International Journal of Agricultural Sciences
Volume 8 |Issue 1| January, 2012 | 168-170

RESEARCH PAPER

Impact of integrated nutrients on growth and yield of Kalmegh [*Andrographis paniculata* (Burm. F) Wall. Ex Nees]

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Abstract **:** Kalmegh [*Andrographis paniculata* (Burm. F) Wall. Ex Nees.] belonging to the family Acanthaceae is an important medicinal plant, which gains importance for its multiple clinical applications. Investigations were carried out to study the effect of organic, inorganic and biofertilizers on growth and yield of Kalmegh at Horticultural College and Research Institute, Periyakulam. Seventeen treatment combinations with two replications were adopted by using Randomized Block Design. In this field trial, the highest plant height (56.54 cm plant^{-1}), number of branches (22.65 plant^{-1}) and number of leaves (41.40 plant^{-1}), leaf area (128.34 cm^2 plant-1), dry biomass (2.639 t ha^{-1}) and fresh herbage (1392.22 kg ha^{-1}) and alkaloid yield (0.739 %) yields of *Andrographis paniculata* were recorded in the treatment containing 15 t FYM ha^{-1} + 45:25:25 kg NPK ha^{-1} +1 kg *Azospirillum* ha^{-1}.

Key Words **:** *Andrographis paniculata,* Integrated nutrients, Yield, Andrographolide, Kalmegh

View Point Article **:** Hemalatha, P. and Suresh, J. (2012). Impact of integrated nutrients on growth and yield of Kalmegh [*Andrographis paniculata* (Burm. F) Wall. Ex Nees]. *Internat. J. agric. Sci.*, **8**(1): 168-170.

Article History **: Received :** *13.06.2011;* **Revised :** *22.08.2011;* **Accepted :** *17.11.2011*

INTRODUCTION

Kalmegh [*Andrographis paniculata* (Burm. F.) Wall. Ex Nees] is the king of bitters and belongs to the family Acanthaceae. The plant contains the major chemical constituent *viz.,* andrographolide, a diterpene lactone and minor chemical constituents including diterpene lactones *viz.,* andrograpanin, deoxyandrographolide; glycosides *viz.,* neoandrographolide and andrographiside and flavonols *viz.,* oroxylin, wogonin, andrographidines A, B, C, D, E and F. The plant has been reported to possess antipyretic, antihepatotoxic, antihistamic, analgesic, antibacterial, anti-inflammatory, antifertility and immunosuppressive properties due to its bitter andrographolide content (Matsuda *et al.,* 1994). A study conducted in Indonesia has revealed anti-HIV activity of the crude extract from the whole plant (Otake *et al*., 1995).

Having such a medicinal value and broad geographical distribution through out the country, indiscriminate collection of *Andrographis paniculata* herb from wild sources, without paying any attention towards its conservation and domestication in regular agriculture, has caused a sharp decline in the availability of the drug to the industries and escalation in its prices. The modern and intensive agriculture calls for the heavy dependence of fertilizers and chemicals, which are not only costly but also cause soil and water pollution. It is, therefore, necessary to supply the plant nutrition in an integrated way and to maintain the overall balance and flow of soil nutrients, seeking maximum efficiency and reducing the waste and losses, with minimal detrimental effects on the human environment. Hence, the present experiment has been carried out to study the effect of integrated nutrients on growth, physiological and yield parameters of *Andrographis paniculata.*

