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Growth and Yield Variation in *Andrographis paniculata* as Influenced by Nutrient Levels and Harvesting Stages

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ABSTRACT

The present study was conducted to determine the effect of integrated dose of manures and fertilizers and harvesting stages on growth and yield of *Andrographis paniculata* in the experimental farm as well as laboratory of Department of Forest Products, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan Himachal Pradesh during the year 2021-22. The experiment was laid out in Randomized Block Design (RBD) factorial under field conditions with eight treatments and three replications. Among various organic manures and fertilizers combinations treatment T_2 (NPK @ 60:45:30 kg/ha) excelled over other treatments for all the growth and yield parameters i.e. plant height (46.98 cm), plant spread (30.07 cm^2), number of branches per plant (19.89), number of leaves per plant (92.39), fresh stem weight per plant (20.30 g), dry stem weight per plant (12.90 g), fresh leaf weight per plant (13.87 g), dry leaf weight per plant (7.47 g), fresh above ground biomass per plant (35.29 g), dry above ground biomass per plant (20.70 g), estimated fresh above ground biomass (26.12 q/ha) and estimated dry above ground biomass (15.32 q/ha) which was followed by T_7 (Vermicompost @ 3.3 t/ha + PK @ 45:30 kg/ha) and minimum values were recorded in control i.e. (T_1). However, in case of interaction effect between organic manures, fertilizers and harvesting stages maximum values for estimated fresh above ground biomass (30.82 q/ha) and estimated dry above ground biomass (18.95 q/ha) were recorded in treatment combination T_2H_2 (NPK @ 60:45:30 kg/ha at flowering stage). Economic analysis revealed that NPK (60:45:30 kg/ha) had the highest benefit cost ratio of 2.06 which was followed by Jeevamrit + PK (45:30 kg/ha) i.e. 1.59 and minimum value was recorded in control.

Keywords *Andrographis paniculata*, Integrated, Jeevamrit, Benefit cost ratio.

INTRODUCTION

Andrographis paniculata commonly known as Kalmegh also known as "King of Bitters" is an annual herb belonging to family Acanthaceae. It posseses immunological, antibacterial and anti-inflammatory properties and is in high demand in the pharmaceutical industries and for making ayurvedic medicines. The entire plant is used to treat bronchitis, influenza,

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diarrhoea, fever, malaria and certain types of dyspepsia. Traditional medicine practitioners use the plant for curing remittent fevers and inflammations (Chopra 1958, Kirtikar *et al.* 1975, Balu *et al.* 1993). The entire herb of this plant is economically valuable and includes various diterpenoids, including andrographolide. The leaves have the highest concentration of andrographolide (2.35%) whereas the roots (0.52 %) and stem (0.35%) have the lowest. It has been used in Asia for years to cure a variety of diseases and is now widely utilized in ayurvedic medicines (Pandey and Mandal 2010).

Local traditional medicine practitioners of Tamil Nadu used *Andrographis paniculata* against snake bite. It is also used in treatment of AIDS and the myriad of symptoms associated with auto immune disorders. It is a bitter herb that is used to treat mild digestive problems in children (Anonymous 1948). It can also be used to cure cold. It has anti-inflammatory, antipyretic and analgesic effects. *Andrographis paniculata* is well-known for its therapeutic and curative effects since the entire plant (stem, leaves and flowers) is used in pharmaceuticals (Farooqi and Sreeramu 2001). Fever, liver disease, diabetes, snake bite, jaundice, diarrhoea, chronic malaria and sore throat are all treated with the leaves and aerial parts. Because of its great "blood purifying" capabilities the plant is also advised for usage in instances of leprosy, gonorrhoea, scabies, boils, skin eruptions, chronic and seasonal fever (Akbar 2011).

