International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 2947-2949

Received: 14-07-2018
Accepted: 15-08-2018

Himanshu Verma
Ph. D. Research Scholar, Department of Agronomy, College of Agriculture, GBPUAT, Pantnagar, Uttarakhand, India

MS Negi
Professor Agronomy, Department of Agronomy, College of Agriculture, GBPUAT, Pantnagar, Uttarakhand, India

Archana Joshi
Ph.D. Research Scholar, Department of Chemistry, College of Basic Science and Humanities, Pantnagar, Uttarakhand, India

Babita Belal
Ph.D. Research Scholar, Department of Chemistry, College of Basic Science and Humanities, Pantnagar, Uttarakhand, India

Anil Shukla
Professor Agronomy, Department of Agronomy, College of Agriculture, GBPUAT, Pantnagar, Uttarakhand, India

BS Mahapatra
Professor Agronomy, Department of Agronomy, College of Agriculture, GBPUAT, Pantnagar, Uttarakhand, India

Jai Paul
Professor Soil Science, Department of Soil Science, College of Agriculture, GBPUAT, Pantnagar, Uttarakhand, India

Correspondence
Himanshu Verma
Ph. D. Research Scholar, Department of Agronomy, College of Agriculture, GBPUAT, Pantnagar, Uttarakhand, India

Growth Attributes of *Kalmegh* [*Andrographis paniculata* (Burm.f.) Wall Nees] as influenced by integrated nutrient management under *Tarai* conditions of Uttarakhand

Himanshu Verma, MS Negi, Archana Joshi, Babita Belal, Anil Shukla, BS Mahapatra and Jai Paul

Abstract
Medicinal and Aromatic plants form a numerically large group of economically important plants which provide basic raw materials for medicines, perfumes, flavours and cosmetics etc. *Kalmegh* is an important medicinal plant. It has been effectively used in traditional Asian medicines. A field experiment was conducted during *kharif* season of 2017 & 2018 at Medicinal Plants Research and Development Centre (M. R. D. C) of G. B. Pant University of Agriculture & Technology, Pantnagar (Uttarakhand) to study the effect of application of Organic and different doses of Nitrogen on growth attributes viz: Plant height (cm), number of branches per plant, Number of leaves per plant and dry matter accumulation (g/m^2) of *Kalmegh*. Results revealed that, among, application of different organic manures, higher growth attributes were recorded in the plots treated with Vermicompost @ 5 t/ha over poultry manure @ 5 t/ha & no organic manure application (Control) while among application of different Nitrogen doses, increasing growth trend of *kalmegh* was observed in the plots treated with 75 (37.5+37.5) Kg N/ha in to 2 splits (First as basal and second as top dress at 25 DAT) and 75 kg N as basal followed by 50 and 0 kg nitrogen per hectare with same P and K.

Keywords: *Kalmegh*, nitrogen, organic, *Tarai*, growth attributes

1. Introduction
India has a long history and strong base for Ayurveda, which is the traditional health care system. Herbal plants play an important role in preventing and treating of human diseases. People have been using plants as a traditional medicine since time immemorial. Medicinal plants are a potential source for the development of new herbal drugs. In the 21st century, the pharmacological effects of medicinal plants are considered as a promising future drug/medicine for the management of health care. In recent years, there has been a resurgence of interest to rediscover medicinal plants as a source of potential drug candidate.

Kalmegh is being used for treating various ailments like treating fever, liver diseases, diabetes, common cold and bronchitis by the ethnic communities of India. It is also known to have antibacterial, immunomodulating, antivenomous and antithrombotic properties. Beyond this pharmaceutical approach to plants, there is a wide tendency to utilize herbal products to supplement the diet, mainly with the intention of improving the quality of life and preventing the diseases of elderly people. *Kalmegh* [*Andrographis paniculata* (Burm.F.) Wall Nees] also known as king of bitters belonging to the family Acanthaceae is probably native to India, is cultivated as rainy season (*kharif*) crop. The climatic requirement for the plant is hot and humid conditions with ample sunshine. *Kalmegh* can be cultivated on wide range of soils from loam to lateritic soils with moderate fertility. Plant growth is a process where the plant utilizes solar energy, CO_2 from the atmosphere and water and nutrients from the soil. Plants continuously extract nutrients from the soil. When insufficient, these nutrients are responsible for limiting crop growth. For maintain optimum nutrient balance in the soil, these has to be applied either through organic or inorganic or both. N, P, K are the primary nutrients which are beneficial for proper growth &development of crops. Among these nutrients, especially

shortage of Nitrogen can inhibit or stunt plant growth (Gruhn *et al.,* 2000)[6]. Application of nutrients through organic fertilizers are also important as in addition to releasing nutrients, they also improve the structure of the soil and increase its ability to hold water and nutrients (Takahashi, 1981)[9]. Thus considering the importance and growing demand of *kalmegh*, it is essential to go for commercial cultivation by adopting efficient nutrient management strategy for achieving higher growth, productivity as well as farmer net profit.

