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EFFECT OF SHADE AND SPACING ON GROWTH AND YIELD OF KALMEGH (*ANDROGRAPHIS PANICULATA* (BRUM.F.) WALL. EX NEES)

ALI ZAFAR AND SHWETA
VERMICULTURE RESEARCH STATION, DEPARTMENT OF ZOOLOGY,
D.S. (PG) COLLEGE, ALIGARH-202 001, INDIA.
(e-mail : kmshweta3@yahoo.com)

Investigations carried out during 2007-2008 on *Andrographis paniculata* (Brum.f.) Wall.ex Nees, an important drug of ISM & H suggest that 75 per cent shade and 10 cm x 10 cm spacing between plant to plant are optimum in terms of over-all growth and yield of the crop, using vermicompost prepared from cattle dung.

Key words : Shade and spacing, growth, yield of Kalmegh (*Andrographis paniculata* (Burm.F.) Wall. Ex Nees)

INTRODUCTION

Tropical forests are an abode of medicinal plants. They are in great demand due to the increased acceptance of ayurveda and traditional medicines, because of their property of less or no side effects. In order to maintain a sustained supply of raw materials to the drug industry, these plants are encouraged to be cultivated outside the forest ecosystem in recent years. *Andrographis paniculata* is a source of several diterpenoids of which andrographolide is important. It is used for the treatment of general debility, dyspepsia, chronic malaria, jaundice and dysentery . Extract of this plant is used in the treatment of upper respiratory tract infections. Weibo (1995) reported andrographolide has the potential to be included in the cocktail vaccine against AIDS by virtue of its antagonistic property with HIV II virus. It is already being used in treating cancer as it promotes all differentiation in tumour cells (Matsuda *et al.*, 1994).

Currently emphasis is on sustainable agriculture, which stresses for the use of less chemical inputs like fertilizers and pesticides having series of adverse effects on soil health, fertility and environment. Vermicomposts are known to improve the nutritional status of soil growth and development of plants. In view of high medicinal potential of the drug, the study was undertaken to develop suitable agro-technology to access the growth and yield under the different shade and spacing on *Andrographis paniculata*.

MATERIALS AND METHODS

Experiments on agro-technological practices using vermicompost for crude drug production of *Andrographis paniculata* were carried out during 2007-2008 at Vermiculture Research Station, D.S. College, Aligarh. The experimental site lies between 27°54'50" N latitude and 78°4'26" E longitude and represents almost a dry climate with a average minimum and maximum temperature ranging 18.6 $\pm$ 0.99°C and 30.75 $\pm$ 0.98°C respectively.

Certified organic seeds were collected from Rajasthan Agro-forestry Corporation Ltd., Sonamukhi Nagar, Jodhpur (Rajasthan) and nursery was developed under controlled conditions. Vermicompost was prepared from cattle manure and organic wastes. The

chemical composition of the experimental materials used in the study are given in Table I.

Table I : Chemical composition of used vermicompost.

Parameters	Nutrient value
pH	6.8 ± 0.78
Total Nitrogen	1.33 ± 0.62
Available Phosphorus	1.47 ± 0.11
Available Potassium	0.15 ± 0.19
Calcium	1.23 ± 0.77
Magnesium	0.16 ± 0.13
Sulphur	0.22 ± 0.03
Organic carbon	13.5 ± 2.93
Iron (mg/100 g)	746.26 ± 2.92
Manganese (mg/100 g)	53.86 ± 1.17
Zinc (mg/100 g)	16.19 ± 1.05
Copper (mg/100 g)	5.16 ± 1.04

The experimental design was RBD, the physical and chemical composition of soil were analysed during the study and are given in Table II.

Table II : Physical and chemical characteristics of the soil prior to the experiment.