Integrated nutrient management (INM) is the use of manures, chemical fertilizers and biological agents to achieve sustainable crop production and improved soil health. It is the best approach for better resource utilization and producing crops with less expenditure. It is a safe way to dispose of organic waste as well as an efficient way to recycle waste into high-quality compost. The primary goal of integrated nutrient management is to sustain economic yield for an extended period of time while minimizing the impact on soil fertility as well as to raise awareness for an environmentally friendly technique (organic farming system) for producing healthy economic returns (Nakade *et al.* 2021).

Kalmegh is one of the most important *kharif* season medicinal plants which is a boon for weaker section of rural areas and can play an important role for their income generation. The National Medicinal Plants Board (NMPB) has proposed 32 prioritized medicinal plant list for cultivation and among them Kalmegh is at 17th position. Due to its wide pharmacological properties and economic value the wild collection is not sufficient to meet the growing demand and at the same time the quality of the raw material available cannot be guaranteed. Thus, keeping in view the medicinal importance of *Andrographis paniculata* and its very high demand in pharmaceutical industries present studies have been conducted.

MATERIALS AND METHODS

The present investigations were carried out in the experimental farm as well as laboratory of Department of Forest Products, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan (HP) during 2021-2022. The altitude of area was 1270 m, Latitude : 30°52'N Longitude : 76°11'E. The maximum rainfall (265.8 mm) was recorded in the month of July followed by September (218.3 mm) and May (148.9 mm) and minimum rainfall was received in the month of October (52.6 mm). Maximum average temperature (30.4°C) was recorded in the month of June followed by July (29.5°C) and minimum average temperature was recorded in the month of October (11.8°C). The maximum relative humidity was recorded in September (79%) whereas minimum relative humidity (59%) was recorded in the month of May (Data pertaining to the relevant meteorological parameters was procured from the Department of Environmental Science of the University) .The topography of the site was undulating with a terraced experimental area. Before transplanting, soil samples were taken at random from the entire experimental area and thoroughly mixed together, thus a composite representative sample was taken from the entire area for chemical analysis to evaluate the fertility status of the soil prior to any treatment. The soil of the experimental area had a silty loam texture with pH (6.72), organic carbon (0.92%), available nitrogen (544.96 kg/ha), available phosphorus (23.34 kg/ha) and available potassium (338 kg/ha).

The experiment was laid out in Randomized

Block Design (RBD) Factorial under field conditions with eight treatments and three replications viz., T_1 – Control (Without fertilizers), T_2 – NPK (60:45:30 kg/ha), T_3 – FYM 9.6 t/ha (N content equivalent to Fertilizer dose), T_4 -Vermicompost 3.3 t/ha (N content equivalent to Fertilizer dose), T_5 – Jeevamrit (Two splits), T_6 – FYM (9.6 t) + PK (45:30 kg/ha), T_7 – Vermicompost (3.3 t) + PK (45:30 kg/ha) and T_8 -Jeevamrit + PK (45:30 kg/ha) with three replications and harvesting was done at three different stages viz., H_1 – Pre flowering stage, H_2 – Flowering stage and H_3 – Pod setting stage. Jeevamrit was applied in two splits i.e. first at the time of transplanting and second after 35 days of transplanting. The comparative efficacy was recorded for different growth and yield parameters. The sowing of seeds was done in the month of May 2021 in the nursery and transplanting during July month with spacing of 45 cm × 30 cm between rows and plants. Quantities of nutrients and fertilizers required in the form of NPK, FYM, Vermicompost and Jeevamrit were calculated before the start of the experimental trial. FYM and Vermicompost were applied at the time of field preparation. N, P and K were applied during transplanting. Jeevamrit was applied in two splits i.e. first as basal dose and second after 35 days of transplanting. The field was irrigated as and when required. Total four irrigations were given followed by weeding which was done manually as and when required. Data on growth and yield parameters were recorded at three different harvesting stages (Pre-flowering, Flowering and Pod-setting stage). The field was irrigated before harvesting of the plants, so that plants could easily be pulled by hands.

The data recorded was subjected to statistical analysis. The analysis of variance was worked out with the help of the latest computer software by using OPSTAT and SPSS.