2. Materials and Method

2.1 Experimental Site

A field experiment was conducted during *kharif* season of 2017 and 2018 at Medicinal Plants Research & Development Centre (M. R. D. C) of G. B. Pant University of Agriculture & Technology Pantnagar, District Udham Singh Nagar (Uttarakhand) to study the effect of different nutrient management approaches on growth attributes viz; plant height, number of leaves & branches/plant and crop matter accumulation (g/m^2) of *Kalmegh*. The research centre lies in the *tarai* belt, 30 km southern end of foothills of Shivalik range of Himalaya at 29º latitude, 79.5º E longitude and at an altitude of 243.83 m above mean sea level. The soil of the experimental site was sandy clay loam in texture having high organic carbon, low available nitrogen, high available phosphorus and medium in exchangeable potassium with slightly alkaline in reaction.

2.2 Experimental Design and Details of treatments

The experiment was laid out in Split plot design with three levels of organic manures and four levels of different nitrogen doses. Among organic manures application, no organic manure, Poultry manure @ 5 t/ha and Vermicompost @ 5 t/ha and among application of different nitrogen dose, 0: 50: 50, 50: 50: 50, 75: 50: 50 and 37.5 + 37.5: 50: 50 kg NPK per hectare were compared.

2.3 Observations

The height of the individual plant was measured from ground surface to the tip of apical leaf of five randomly selected tagged plants in the third row of each plot at 30 days after transplanting (30 DAT) till harvest with the help of a meter scale and mean values of five tagged plants were computed. For measuring Number of leaves and branches per plant, a total number of fully developed and functional leaves and primary & secondary branches bearing pairs of fully developed leaves of five tagged plants in third row in each plot were counted and mean value was calculated for individual plant.

For determining the crop dry matter accumulation (g/m^2), plant samples taken for the fresh weight were dried in the sun and subsequently into a hot air oven dryer at 70ºC ± 5ºC temperatures for 48-72 hours or till constant weight was obtained at monthly intervals starting from 30 days after transplanting till harvest. The mean dry weight of five plants was used to calculate the crop dry matter accumulation per meter square.

3. Results and Discussion

In general, plant height, number of branches & leaves per plant and crop dry matter accumulation (g/m^2) increased as the crop advanced in age and reached its maximum at harvest stage. The difference in these growth attributes under different integrated nutrient management approach differs significantly at all the stages of crop growth except at 30 DAT stage where application of organic manure and fertility level found non-significant during both the years and first year in case of leaves; respectively. Application of vermicompost @ 5 t/ha achieved significantly higher crop height at 60 and 90 DAT stage which was significantly on a par with poultry manure application during both the years. Higher number of branches & leaves per plant was also recorded in Vermicompost @ 5 t/ha during both the years. **(Table No. 1 & 2).** Application of organic manure has significantly influenced crop dry matter accumulation (g/m^2) at all the stages of crop growth during both the years except at 30 days stage during the second year of experimentation where it was found non- significant. However higher crop dry matter accumulation was recorded in the plots where vermicompost @ 5 t/ha was applied. Higher growth of *kalmegh* was recorded in the plots treated with vermicompost @ 5 t/ha which might be attributed due to the fact that vermicompost might have retained nutrients for longer period of the time and involved in the various endogenous hormonal functions in the plant tissues hence responsible for better vegetative growth hence enhanced plant height. Similar findings were also reported by Alam *et al*. 2007[1]. Lowest numbers of leaves & branches per plant, plant height and crop dry matter accumulation g/m^2 were observed in the plots without organic matter addition which might be attributed to the fact that the added organic manure in to the soil not only acted as a source of nutrient but might have influenced their availability also. Similar findings were also reported by Amanullah *et al*. (2007) [2].

Table 1: Plant height (cm) and number of branches per plant as influenced by nutrient management approaches during *kharif* season of 2017 & 2018 at different stages of crop growth stages.