Parameters	Soil characteristics
Texture	Clay loam
Structure	Granular
pH	6.09 ± 0.62
Available nitrogen (ppm)	144.48 ± 0.86
Available phosphorus (ppm)	2.90 ± 1.0
Available potassium (ppm)	68.00 ± 1.96
Cu (ppm)	175.80 ± 0.90
Mg (ppm)	16.07 ± 0.56
S (ppm)	5.22 ± 1.15
Fe (ppm)	20.36 ± 0.56
Mn (ppm)	9.58 ± 1.16
Zn (ppm)	1.75 ± 0.29
Cu (ppm)	3.85 ± 0.24

RESULTS AND DISCUSSION

Appropriate agro-technological practices are recorded to ensure adequate availability of quality crude drugs and fetch high return to the farmers.

In the present investigation the plant height (cm) was found maximum (65.63± 1.15) in 75 percent shade at 6 MAP (month after planting) stage while, minimum (33.76±1.08) in 0 percent shade at 2 MAP stage. The plant height (cm) in the different spacing was maximum (64.81±0.98) recorded in 10x10 cm spacing at 6 MAP stage while, the minimum (38.86±1.25) in 20 x 10 cm spacing at 2 MAP stage. spacing at 2 MAP stage. The flower size (cm) was maximum (1.07 ± 0.43) in the 75 per cent

Table III : Effect of shade and spacing on plant height (cm) of *Andrographis paniculata*.

MAP*	Plant height (cm)		
	2	4	6
Shade (%)			
0	33.76±1.08	42.46 ±0.64	46.10±0.86
25	40.73±2.22	49.19±1.20	52.66±1.07
50	42.42±0.80	50.30±1.33	52.68±0.83
75	58.80±1.08	59.76±1.13	65.63±1.15
Spacing (cm)			
10 x 10	40.20 ± 1.35	45.26 ± 1.16	64.81 ± 0.98
20 x 10	38.86 ± 1.25	47.87 ± 1.19	62.93 ± 1.11
20 x 20	41.28 ± 1.19	49.26 ± 1.16	63.61 ± 1.31
30 x 20	41.36 ± 1.07	47.87 ± 1.16	63.26 ± 1.07

* : Months after planting.

Table IV : Effect of shade and spacing on leaf production of *Andrographis paniculata*.

MAP	Leaf production (Nos.)		
	2	4	6
Shade (%)			
0	116.36 ± 1.41	148.38 ± 0.96	198.77 ±1.08
25	123.42 ±1.08	139.54 ±0.94	210.83 ± 1.03
50	122.00 ±2.99	142.23 ± 1.20	208.27 ± 1.14
75	132.93 ±1.09	163.86 ±1.25	224.39 ± 0.92
Spacing (cm)			
10 x 10	38.24 ±1.82	164.38 ±0.93	246.83 ± 1.18
20 x 10	129.83 ±1.14	158.26 ±0.98	240.23 ± 1.20
20 x 20	121.76 ±1.19	156.28 ± 0.97	234.29 ±0.98
30 x 20	109.22 ±1.21	122.88 ±1.09	182.37 ±1.30

Table V : Effect of shade and spacing on number of branches/plant of *Andrographis paniculata*.

MAP	Branches/plant (Nos.)		
	2	4	6
Shade (%)			
0	6.28 ± 1.19	8.86 ± 1.25	12.87 ±1.19
25	6.13 ±1.01	8.37 ± 0.99	12.82 ± 1.16
50	5.87 ±0.78	6.32 ± 1.05	10.28 ± 1.14
75	7.36 ±1.41	10.58 ±0.97	13.60 ±1.39
Spacing (cm)			
10 x 10	5.82 ± 1.16	7.86 ±1.08	12.63 ± 0.93
20 x 10	8.87 ±1.08	9.88 ±0.74	14.23 ± 0.97
20 x 20	6.34 ± 1.12	8.27 ±1.14	13.87 ± 0.04
30 x 20	7.23 ±1.06	8.92 ±0.13	13.38 ±1.08

shade at 6 MAP stage while, minimum (0.87±0.33) in 0 per cent shade at 5 MAP stage and in the different spacing, the maximum flower size was found (1.04±0.19) in 10 x 10 cm spacing at 6 MAP stage while, minimum (0.89±0.49) in 30 x 20 cm spacing at 5 MAP stage.