RESULTS AND DISCUSSION

The experiment was conducted to evaluate the effect of different organic manures, fertilizers and their interactions and different harvesting stages on the growth and yield of *Andrographis paniculata*. The data presented in (Tables 1–6) revealed that application of NPK @ 60:45:30 kg/ha in treatment T_2 resulted in maximum growth and yield parameters .e. plant height (46.98 cm), plant spread (30.07 cm^2), number of branches per plant (19.89), number of leaves per plant (92.39), fresh stem weight per plant (20.30 g), dry stem weight per plant (12.90 g), fresh leaf weight per plant (13.87 g), dry leaf weight per plant (7.47 g), fresh above ground biomass per plant (35.29 g), dry above ground biomass per plant (20.70 g), estimated fresh above ground biomass (26.12 q/ha) and estimated dry above ground biomass (15.32 q/ha) which was followed by T_7 (Vermicompost @ 3.3 t/ha + PK @ 45:30 kg/ha) and minimum values were recorded in control i.e. (T_1) when plants were harvested at full flowering stage i.e. H_2. With respect to different harvesting stages highest values for estimated fresh above ground biomass (25.68 q/ha) and estimated dry above ground biomass (16.18 q/ha) were recorded when plants were harvested at full flowering stage i.e. H_2 and minimum was recorded in pre-flowering stage i.e. H_1. However, in case of interaction effect between organic manures, fertilizers and harvesting stages maximum values for estimated fresh above ground biomass (30.82 q/ha) and estimated dry above ground biomass (18.95 q/ha) were recorded in treatment combination T_2H_2 (NPK @ 60:45:30 kg/ha at Flowering stage) followed by T_7H_2 (Vermicompost @ 3.3 t/ha + PK @ 45:30 kg/ha at Flowering stage) and minimum value was recorded in treatment combination T_1H_1 (4.55 q/ha).

In the present study the maximum plant height, plant spread, number of branches, number of leaves, fresh stem weight, dry stem weight, fresh leaf weight, dry leaf weight, fresh above ground biomass, dry above ground biomass, estimated fresh above ground biomass and estimated dry above ground biomass was recorded in treatment T_2 (NPK 60:45:30 kg/ha) followed by T_7 (Vermicompost @ 3.3 t/ha + PK @ 45:30 kg/ha) and minimum value for all growth and yield parameters was recorded in control. Similar findings have been reported by Aladakatti *et al.* (2012) in stevia (*Stevia rebaudiana* Bertoni.) where plant height at harvest was significantly influenced by higher levels of nitrogen, phosphorus and potassium which in turn were responsible for higher number of branches per plant and number of leaves per plant resulting into higher leaf yield. Vembu *et al.* (2010) also advocated that application of NPK fertilizer brought out significant increase in the leaf yield, root

Table 1. Effect of different organic manures, fertilizers and time of harvesting on plant height (cm) and plant spread (cm^2) in *Andrographis paniculata* (Burm.f.) Wall. ex Nees.

Treatments	Plant height (cm)				Plant spread (cm^2)			
	H_1	H_2	H_3	Mean	H_1	H_2	H_3	Mean
T_1 Control	32.17	35.78	34.22	**34.05**	14.42	20.78	19.94	**18.38**
T_2 NPK (60:45:30 kg/ha	43.78	48.50	48.67	**46.98**	23.61	34.22	32.39	**30.07**
T_3 FYM 9.6 t/ha	34.44	38.94	41.04	**38.14**	17.17	26.44	23.89	**22.50**
T_4 Vermicompost 3.3 t/ha	35.17	40.10	43.39	**39.55**	19.11	26.89	25.45	**23.82**
T_5 Jeevamrit	33.61	38.44	40.78	**37.61**	16.61	25.33	23.66	**21.87**
T_6 FYM 9.6 t +PK (45:30 kg/ha	38.83	42.61	44.56	**42.00**	20.72	30.67	29.45	**26.95**
T_7 Vermicompost 3.3 t + PK (45:30 kg/ha)	42.05	43.67	45.89	**43.87**	22.61	32.17	30.44	**28.41**
T_8 Jeevamrit + PK (45:30 kg/ha)	36.50	42.00	41.89	**40.13**	19.72	28.72	27.72	**25.39**
Mean	**37.07**	**41.26**	**42.55**		**Mean**	**19.25**	**28.15**	**26.62**
	SE (m)	SE (d)	CD (0.05)		SE (m)	SE (d)	CD (0.05)	
Treatment	0.841	1.190	2.392		0.513	0.726	1.459	
Harvesting	0.515	0.729	1.465		0.314	0.444	0.893	
T × H	1.457	2.061	4.142		0.889	1.257	2.526	

