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Effect of INM on Vegetative Growth, Flowering and Fruiting of *Andrographis Paniculata*

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Abstract An experiment was conducted to find out the effect of INM on vegetative growth, flowering and fruiting of *Andrographis paniculata*. The experiment was followed in a randomized block design with 8 treatments. The different treatments were T_1- no treatment, T_2-vermicompost, T_3-biofertilizers, T_4-chemical fertilizers, T_5-biofertilizers + vermicompost, T_6- biofertilizers + chemical fertilizers, T_7- chemical fertilizers + vermicompost, T_8-biofertilizers + chemical fertilizers + vermicompost. The results indicated that maximum growth i.e. plant height, number of branches, number of leaves, leaf length and breadth, leaf area, land area occupied by per plant and leaf area index, number of flowers and fruits of *A. paniculata* was found in T_8 plot treatment compare to other plots. From the analysis of result it has concluded that integrated use of biofertilizers, chemical fertilizers and vermicompost treatments significantly increased growth parameters of *A. paniculata*.

Keywords Biofertilizers, Chemical Fertilizers, Vermicompost, INM, *Andrographis paniculata*

1. Introduction

Medicinal plants offer alternative remedies with tremendous opportunities. Most of medicinal plants, even today are known to grow widely and naturally. Unfortunately, many of these plants are threatened by the hazard of extinction. Not surprisingly, wild plants species used for medicinal purposes are receiving ever increasing attention from the scientific community and commercial enterprises. It is necessary to initiate systematic cultivation of medicinal plants in order to conserve biodiversity and protect endangered species.

Agriculture has the greatest environmental impact of all types of economic activity, mainly because it is so land-intensive. Today, little undeveloped arable land remains on Earth. A wide variety of factors hinders the cultivation of new land, including low soil quality, arid climate, lack of infrastructure and environmental restrictions. The application of an integrated plant nutrient supply system is becoming popular as it is scientifically sound and assures sustainable development in agriculture. The use of judicious combination of organic and inorganic fertilizer source is essential not only to maintain soil health but also sustain productivity (Malewar *et al.,* 1998).

A.paniculata has been used for centuries in Asia for the treatment of various ailments. It is one among the prioritized medicinal plant in India. The plant is known as ' King of bitters'. it is one of the bitterest, annual herbaceous plant. The plant contains a number of diterpenoid. Andrographolide (the diterpenoid lactones) is the main bitter principle found in high concentrations in the leaves of Kalmegh (Tang.W. *et al*., 1992). Andrographolide showed anticancer activity on diverse cancer cells representing different types of human cancers (Kumar R.A. *et al.*, 2004). Calabrese, *et al.,* (2000) has conducted a trial on HIV patients and found effective.). Beyond this effects it is useful as an anti inflammatory (Shen Y.C. *et al.*, 2002), antiviral (Wiart C. *et al.,* 2005), antimalarial (Mishra P. *et al.,* 1992 and Rahman, *et al.,* 1999) hepatoprotective (Handa S.S. *et al.*, 1990) etc. Looking at the utility and importance of *A.paniculata*, it is need to make better by developing systematic agro-techniques. To achieve maximum growth, we should apply biofertilizers, chemical fertilizers and organic manures i.e. vermicompost. For sustainability, it's important to incorporate bio-organisms and organic matter into the soil. The present investigation was, therefore, carried out to see the effect of INM on vegetative growth, flowering and fruiting of *Andrographis paniculata*.

