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EFFECT OF SOURCES AND LEVELS OF NITROGEN ON GROWTH, YIELD AND QUALITY OF KALMEGH

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ABSTRACT

A field experiment was conducted during rainy season of 2009 and 2010 to study the effect of sources and levels of nitrogen on growth, yield and quality of kalmegh. Amongst the organic sources of nitrogen, 60 kg N ha^{-1} applied through farmyard manure produced maximum growth, fresh and dry herbage yield (37.12 and 25.59 q ha^{-1}), andrographolide content (2.55%) and its yield (93.16 kg ha^{-1}) with the highest net income (Rs. 1.202 lakhs ha^{-1}). This was equally followed by vermicompost, poultry manure and urban compost applied @ 60 kg N ha^{-1}. Application of 60 kg N ha^{-1} through urea was not found so advantageous under the existing agro-climatic conditions.

Keywords: Sources, levels, nitrogen, yield, quality, Kalmegh

INTRODUCTION

Intensive cropping and use of chemical fertilizers has degraded the physical, chemical and biological properties of soil, its environment and health. Kalmegh (*Andrographis paniculata* Nees.) commonly known as "King of Bitters" is a member of the family of *Acanthaceae*. Whole plant (stem, leaves and inflorescence) constitutes a drug which contains andrographolide content. This is the active ingredient of kalmegh being used for treatment of liver/digestive disorders, vermifuge and also used as antibiotic and antipyretic. It is mainly used in the treatment of typhoid, malaria/fever and liver cirrhosis. It is a branched annual herb of medicinal importance. Leaves and stems are used to extract the active phyto-chemicals. It is found all over India in moist-deciduous forests as well as in plains. Nitrogen encourages the plant foliage and boosts plant growth at every stage, because it is an integral part of the chlorophyll, all proteins, enzymes and structural materials. In order to strengthen the organic farming of medicinal plants, it is essential to identify which is the best organic source of nitrogen and its optimum dose so that yield and quality of kalmegh may be increased on a sustainable basis without deteriorating the soil health. Now-a-days, the research on nutritional requirement of medicinal plant especially kalmegh is rather in scanty. Hence, the present study was taken up.

MATERIALS AND METHODS

The field experiment was conducted during rainy seasons of 2009 and 2010 on a Private Research Farm, Beena-Semaria Road, Rewa (MP). The soil was silty clay-loam having pH 7.5 and 7.6, electrical conductivity 0.32 and 0.34 dSm^{-1}, organic carbon 8.6 and 8.8 g kg^{-1}, available N, P_2O_5 and K_2O 230 and 238, 13.8 and 14.3 and 372 and 381 kg ha^{-1}, respectively. The total rainfall during June to October was 681 and 714 mm in first and second year, respectively. The treatments comprised six sources of nitrogen (FYM 0.75% N, vermicompost 1.2% N, poultry manure 3.5% N, urban compost 1.2% N, castor cake 1.35% N and urea 46% N) and four levels of nitrogen (15, 30, 45 and 60 kg ha^{-1}). These were laid out in a factorial randomized block design with three replications. A uniform dose of 40 kg P_2O_5 and 30 kg K_2O ha^{-1} was applied to all the treatments. Forty days old seedlings of local variety of kalmegh were transplanted in rows 30 cm apart by the end of July. Irrigation and weeding operations were performed as per recommended package of practices. The crop was harvested in the second week of October in both the years. Andrographolide content in dry herbage was determined by following the procedure of Handa and Sharma (1990). The net income per hectare was estimated in each treatment based on the existing market rates of inputs and outputs (kalmegh herbage).

RESULTS AND DISCUSSION

Growth parameters: Out of five organic sources of nitrogen, FYM raised the plant height, number of branches and leaves/plant up to the maximum sources of N were vermicompost and poultry

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extent. The second and third best organic manure, respectively. The significant variation in growth parameters of kalmegh to different organic sources might be owing to variation in their nutrient contents, decomposition of organic residues, C: N ratio, nutrient release pattern, climate and soil characteristics (Dhama, 2003 and Sanwal *et al.* 2007). Application of nitrogen up to 60 kg/ha enhanced all these growth parameters significantly. The beneficial effect of N on these growth parameters may be ascribed to the fact that N is an integral part of the chlorophyll, all proteins, enzymes and structure materials. In fact, leaf is the factory for the conversion of solar energy into the chemical energy by the process of photosynthesis. The significant role of increased applied-N might have encouraged the multiplication of cell division, photosynthesis and foliage enlargement up to maximum extent. The interactions were found to be significant. Application of 60 kg N ha^{-1} through FYM resulted in maximum growth parameters. This was followed by vermicompost and then poultry manure having the same N level.