MATERIALS AND METHODS

The experiment was laid out in Randomized Block Design

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with seventeen treatment combinations and two replications. The entire treatment combinations were designed on the basis of the recommended dose of chemical fertilizers (60:25:25 kg NPK ha^{-1}) as follows : T_1–15 t FYM ha^{-1}, T_2–2 t Vermicompost ha^{-1}, T_3–60: 25:25 kg NPK ha^{-1}, T_4–15 t FYM ha^{-1} + 60:25:25 kg NPK ha^{-1}, T_5–2 t Vermicompost ha^{-1} + 60:25:25 kg NPK ha^{-1}, T_6–15 t FYM ha^{-1}+ 60:25:25 kg NPK ha^{-1}+ 1 kg *Azospirillum* ha^{-1}, T_7–15 t FYM ha^{-1}+ 45:25:25 kg NPK ha^{-1} + 1 kg *Azospirillum* ha^{-1}, T_8–15 t FYM ha^{-1}+ 60:25:25 kg NPK ha^{-1}+ 1 kg Phosphobacteria ha^{-1}, T_9–15 t FYM ha^{-1}+ 60:20:25 kg NPK ha^{-1} + 1 kg Phosphobacteria ha^{-1}, T_{10}–15 t FYM ha^{-1}+ 60:25:25 kg NPK ha^{-1} + 1 kg Azophos ha^{-1}, T_{11}–15 t FYM ha^{-1}+ 45:20:25 kg NPK ha^{-1} + 1 kg Azophos ha^{-1}, T_{12}–2 t Vermicompost ha^{-1} + 60:25:25 kg NPK ha^{-1}+ 1 kg *Azospirillum* ha^{-1}, T_{13}–2 t Vermicompost ha^{-1} + 45:25:25 kg NPK ha^{-1}+ 1 kg *Azospirillum* ha^{-1}, T_{14}–2 t Vermicompost ha^{-1} + 60:25:25 kg NPK ha^{-1}+ 1 kg Phosphobacteria ha^{-1}, T_{15}–2 t Vermicompost ha^{-1}+ 60:20:25 kg NPK ha^{-1} + 1 kg Phosphobacteria ha^{-1}, T_{16} 2 t Vermicompost ha^{-1}+ 60:25:25 kg NPK ha^{-1}+ 1 kg Azophos ha^{-1} and T_{17}– 2 t Vermicompost ha^{-1}+ 45:20:25 kg NPK ha^{-1}+ 1 kg Azophos ha^{-1}.

The soil analysis of the experimental field inferred as red sandy loam in texture with a pH of 7.8 and EC of 0.51 m mohs cm^{-1}. Full dose of nutrients *viz*., FYM, vermicompost, phosphorus and potassium and half the dose of nitrogen was applied as basal. Remaining half dose of nitrogen was applied as top dressing at 30 days after planting. The biofertilizers were applied as seedling dip prior to the transplantation of seedlings. The observations were recorded at 30, 60 and 90 days after planting in ten plants selected at random in each treatment and mean values were arrived out and recorded. The leaf samples were used for the extraction and estimation of alkaloid by following the method suggested by Senthilkumaran *et al*. (2003).

RESULTS AND DISCUSSION

The results obtained from the present investigation have been duscussed below:

Growth parameters:

The study revealed that the growth parameters were significantly influenced by the application of various treatments. The application of 15 t FYM ha^{-1} + 45:25:25 kg NPK ha^{-1} + 1 kg *Azospirillum* ha^{-1} registered the highest value for plant height (56.54 cm $plant^{-1}$), number of branches (22.65 $plant^{-1}$) and number of leaves (41.40 $plant^{-1}$) as in Table 1. This might be due to the presence of FYM, an easily decomposable organic residue which help in remineralization of immobilized inorganic N, which is subsequently made available to the plants for longer period. Nitrogen being a main constituent of protein and nucleic acid, it greatly influences the cell division and cell enlargement and thereby it could increase the shoot length. By the increased availability of nitrogen, the plant synthesizes protein and other enzymes, which results in increased cell number and cell size leading to better growth of the plant. The presence of phosphorus is essential for

Table 1 : Effect of integrated nutrients in kalmegh [*Andrographis paniculata* (Burm. F) Wall. Ex Nees.]

