	100
SAP-4	140	50	SAP-51	160	90
SAP-5	180	50	SAP-52	150	80
SAP-6	100	60	SAP-53	270	120
SAP-7	180	120	SAP-54	210	150
SAP-8	180	70	SAP-55	250	160
SAP-9	320	130	SAP-56	200	120
SAP-10	220	90	SAP-57	260	110
SAP-11	160	58	SAP-58	260	140
SAP-12	250	130	SAP-59	280	130
SAP-14	150	90	SAP-60	240	196
SAP-15	130	60	SAP-61	240	100
SAP-16	290	140	SAP-62	280	130
SAP-17	140	60	SAP-63	130	95
SAP-18	200	100	SAP-64	110	90
SAP-19	240	100	SAP-65	200	110
SAP-20	270	130	SAP-66	180	100
SAP-21	190	100	SAP-67	196	120
SAP-22	130	70	SAP-68	130	90
SAP-24	150	60	SAP-69	180	80
SAP-25	350	170	SAP-70	210	150
SAP-26	90	60	SAP-71	190	110
SAP-27	<u>70</u>	<u>40</u>	SAP-72	80	50
SAP-28	190	110	SAP-73	160	80
SAP-29	150	80	SAP-74	130	90
SAP-30	120	90	SAP-75	240	180

SAP-31	190	100	SAP-76	130	80
SAP-32	230	110	SAP-77	136	98
SAP-33	120	50	SAP-78	180	100
SAP-34	100	70	SAP-79	190	110
SAP-35	80	60	SAP-80	90	50
SAP-36	120	80	SAP-81	210	180
SAP-37	<u>70</u>	<u>40</u>	SAP-82	120	91
SAP-38	80	50	SAP-83	170	90
SAP-39	100	60	SAP-84	120	90
SAP-40	100	70	SAP-85	230	140
SAP-41	150	100	SAP-86	110	80
SAP-42	110	80	SAP-87	300	180
SAP-43	140	90	SAP-88	100	80
SAP-44	190	100	SAP-89	120	90
SAP-45	160	90	Average	163.93	84.40
SAP-46	150	100	Maximum	350.00	70.00
SAP-47	130	100	Minimum	196.00	40.00

CONCLUSIONS

All the samples were cultivated for assessment of growth parameters. Comparative analysis revealed that maximum height of the plants recorded in sample number SAP-3 (0.78), SAP-1 (1.13), SAP-3&10 (7.28), SAP-59 (14.00), SAP-10 (28.00), SAP-76 (37.80), SAP-76 (51.60), SAP-76 (63.20), SAP-77 (74.00), SAP-77 (76.00) and SAP-77 (77.20) after 15th, 30th 45th, 60th, 75th, 90th, 105, 120th, 135th, 150th, 165 days, maximum number of branches/plant of different samples was recorded in sample number SAP-3, 10, 14, 27, 31, 46, 54, 55, 57, 69, 76, 78, 83, 85, 86 & 89 (6), SAP-3, 10, 18, 22, 27, 39, 46, 54, 55, 57, 59, 76, 78, 79 & 84 (12), SAP-57, 76 & 78 (16), SAP-76 (23), SAP-76 (25), SAP-76 (32), SAP-76 (33) and SAP-76 (33) after 60th, 75th, 90th, 105, 120th, 135th, 150th and 165 days., maximum numbers of leaves/plants of different samples were recorded in sample number SAP-55, 58, 64, 65, 70, 85 & 86 (6), SAP-84 & 88 (8), SAP-10 & 84 (13), SAP-57 (25), SAP-24, 25, 31 & 57 (40), SAP-85 (68.2), SAP-9 (134.4), SAP-54 (169), SAP-54 (233.00), SAP-54 (274) and SAP-54 (406.40) after 15th, 30th 45th, 60th, 75th, 90th, 105, 120th, 135th, 150th and 165 days and their maximum Green/Fresh weight (10 plants/sample in gm) of different samples were recorded in sample number SAP-25 (350) and Dry weight (10 plants/sample in gm) sample number SAP-60 (196) after 165 days. Sample codes SAP-77, SAP-76, SAP-54 and SAP-25 are very good results showed after 165 days.

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