yield, fresh leaf weight, dry leaf weight, fresh root weight and dry root weight per plant in *Catharanthus roseus*. Tapre *et al.* (2018) revealed that herbage yield and GMR was significantly highest with application of NPK in the ratio 80:30:50 kg/ha as compared to control in *Andrographis paniculata*. Basak *et al.* (2020) reported higher herbage and andrograholide yield in *Andrographis paniculata* with the application of vermicompost and castor cake. Jat and Gajbhiye (2019) concluded that integrated use of castor cake 2.5 t and NPK 80:30:50 kg/ha with split application of nitrogen produced highest dry herbage yield in *Andrographis paniculata*.

Cheena *et al.* (2020) reported that recommended dose of NPK and vermicompost enhanced the growth and yield of *Andrographis paniculata* with pruning twice at 6 and 8 weeks after sowing. Dhanush *et al.* (2018) reported that application of FYM in combination with 100% Nitrogen and 75% Potassium

Table 2. Effect of different organic manures, fertilizers and time of harvesting on number of branches per plant and number of leaves per plant in *Andrographis paniculata* (Burm.f.) Wall. ex Nees.

Treatments	Number of branches per plant				Number of leaves per plant			
	H_1	H_2	H_3	Mean	H_1	H_2	H_3	Mean
T_1 Control	9.00	11.00	10.33	**10.11**	53.67	67.67	56.89	**59.41**
T_2 NPK (60:45:30 kg/ha)	16.67	21.67	21.33	**19.89**	84.51	106.89	85.78	**92.39**
T_3 FYM 9.6 t/ha	11.00	13.33	14.00	**12.78**	64.57	75.55	66.56	**68.89**
T_4 Vermicompost 3.3 t/ha	11.67	14.33	16.00	**14.00**	70.05	78.80	72.00	**73.62**
T_5 Jeevamrit	10.33	12.33	12.33	**11.67**	59.30	73.22	60.95	**64.49**
T_6 FYM 9.6 t +PK (45:30 kg/ha)	14.00	19.00	18.00	**17.00**	81.04	85.44	82.67	**83.05**
T_7 Vermicompost 3.3 t + PK (45:30 kg/ha)	15.00	20.00	19.33	**18.11**	82.29	93.63	83.89	**86.60**
T_8 Jeevamrit + PK (45:30 kg/ha)	12.67	18.00	17.00	**15.89**	75.92	82.89	77.89	**78.90**
Mean	**12.54**	**16.21**	**16.04**		**71.42**	**83.01**	**73.33**	
	SE (m)	SE (d)	CD (0.05)		SE (m)	SE (d)	CD (0.05)	
Treatment	0.380	0.538	1.081		1.479	2.092	4.204	
Harvesting	0.233	0.329	0.662		0.906	1.281	2.575	
T × H	0.659	0.932	1.873		2.562	3.623	7.282	

Table 3. Effect of different organic manures, fertilizers and time of harvesting on fresh stem weight per plant (g) and dry stem weight per plant in *Andrographis paniculata* (Burm.f.) Wall. ex Nees.