2. Material and Method

The field experiment was conducted at Sarojini Naidu Govt. Girls P.G. (Autonomous) college, Bhopal, Madhya Pradesh. The experiment was conducted in a randomized block design (RBD) with 8 treatments and 3 replicas of each, using chemical fertilizers (NPK), vemicompost, and bio fertilizers (*Azotobacter*, phosphate solubilizing bacteria) in different combinations including one control treatment. The treatments were T_1 - control (no treatment), T_2

-Vermicompost 5t ha^{-1}, T_3 - Biofertlizers (250g *Azotobacter* ha^{-1} + 250g PSB ha^{-1}), T_4 - Chemical fertilizers (60:30:30kg NPK ha^{-1}), T_5 – BF + VC (125g *Azotobacter* + 125g PSB + 5t vermicompost ha^{-1}), T_6 - BF + CF [125g *Azotobacter* + 125g PSB + 50% NPK (RDF) ha^{-1}], T_7 - CF + VC (50% NPK + 5t vermicompost ha^{-1}) and T_8 - BF + CF + VC [250g bio fertilizers (125g *Azotobacter* + 125g PSB) + 50% NPK (RDF as 30:15:15 kg per ha^{-1}) + 5t VC.

For recording various biometric observations, five plants were randomly selected for sampling, and tagged for recording the growth parameters. After sowing, 30 DAS plant height, number of branches, number of leaves, leaf length and breadth, leaf area, land area occupied by per plant and leaf area index, no. of flowers and fruits were recorded.

Leaf area was calculated by the formula:-

Leaf Area = leaf length × leaf breadth

Leaf area index was worked out by the formula (Sesak et al*.,* 1971).

$$LAI = \frac{\text{Leaf area of per plant}}{\text{Land area occupied by per plant.}}$$

The results were statistically analyzed by using SPSS software, version 20, 2011.

3. Result and Discussion

Table 1. Effect of different nutrient sources on morphological parts of *A. paniculata* at vegetative stage.

Plot No.	Treatment		30 DAS Stage							
			Plant height (cm)	Number of branches per plants	Number of leaves per plant	Leaf length (LL) and Leaf breadth (LB)(cm)		Leaf area (cm^2)	Land area occupied by per plant (cm)	Leaf area index
						LL	LB			
T_1	NT		2.46	0.4	6.4	2.0	1.0	2.00	2.3	0.86
T_2	VC		5.38	1.2	9.2	2.8	1.2	3.36	3.5	0.96
T_3	BF		5.52	1.6	11.2	3.1	1.3	4.03	4.0	1.00
T_4	CF		3.48	0.8	7.2	2.6	1.1	2.86	3.0	0.95
T_5	BF+VC		6.68	2.8	12.8	3.8	1.8	6.84	6.4	1.06
T_6	BF+CF		6.42	2.4	12.0	3.6	1.6	5.76	5.5	1.04
T_7	CF+VC		5.82	2.0	11.6	3.5	1.4	4.90	4.8	1.02
T_8	BF+CF+VC		7.0	3.6	13.6	4.0	1.9	7.60	7.1	1.07
SA	Mean		5.3450	1.8500	10.5000	3.175	1.413	4.6688	4.5750	0.995
SA	SD		1.59176	1.06771	2.62515	0.678	0.327	1.96635	1.67992	0.0696
SA	SEm		0.56277	0.37749	0.92813	0.24	0.116	0.69521	0.59394	0.0246
SA	95% confidence interval of the difference	Lower	4.0143	0.9574	8.3053	2.608	1.139	3.0248	3.1705	0.936
		Upper	6.6757	2.7426	12.6947	3.742	1.686	6.3127	5.9795	1.053

Table 2. Effect of different nutrient sources on morphological parts of *A. paniculata* at Harvesting stage.

Plot No.	Treatment		135 DAS							
			Plant height (cm)	Number of branches per plants	Number of leaves per plant	Leaf length (LL) and Leaf breadth (LB)(cm)		Leaf area (cm^2)	Land area occupied by per plant (cm)	Leaf area index
						LL	LB			
T_1	NT		26.26	38.0	78.4	4.4	1.7	7.48	6.8	1.10
T_2	VC		42.26	47.6	84.4	8.3	2.1	17.43	15.3	1.13
T_3	BF		45.22	50.4	86.0	8.5	2.2	18.70	16.4	1.14
T_4	CF		38.6	42.0	80.0	6.1	1.9	11.59	10.4	1.11
T_5	BF+VC		48.34	62.0	91.2	9.6	2.6	24.96	20.1	1.24
T_6	BF+CF		48.28	60.0	90.4	9.3	2.4	22.32	18.1	1.23
T_7	CF+VC		45.5	58.4	89.6	9.1	2.3	20.93	17.6	1.18
T_8	BF+CF+VC		51.64	66.0	91.6	9.8	2.7	26.46	20.3	1.30
SA	Mean		43.2625	53.0500	86.4500	8.138	2.238	18.7338	15.6250	1.1788
SA	SD		7.94450	10.07160	5.14670	1.907	0.338	6.49755	4.74786	0.0716
SA	SEm		2.80881	3.56085	1.81963	0.674	0.119	2.29723	1.67862	0.0253
SA	95% confidence interval of the difference	Lower	36.6207	44.6299	82.1472	6.543	1.955	13.3017	11.6557	1.118
		Upper	49.9043	61.4701	90.7528	9.732	2.52	24.1658	19.5943	1.238