Treatment	Plant Height (cm)						Number of Branches per plant					
	30 DAT		60 DAT		At Harvest		30 DAT		60 DAT		At Harvest	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Organic Manures												
No Organic Manure (Control)	18.3	18.4	43.7	44.2	63.1	62.8	11.5	11.6	52.1	52.5	67.9	68.2
Vermicompost @ 5 t/ha	18.4	18.6	45.1	45.2	65.2	65.4	12.1	12.5	54.2	54.4	71.7	72.2
Poultry Manure @ 5 t/ha	18.4	18.9	44.4	45.1	64.3	64.8	11.9	12.1	53.9	53.3	70.5	71.1
±SEM	NS	NS	0.5	0.4	0.2	0.2	0.2	0.1	0.3	0.1	0.3	0.1
CD (5%)	NS	NS	1.1	0.5	0.9	0.8	0.1	0.3	0.8	0.5	1.0	0.9
Different Nitrogen doses												
0: 50: 50 kg NPK/ha	18.5	18.5	43.8	44.4	63.4	63.0	11.9	11.9	52.7	53.4	69.2	69.5
50: 50: 50 kg NPK/ha	18.7	18.8	45.0	44.9	64.3	63.8	11.9	11.8	54.0	53.5	71.0	71.7
(37.5+37.5): 50 :50 kg NPK/ha	18.8	19.2	47.7	47.5	65.9	66.2	12.4	12.6	55.3	55.3	73.5	73.1
75: 50: 50 kg NPK/ha	18.8	19.3	45.4	45.6	65.3	65.0	12.1	12.2	54.3	54.8	72.4	72.3
±SEM	0.1	0.2	0.6	0.6	0.5	0.4	0.1	0.2	0.3	0.2	0.4	0.4
CD (5%)	NS	0.5	1.8	1.7	0.9	1.1	0.4	0.5	0.9	0.7	1.1	1.1

DAT- Days after transplanting, t/ha- Tones per hectare

Among different doses of nitrogen, application of 75 kg (37.5 as basal + 37.5 as top dressing 25 DAT) and 75 kg N/ha as basal achieved significantly higher number of branches & leaves per plant, plant height and crop dry matter accumulation (g/m^2) over 0 kg, 50 kg N/ha with same P & K.**(Table No. 1 & 2).**This could be attributed to higher availability of nitrogen during all crop growth stages viz: 30, 60 and 90 DAT (At harvest stage) as with the split application, losses of nitrogen were minimized and the nitrogen was effectively taken up by the plant. Panchbhai *et al*. (2006)[8] also observed that each increment of nitrogen level significantly increased root length, root diameter thereby better uptake of essential nutrients hence increase the growth and development of leaves. This might also be due to the fact that N is an essential constituent of chlorophyll, which helps in capturing the solar energy and production of more photosynthates, hence increasing growth trend (Dhanush *et al*., 2018)[5]. Application of Nitrogen along with its top Dressing after 25 days achieved higher number of branches which might be attributed due to increased availability of N supply which could have promoted protein synthesis from reserved carbohydrate source, leading to enhancement of growth, hence more number of primary and secondary branches. Similar findings were also reported by (Chaniara and Damor 1982 & Maryada *et al*., 2001)[3, 7]. It shows that the increased supply of Nitrogen influenced favorably the number of primary and secondary branches per plant (Vir and Verma; 1979)[10]. Application of N @ 37.5(Basal) +37.5(Top Dressed) and 75 kg N only as basal achieved increased plant height at all stages of plant growth during both the years. This might be due to the fact that application of higher amount of Nitrogen involve in better vegetative growth (increased cell division and cell elongation) thereby attain the highest plant height. Similar trend was also reported by Chauhan *et al.* (2002) [4].

Table 2: Number of leaves per plant and crop dry matter accumulation (g/m^2) as influenced by nutrient management approaches during *kharif* season of 2017 & 18 at different stages of crop growth cycle.