Treatments	Fresh stem weight per plant (g)				Dry stem weight per plant (g)			
	H_1	H_2	H_3	Mean	H_1	H_2	H_3	Mean
T_1 Control	7.44	15.91	14.80	**12.72**	2.74	10.15	7.82	**6.90**
T_2 NPK (60:45:30 kg/ha)	11.59	25.06	24.27	**20.30**	5.76	17.12	15.83	**12.90**
T_3 FYM 9.6 t/ha	8.70	20.99	19.65	**16.45**	3.89	15.12	12.95	**10.66**
T_4 Vermicompost 3.3 t/ha	9.80	21.60	19.94	**17.11**	4.21	15.78	12.93	**10.97**
T_5 Jeevamrit	8.40	18.91	18.26	**15.19**	3.58	13.54	11.33	**9.48**
T_6 FYM 9.6 t +PK (45:30 kg/ha)	11.08	23.61	21.81	**18.83**	5.24	16.56	14.14	**11.98**
T_7 Vermicompost 3.3 t + PK (45:30 kg/ha)	11.21	24.46	23.15	**19.61**	5.61	16.99	14.86	**12.49**
T_8 Jeevamrit + PK (45:30 kg/ha)	10.93	21.86	20.40	**17.73**	4.84	15.76	13.15	**11.25**
Mean	**9.89**	**21.55**	**20.29**		**4.48**	**15.13**	**12.88**	
	SE (m)	SE (d)	CD (0.05)		SE (m)	SE (d)	CD (0.05)	
Treatment	0.414	0.586	1.177		0.290	0.411	0.825	
Harvesting	0.254	0.359	0.721		0.178	0.251	0.505	
T × H	0.717	1.015	2.039		0.503	0.711	1.430	

increased the growth and yield in *Andrographis paniculata*. Amala *et al.* (2023) concluded that treatment combinations of vermicompost, neem cake, poultry manure and arka microbial consortium recorded the highest quality in kalmegh.

Mishra and Jain (2014) reported that integrated use of biofertilizers, chemical fertilizers and vermicompost treatments significantly increased growth parameters in *Andrographis paniculata.*

Parvin *et al.* (2018) found that combination of 45% cowdung and 60 kg N/ha was the optimum level for achieving the maximum growth and yield of kalmegh.

In the present study data on harvesting stages (H_1: Pre-flowering stage, H_2: Flowering stage and H_3: Pod-setting stage) revealed that significantly higher values were recorded for all growth and yield parameters when plants were harvested at full flowering stage.

Table 4. Effect of different organic manures, fertilizers and time of harvesting on fresh leaf weight per plant (g) and dry leaf weight per plant in *Andrographis paniculata* (Burm.f.) Wall. ex Nees.

Treatments	Fresh leaf weight per plant (g)				Dry leaf weight per plant (g)			
	H_1	H_2	H_3	Mean	H_1	H_2	H_3	Mean
T_1 Control	6.20	6.61	6.48	**6.43**	3.15	3.71	3.20	**3.35**
T_2 NPK (60:45:30 kg/ha)	13.49	14.15	13.96	**13.87**	6.86	8.20	7.35	**7.47**
T_3 FYM 9.6 t/ha	7.70	10.53	7.76	**8.66**	3.90	5.83	4.88	**4.87**
T_4 Vermicompost 3.3 t/ha	8.26	11.25	8.58	**9.37**	4.05	6.45	4.93	**5.14**
T_5 Jeevamrit	6.72	8.95	6.82	**7.49**	3.41	4.71	3.49	**3.87**
T_6 FYM 9.6 t+PK (45:30 kg/ha)	9.87	12.51	10.16	**10.85**	4.77	7.50	6.25	**6.17**
T_7 Vermicompost 3.3 t + PK (45:30 kg/ha)	11.29	13.12	10.79	**11.73**	6.26	8.18	6.79	**7.08**
T_8 Jeevamrit + PK (45:30 kg/ha)	9.13	11.71	9.20	**10.01**	4.55	6.56	5.05	**5.39**
Mean	**9.08**	**11.10**	**9.22**		**4.62**	**6.39**	**5.24**	
	SE (m)	SE (d)	CD (0.05)		SE (m)	SE (d)	CD (0.05)	
Treatment	0.407	0.576	1.158		0.204	0.289	0.581	
Harvesting	0.249	0.353	0.709		0.125	0.177	0.356	
T × H	0.705	0.997	2.005		0.354	0.500	1.006	

Table 5. Effect of different organic manures, fertilizers and time of harvesting on fresh above ground biomass per plant (g) and dry above ground biomass per plant (g) in *Andrographis paniculata* (Burm.f.) Wall. ex Nees.