Table 3. Effect of different nutrient sources on reproductive part of *Andrographis paniculata* at vegetative and harvesting stage.

Plot No.	Treatments		30 DAS		135 DAS	
			Number of Flowers	Number of Fruits	Number of Flowers	Number of Fruits
T_1	NT		-	-	50.6	15.5
T_2	VC		-	-	64.2	19.4
T_3	BF		-	-	66	20.0
T_4	CF		-	-	60.8	17.2
T_5	BF+VC		-	-	72.4	25.5
T_6	BF+CF		-	-	71.6	23.2
T_7	CF+VC		-	-	69	22.4
T_8	BF+CF+VC		-	-	75.2	27.8
SA	Mean		0.000	0.000	66.2250	21.3750
SA	SD		0.000	0.000	7.86489	4.14755
SA	SEm		0.000	0.000	2.78066	1.46638
SA	95% confidence interval of the difference	Lower	0.000	0.000	59.6498	17.9076
		Upper	0.000	0.000	72.8002	24.8424

Abbreviations:- NT- No Treatment, BF-Biofertilizers, CF- Chemical Fertilizers, LL-Leaf Length, LB-Leaf Breadth, VC- Vermicompost, SD- Standard Deviation, SEm- Standard Error mean, SA-Statistical Analysis, INM- Integrated Nutrient Management, N-nitrogen, P-phosphorus, K- Potassium, PSB-phosphate solubilising bacteria.

In the present research, it was found that, at 30 DAS, maximum plant height (7.0 cm), number of branches (3.6), number of leaves (13.6), leaf length and breadth (4.0cm LL, 1.9cm LB), leaf area (7.60 cm^2), land area occupied by per plant (7.1cm) and leaf area index (1.07) was recorded in T_8 plot followed by T_5 plot treatment (Table 1) whereas no flowering was seen (Table 3). Similarly, at 135 DAS Maximum plant height (51.64 cm), number of branches (66.0), number of leaves (91.6), leaf length and breadth (9.8cm LL , 2.7cm LB), leaf area (26.46 cm^2), land area occupied by per plant (20.3 cm) and leaf area index (1.30) was recorded in T_8 plot (Table 2). Maximum number of flowers (75.2) and fruits (27.8) were also recorded in T_8 plot (Table 3) follower by T_5 plot treatment.

The present study reveals that maximum growth of morphological and reproductive parts of plants increases in T_8 plot compare to other plots. Same results has been already reported by Tara DW and MS Fatima., 2008 in Cowpea; Sarhan *et al.,*2011 in summer Squash; Shanthi *et al.,* 2012 in Sunflower; Meenakumari and Shekher, 2012 in Tomato; Rubee Lata *et al.,* 2013 in strawberry; Anita Mohanty *et al.,* 2013 in Marigold. Good soil fertility management ensures adequate nutrient availability to plant and improve their growth. Only inorganic fertilizers can't sustain plant growth of land under modern farming. Likewise, nutrient supply through organic manures or biofertilizers can hardly fulfil the need of a plant. From the above results it may be stated that the use of bio-fertilizers, chemical fertilizers along with vermicompost in integrated manner is beneficial in improving the growth of *Andrographis paniculata.*

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