	Number of Leaves per plant						Dry matter accumulation g/m^2					
	30 DAT		60 DAT		At Harvest		30 DAT		60 DAT		At Harvest	
Treatment	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
Organic Manures												
No Organic manure(Control)	58.6	59.2	133.4	133.7	160.3	160.8	47.3	48.0	348.0	349.2	625.2	625.8
Vermicompost @ 5 t/ha	61.6	61.9	136.4	136.7	164.4	165.1	48.4	48.5	350.4	352.0	629.2	631.5
Poultry Manure @ 5 t/ha	60.4	60.5	135.3	136.1	162.7	163.0	47.9	48.1	348.5	349.9	629.2	629.2
±SEM	0.2	0.2	0.3	0.2	0.2	0.1	0.2	0.1	0.2	0.2	0.3	0.4
CD (5%)	0.9	0.6	1.0	0.5	0.8	0.5	0.6	NS	0.8	1.0	1.3	1.8
Different Nitrogen Doses												
0: 50: 50 kg NPK/ha	60.2	60.6	134.8	135.2	162.1	162.5	46.4	47.4	345.9	346.0	610.8	610.1
50: 50: 50 kg NPK/ha	61.2	61.4	135.7	135.9	162.7	163.4	47.5	47.8	347.3	348.6	616.8	618.2
(37.5+37.5): 50 :50 kg NPK/ha	63.0	63.6	138.9	138.4	165.7	165.6	49.0	48.9	352.0	354.5	644.4	646.8
75: 50: 50 kg NPK/ha	61.6	61.8	137.4	137.7	164.7	164.0	48.6	48.7	350.7	352.4	639.5	640.3
±SEM	0.3	0.3	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.5	0.4
CD (5%)	0.8	0.8	0.8	0.9	0.5	0.6	0.8	0.5	0.5	0.5	1.6	1.1

DAT- Days after transplanting, t/ha- Tones per hectare

4. Conclusion: On the basis of experimental results, it can be concluded that application of vermicompost @ 5 t/ha recorded increased growth trend of *kalmegh* over Poultry manure @ 5 t/ha and no organic manure application while among different doses of nitrogen, (37.5+ 37.5): 50: 50 and 75: 50: 50 kg NPK/ha achieved higher growth viz: plant height, No. of leaves & branches/plant and dry matter accumulation (g/m^2) at all the stages of crop growth during both the years.

5. References

1. Alam MN, Jahan MS, Ali MK, Ashraf MA, Islam MK. Effect of vermicompost and chemical fertilizers on growth, yield and yield components of potato in barind soils of Bangladesh. Journal of Applied Sciences Research.2007; 3(12):1879-1888
2. Amanullah MM, Somasundaram E, Vaiyapuri K, Sathyamoorthi K. Poultry manure to crops. A Review. Agric. Rev. 2007; 28:216-222
3. Chaniara NJ, Damor UM. Effect of irrigation intervals and various levels of Nitrogen and Phosphorus on the yield of mustard variety 'Varuna'. Indian journal of Agronomy.1982; 27(4):472-474.
4. Chauhan SK, Maheshwari SK,Tiwari G. Effect of source and levels of Nitrogen on morphological attributes and dry matter production of *Kalmegh* (*Andrographis paniculata* (Burm.F.) Wall ex Nees) under rainfed conditions of Malwa plateau. Annals of Agricultural Research. 2002; 23(4):28-729.
5. Dhanush SL, Mallikarjuna Gowda AP, Anand JK, Anil Kumar S, Chandramohan Reddy G. Effect of nutrient levels on growth, yield, quality and economics of second ratoon crop in Kalmegh (*Andrographis paniculata* Nees.). International journal of pure and applied bio sciences.2018; 6(1):721-725
6. Gruhn P, Golleti F, Yudelman M. Integrated Nutrient Management, Soil Fertility and Sustainable Agriculture: Current Issues and Future Challenges. Food, Agriculture and the Environment Discussion Paper 32. Washington, DC: IFPRI, 2000.
7. Maryada SK, Kaistha BP. Response of ashwagandha (*Withania somnifera* Dunal) to nitrogen fertilization under midhill conditions of Himachal Pradesh. Journal of Agricultural Research.2001; 27(1/2):77-80.
8. Panchbhai DM, Bachkar BR, Deokar PL, Wankade SG. Effect of nitrogen and phosphorous on root yield and quality of ashwagandha (*Withania somnifera*) Ad. Plant Sci. 2006; 19(I):89-92.
9. Takahashi K. Physiological disorders in Chinese cabbage. In: Talekar, N. S.,Griggs, T. D., (Eds), Chinese cabbage. AVRDC, Shanhua, Taiwan, 1981, 225-233.
10. Vir P, Verma BS. Effect of rates and methods of Nitrogen application on the growth, yield and quality of

mustard under rainfed conditions of Agra region. Indian Journal of Agronomy. 1979; 24:130-134