Treatments	Fresh above ground biomass per plant (g)				Dry above ground biomass per plant (g)			
	H_1	H_2	H_3	Mean	H_1	H_2	H_3	Mean
T_1 Control	13.98	24.59	22.24	**20.27**	6.15	14.21	11.42	**10.59**
T_2 NPK (60:45:30 kg/ha)	25.36	41.64	38.88	**35.29**	12.98	25.61	23.50	**20.70**
T_3 FYM 9.6 t/ha	16.81	33.34	29.37	**26.51**	8.21	21.36	18.15	**15.91**
T_4 Vermicompost 3.3 t/ha	18.58	34.82	29.44	**27.61**	8.54	22.56	18.24	**16.45**
T_5 Jeevamrit	15.51	29.39	25.76	**23.55**	7.31	18.56	15.20	**13.69**
T_6 FYM 9.6 t +PK (45:30 kg/ha)	21.17	37.88	32.59	**30.55**	10.42	24.39	20.78	**18.53**
T_7 Vermicompost 3.3 t + PK (45:30 kg/ha)	22.82	40.27	34.81	**32.63**	12.22	25.53	22.03	**19.93**
T_8 Jeevamrit + PK (45:30 kg/ha)	20.26	35.61	30.11	**28.66**	9.76	22.71	18.64	**17.03**
Mean	**19.31**	**34.69**	**30.40**	**19.31**	**9.45**	**21.87**	**18.50**	

	SE (m)	SE (d)	CD (0.05)	SE (m)	SE (d)	CD (0.05)
Treatment	0.639	0.904	1.817	0.351	0.497	0.999
Harvesting	0.391	0.553	1.112	0.215	0.304	0.612
T × H	1.107	1.565	3.146	0.609	0.861	1.730

These results are in line with Kumar and Kumar (2013) who reported that maximum dry herbage yield was maximum when kalmegh plants were harvested after 135 days i.e. full flowering stage. Kumar *et al*. (2006) also reported that andrographolide content and yield of kalmegh were found to be maximum at 135 DAT and iron content was maximum at 120 DAS.

Pandey *et al*. (2003) advocated that the dry biomass was highest in *Andrographis paniculata* between 135-150 days after planting. The andrographolide content was maximum in the crop harvested after 135 days of planting and minimum after 60 days of planting. Hence the harvesting date was recommended between 135-150 days after planting to obtain

Table 6. Effect of different organic manures, fertilizers and time of harvesting on estimated fresh above ground biomass (q/ha) and estimated dry above ground biomass (q/ha) in *Andrographis paniculata* (Burm.f.) Wall. ex Nees.

Treatments	Estimated fresh above ground biomass (q/ha)				Estimated dry above ground biomass (q/ha)			
	H_1	H_2	H_3	Mean	H_1	H_2	H_3	Mean
T_1 Control	10.34	18.20	16.46	**15.00**	4.55	10.52	8.45	**7.84**
T_2 NPK (60:45:30 kg/ha)	18.76	30.82	28.77	**26.12**	9.61	18.95	17.40	**15.32**
T_3 FYM 9.6 t/ha	12.44	24.68	21.74	**19.62**	6.08	15.81	13.43	**11.77**
T_4 Vermicompost 3.3 t/ha	13.75	25.77	21.79	**20.44**	6.32	16.70	13.50	**12.17**
T_5 Jeevamrit	11.48	21.76	19.06	**17.43**	5.41	13.74	11.25	**10.13**
T_6 FYM 9.6 t +PK (45:30 kg/ha)	15.67	28.03	24.12	**22.61**	7.78	18.05	15.38	**13.74**
T_7 Vermicompost 3.3 t + PK (45:30 kg/ha)	16.89	29.80	25.76	**24.15**	9.04	18.90	16.30	**14.75**
T_8 Jeevamrit + PK (45:30 kg/ha)	14.99	26.36	22.29	**21.21**	7.22	16.81	13.80	**12.61**
Mean	**14.29**	**25.68**	**22.50**		**7.00**	**16.18**	**13.69**	