Treatments	Plant height (cm)	Number of branches	Number of leaves	Leaf area (cm^2)	Dry biomass (t ha^{-1})	Fresh herbage yield (kg ha^{-1})	Andrographolide content (%)
T_1	46.13	16.79	33.62	82.40	2.195	857.96	0.0580
T_2	42.96	15.29	30.70	68.17	2.194	765.74	0.535
T_3	46.28	17.34	33.84	85.91	2.244	907.96	0.587
T_4	55.15	20.86	40.90	124.89	2.497	1158.52	0.725
T_5	44.69	15.98	31.89	73.91	2.226	777.04	0.545
T_6	48.18	19.29	35.50	97.21	2.284	983.70	0.650
T_7	56.54	22.65	41.40	128.34	2.639	1392.22	0.739
T_8	52.14	20.38	39.17	113.35	2.412	1047.04	0.717
T_9	48.82	19.51	36.18	100.44	2.298	1001.48	0.688
T_{10}	47.37	18.92	35.09	95.19	2.270	975.37	0.625
T_{11}	49.69	19.92	37.51	105.29	2.323	1028.52	0.707
T_{12}	48.88	19.66	36.67	102.79	2.301	1006.30	0.698
T_{13}	47.39	18.48	34.86	91.64	2.268	952.04	0.618
T_{14}	46.70	17.87	34.52	87.90	2.258	925.00	0.606
T_{15}	50.48	20.05	38.41	106.88	2.341	1037.97	0.710
T_{16}	53.52	20.61	40.17	121.19	2.431	1085.19	0.718
T_{17}	45.61	16.54	32.47	78.81	2.198	808.15	0.555
Mean	48.86	18.83	36.05	97.90	2.316	982.95	0.616
C.D. (P=0.05)	0.1765	0.2763	0.4103	3.2330	0.0105	12.7289	0.0063

numerous metabolic processes such as photosynthesis and respiration and also it enhances the root proliferation. This could make the nutrients uptake much better resulting in growth of the plant. The potassium helps in better conversion of photosynthates for the better growth of the plant. It may also be due to the production of growth substances like auxin in addition to the additional nitrogen fixed by *Azospirillum*, which resulted in cell division and cell elongation (Bist *et al.,* 2000).

Physiological parameters:

The leaf area is responsible for the photosynthetic effect for growth and development of the crop. Greater leaf area aids the crop to synthesize more metabolites exhibiting high photosynthetic rate and good source sink relationship during the period of growth and development. The present investigation also revealed the a steady increase in leaf area (128.34 cm^2 plant-1) with the application of 15 t FYM ha^{-1} + 45:25:25 kg NPK ha^{-1} + 1 kg *Azospirillum* ha^{-1} (Table 1). In addition to mineralization and long term availability of nutrients by FYM, increased auxin activity, carbohydrates and other organic compounds produced by nitrogen, application of adequate phosphorus and potassium enhancing the availability of nutrients along with the production of growth hormones like IAA, GA and cytokinins, by the application of *Azospirillum* might be the reason to cause increase in the length and breadth of the leaves leading to increased leaf area (Manjunatha *et al*., 2002).

The dry biomass (2.639 t ha^{-1}) was also increased by the application of 15 t FYM ha^{-1} + 45:25:25 kg NPK ha^{-1} + 1 kg *Azospirillum* ha^{-1}. The dry biomass was considered to be the necessary prelude to higher plant yield. The combined application of 15 t FYM ha^{-1} + 45:25:25 kg NPK ha^{-1} + 1 kg *Azospirillum* ha^{-1} recorded the highest DMP. *Azospirillum* inoculation would have induced changes in fluidity of cell membranes due to auxin and enzymes that prevent the loss of nutrients and metabolic products from the plants. These nutrients and metabolic products would have been either reabsorbed or metabolized, leading to the utilization of the energy, for the increased growth and accumulation of dry matter (Arumugam *et al*., 2001).