Table VI : Effect of shade and spacing on number of flowers/plant of *Andrographis paniculata.*

MAP	Flower (Nos.)	
	5 MAP	6 MAP
Shade (%)		
0	5.44 ±1.51	42.87 ± 1.14
25	5.88 ±2.04	44.29 ±1.01
50	5.72 ± 0.95	43.82 ±1.10
75	6.28 ± 0.94	47.20 ±1.03
Spacing (cm)		
10 x 10	6.39 ± 1.47	47.28 ± 1.03
20 x 10	5.11 ± 0.88	32.71 ±1.10
20 x 20	6.16 ± 1.09	42.92 ± 1.05
30 x 20	7.24 ±1.17	44.67 ±1.23

Table VII : Effect of shade and spacing on number of capsules (fruits) of *A. paniculata.*

MAP	Capsules (fruits)		
	2	4	6
Shade (%)			
0	36.87 ±1.06	91.60 ±1.03	124.66 ± 1.27
25	52.68 ± 0.96	86.27 ±1.05	131.18 ± 1.01
50	53.80 ±0.65	85.82 ± 0.76	128.27 ±1.22
75	56.82 ±1.18	88.27 ±2.11	137.09 ±1.13
Spacing (cm)			
10 x 10	47.23 ±2.07	93.87 ± 2.09	138.88 ± 0.74
20 x 10	48.39 ±0.81	96.27 ±1.34	13.9.27 ± 0.28
20 x 20	53.27 ± 0.94	91.82 ±1.05	134.80 ± 0.11
30 x 20	53.29 ±1.12	93.24 ±0.83	134.24 ± 0.87

Table VIII : Effect of shade and spacing on flower size (cm) of *Andrographis paniculata.*

MAP	Flower size (cm)	
	5 MAP	6 MAP
Shade (%)		
0	0.87 ±0.33	0.92 ± 0.36
25	0.82 ±0.63	0.95 ±0.39
50	0.93 ± 0.38	0.98 ± 0.54
75	1.03 ±0.08	1.07 ±0.43
Spacing (cm)		
10 x 10	1.01 ±0.46	1.04 ±0.19
20 x 10	0.98±.57	1.03 ±0.35
20 x 20	0.94 ±0.54	0.98 ±0.32
30 x 20	0.89 ±0.40	1.0 ±0.64

Menon & Potty (1998, 1999) have reported that heavily shade uplands gave high quality grains in Njavara rice. Vyas & Nein (1999) also observed that shade increased plant height, number of nodes and internodal length in *Cassia angustifolia.* The leaf growth also increased in terms of number and dry matter accumulation and the promoting effect was more prominent at 25 per cent shade, however, the impact of further increase in shade level was marginal. Dopte *et al.* (1999) observed that the growth of *Withania*

somnifera in polynet-house (50 per cent light intensity) was increased by 84.1 per cent along with 80.8 per cent increase in leaf number and 83.6 per cent increase in leaf compared to growth ambient conditions. Fertilizer application promoted nutrient uptake under shaded situation and was highest at 25 per cent shade in ginger (Aney & Jayachandran, 1998).

Kattamani & Reddy (2000) reported that plant height, number of branches per plant, number of leaves per plant and leaf area index were significantly increased with respect to runners as planting material at 60 cm row spacing in *Mentha arvensis*. Sundharaiya *et al.* (2000) observed increase in number of fruits per plant, fruit weight and yield per plant in spacing and fertilizer application in *Solanum khasianum*. Kanjilal *et al.* (2001) reported highest herb yield with 60 x 60 cm spacing in *Wedelia calendulacea* Less.

The above studies corroborate our findings and suggest that 75 per cent shade as compared to open and other shaded conditions and plant to plant spacing of 10 cm x 10 cm gave the best results in terms of growth and yield of *Kalmegh*, the 'king of Bitters'.

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