	SE (m)	SE (d)	CD (0.05)	SE (m)	SE (d)	CD (0.05)
Treatment	0.531	0.750	1.508	0.472	0.668	1.342
Harvesting	0.325	0.459	0.923	0.289	0.409	0.822
T × H	0.919	1.300	2.612	0.818	1.156	2.324

Table 7. Economics of cost of cultivation, gross income, net income and B:C ratio in *Andrographis paniculata* (Burm.f.) Wall. ex Nees.

Treatments	Dry yield (kg/ha)	Average price (Rs/kg)	Gross income (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	B:C ratio
T_1 (Control) TT_1 (Control)	1051.70	125	1,31,462.50	70,364.00	61,098.50	0.86
T_2 NPK (60:45:30 kg/ha)	1895.30	125	2,36,912.50	77,355.93	1,59,556.57	2.06
T_3 FYM 9.6 t/ha	1581.00	125	1,97,625.00	86,374.00	1,11,251.00	1.28
T_4 Vermicompost 3.3 t/ha	1669.73	125	2,08,716.25	1,09,884.00	98,832.25	0.89
T_5 Jeevamrit	1374.00	125	1,71,750.00	75,313.25	96,436.75	1.28
T_6 FYM 9.6 t + PK (45:30 kg/ha)	1805.13	125	2,25,641.25	91,980.13	1,33,661.12	1.45
T_7 Vermicompost 3.3 t + PK (45:30 kg/ha)	1889.77	125	2,36,221.25	1,15,490.13	1,20,731.12	1.04
T_8 Jeevamrit+PK (45:30 kg/ha)	1680.60	125	2,10,075.00	80,919.38	1,29,155.62	1.59

quality herb with optimum production. Wankhade *et al.* (2005) also reported that the planting at 1st July and harvesting on 1st November yields for maximum herbage yield in *Andrographis paniculata*.

Maximum fresh herb yield obtained by harvesting at flowering stage of harvest could be attributed to increased growth traits which might have contributed to more leaves and number of branches. The decline in number of leaves and yield at pod-setting stage of harvest might be due to abscission of lower leaves as a result of natural senescence.

The comparative efficacy of organic manures and fertilizers on growth and yield of *Andrographis paniculata* was investigated. The cost of cultivation included all inputs such as seed costs, labor charges involved in field preparation, intercultural operations and crop harvesting which were all calculated in terms of total money in rupees. Similarly, when calculating the return, the estimated total dry above ground biomass was multiplied by the current market rate of *Andrographis paniculata* (Rs 125/kg). Highest benefit: Cost ratio (2.06) was obtained with the application of NPK (60:45:30 kg/ha) followed by Jeevamrit + PK (45:30 kg/ha) (1.59) and FYM @ 9.6 t/ha + PK @ 45:30 kg/ha (1.45). However, minimum benefit: Cost ratio (0.86) was recorded in control (Table 7).

Maximum B:C ratio was recorded in T_2 (NPK @ 60:45:30 kg/ha) i.e. 2.06 followed by T_8 (Jeevamrit + PK (45:30 kg/ha) (1.59) and T_6 (FYM 9.6 t +PK (45:30 kg/ha) (1.45). Apart from application of chemical fertilizers, integration of FYM + PK and Jeevamrit + PK can be a viable option for kalmegh cultivation due to lesser inputs involved in FYM production and preparation of Jeevamrit. Treatment T_4 (Vermicompost 3.3 t/ha) recorded lower B:C ratio of 0.89 which was due to higher rate of vermicompost and lowest B:C ratio was recorded in control (0.86).

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