Yield parameters:

The herbage yield (1392.22 kg ha^{-1}) of the plant markedly increased with the age of the plant by the application of 15 t FYM ha^{-1} + 45:25:25 kg NPK ha^{-1} + 1 kg *Azospirillum* ha^{-1} (Table 1). 'N' helps the plant for luxuriant vegetative growth by causing synthesized photosynthates to get metabolically converted into protein and there by adding to production of more vegetative tissues. The phosphorus, a constituent of DNA and RNA, plays a significant role in metabolic process of plants. 'K' aids in the effective conversion of phytosynthates for the better growth and ultimately yield of the plant. Finally, *Azospirillum* increases the photosynthetic rate, nitrogen reductase activity, glutamine synthetase activity and chlorophyll content of the plant (Manjunatha *et al*., 2002).

Among the treatments, the highest percentage of andrographolide content (.739 %) was recorded in the treatment supplied with 15 t FYM ha^{-1} + 45:25:25 kg NPK ha^{-1} + 1 kg *Azospirillum ha*$^{-1}$. This might be due to the higher availability and uptake of nutrients, which enhanced the higher photosynthetic activity, and accumulation of more photosynthates at the sink when compared to the other treatments. Higher photosynthates in turn correspond to the higher amount of andrographolide. Nitrogen is found increasing the dry matter production, which might lead to the increase in alkaloid content (Poongodi, 2003). The higher availability of nitrogen in the particular treatment might be attributed for higher quantity of andrographolide synthesis.

Hence, it may be concluded that, the highest plant height (56.54 cm $plant^{-1}$), number of branches (22.65 $plant^{-1}$), number of leaves (41.40 $plant^{-1}$), leaf area (128.34 cm^2 $plant^{-1}$), dry biomass (2.639 t ha^{-1}), fresh herbage (1392.22 kg ha^{-1}) and alkaloid yield (0.739 %) of *Andrographis paniculata* were recorded in the treatment containing 15 t FYM ha^{-1} + 45:25:25 kg NPK ha^{-1} +1 kg *Azospirillum* ha^{-1}.

REFERENCES

Arumugam, T., Doraipandian, A., Premalakshmi, V. and Vijayakumar, M. (2001). Studies on the effect of biofertilizer on biomass production in senna (*Cassia angustifolia* Vahl.). *South Indian J. Hort.,* **49**: 178-180.

Bist, L.D., Singh, A.K. and Nand, K. (2000). Growth and yield on isabgol (*Plantago ovata* Forsk.) cv. GUJARAT isabgol-2 in response to nitrogen levels. *Prog. Hort.,* **32**(2): 202-203.

Manjunatha, R., Farooqi, A.A., Vasundhara, M. and Srinivasappa, K.N. (2002). Effect of biofertilizers on growth, yield and essential oil content in patchouli (*Pogestemon cablin* Pellet.). *Indian Perfumer,* **46**(2): 97-104.

Matsuda, T., Kuroyanangi, M., Sygiyama, S., Umebara, K., Ueno, A. and Nishi, K. (1994). Cell differentiation - inducing diterpenes from *Andrographis paniculata*. *Chemical & Pharmaceutical Bulletin,* **42** *:* 16-25.

Otake, T., Mori, H., Morimoto, L.T., Hattori, M. and Namba, T. (1995). Screening of Indonesian plant extracts for antihuman immunodeficiency Virus – Type I (HIV-I) activity. *Phytother. Res.,* **9**: 6-10.

Poongodi, P. (2003). Integrated nutrient management in *Mucuna pruriens* (L.) Dc. for growth and yield. M.Sc. (Hort.) Thesis, Agriculture College and Research Institute, TNAU, MADURAI, T.N. (India).

Senthilkumaran, K., Thirugnanasambanthan, P., Viswanathan, S. and Sreeramamurthy, M. (2003). An HPLC method for the estimation of andrographolide in rabbit serum. *Indian J. Pharmacol.,* **35**: 109-112.

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