Table 1: Growth parameters, yield, quality and net income from kalmegh as influenced by organic and inorganic sources of nitrogen (mean of two years)

Treatments	Plant height (cm)	Primary branches/ plant	Secondary branches/ plant	Leaves/ plant	Herbage yield (q ha^{-1})	Dry herbage yield (q ha^{-1})	Andro-grapholide content (%)	Andro-grapholide yield (kg ha^{-1})	Net income (Rs.ha^{-1})	Difference over urea and lowest N levels (Rs. ha^{-1})	Benefit: cost ratio
Source of nitrogen											
FYM	44.30	32.61	197.49	202.23	34.03	23.74	2.37	80.40	112068	14000	4.71
Vermicompost	42.39	30.46	186.11	189.98	33.27	23.34	2.33	77.86	99050	982	3.50
Poultry manure	40.75	28.11	174.57	179.58	32.39	22.70	2.31	74.95	107670	9602	4.78
Urban compost	39.03	26.41	163.19	167.84	32.00	22.56	2.27	72.85	106878	8810	4.76
Castor cake	37.99	24.77	151.16	156.33	31.36	22.10	2.24	70.39	88030	-10038	3.06
Urea	36.60	23.21	139.88	142.03	29.12	20.73	2.18	63.55	98068	--	4.72
CD (P=0.05)	**2.09**	**1.17**	**5.46**	**10.07**	**0.98**	**0.67**	**0.055**	**2.74**	--	--	--
Levels of nitrogen (kg ha^{-1})											
15	37.79	24.51	124.17	139.45	29.02	20.88	2.14	62.03	96792	--	4.44
30	39.22	26.49	156.25	161.21	31.07	21.93	2.24	69.61	99948	3156	4.28
45	40.86	28.40	187.14	187.00	32.63	22.74	2.32	75.71	101660	4868	4.13
60	42.82	30.98	207.36	203.00	35.41	24.56	2.44	85.98	109442	12650	4.18
CD (P=0.05)	**1.71**	**0.96**	**4.46**	**8.22**	**0.80**	**0.55**	**0.045**	**2.24**	--	--	--
Interaction	**41.7**	**2.34**	**10.91**	**20.14**	**1.96**	**1.35**	**0.11**	**5.48**	--	--	--

Productivity of herbage: Nitrogen applied through FYM or vermicompost gave equally highest fresh and dry herbage yield, being significantly superior to those of urban compost, castor cake and urea. Nitrogen applied through urea resulted in the significantly lowest yield in each case. The best performance of FYM on growth and herbage productivity may be attributed to its multifarious role and contribution towards controlled release of nitrogen (Dwivedi *et al.*, 2008) as well as significantly higher photosynthetic rates as compared to other treatments (Sanwal *et al*, 2007). The beneficial effect of vermicompost on growth and yield attributes might be due to the fact that worm casts contain five times more nitrogen, seven times more phosphorus and eleven times more potassium than ordinary soil in addition to a lot of beneficial soil microorganisms (Sharma and Agrawal, 2004). The present findings corroborate with those of Sanjutha *et al.* (2008) and Ramesh *et al.* (2011) who studied on the integrated nutrient management in kalmegh. The increasing levels of nitrogen from 15 to 60 kg ha^{-1} increased the fresh and dry herbage yield significantly. Thus, the maximum fresh and dry yields under 60 kg N ha^{-1} were 35.41 kg and 24.56 kg ha^{-1}, respectively. The improvement in herbage yield may be ascribed to the increased photosynthesis and improved vegetative growth as a result of increased supply of nitrogen. The present findings agree with those of Chauhan *et al.* (2002 b) and Haque *et al.* (2007). The interactions were

found to be significant. Thus, the application of 60 kg N ha^{-1} through FYM or vermicompost resulted in highest fresh and dry herbage yield of kalmegh.

Qualitative parameters: Nitrogen supplied through FYM or vermicompost recorded equally higher andrographolide content (2.33 – 2.37%) as well as andrographolide yield (77.86 to 80.40 kg ha^{-1}) over rest of the organic sources of nitrogen. Similarly, N-sources through poultry manure and urban compost gave the identical performance, but significantly superior to urea-N. Thus, the lowest qualitative parameters were recorded in case of urea-N. The differential qualitative response due to different organic sources may be owing to differences in their decomposition and nutrient supplying power as well as nutrients release pattern (Chauhan *et al*. 2003 a and Chauhan and Tiwari, 2003). Each increase in N-level from 15 to 60 kg ha^{-1} registered significant rise in the qualitative parameters. Thus at the highest N-level, the andrographolide content and its yield were highest (2.44% and 85.98 kg/ha, respectively). On the other hand, the significantly lowest values were noted with the lowest level of nitrogen. The best interaction treatment was 60 kg N ha^{-1} applied through FYM, followed by vermicompost and then poultry manure with the same level of nitrogen.

Economical gain: Among the organic-N sources, FYM gave the maximum net income (Rs.1.121 lakhs ha^{-1}) i.e. higher by Rs.14000 ha^{-1} over urea source of nitrogen. This was followed by poultry manure and urban compost, being higher by Rs.9602 and Rs.8810 ha^{-1}, respectively over urea source of nitrogen. Vermicompost and castor cake came out with the fourth and fifth positions, i.e. net income being higher only by Rs.982 ha^{-1} and lower by Rs. 10038 ha^{-1}, respectively over urea-N. The benefit: cost ratio showed the similar trend. The variation in the net income was due to variation in the herbage yield as well as market rates of the applied organic sources of nutrients. Application of 60 kg N ha^{-1} gave the highest net income (Rs. 1.094 lakhs ha^{-1}) as against the preceding N levels. Thus, 30, 45 and 60 kg N ha^{-1} gave extra net income by Rs.3156, Rs.4868 and Rs.12650 ha^{-1}, respectively over 15 kg N ha^{-1}. The benefit:cost ratio indicated the same trend. The interaction of 60 kg N ha^{-1} applied through FYM resulted in highest net income up to Rs.1.202 lakhs ha^{-1}. This was followed by poultry manure and then urban compost with the same N level.

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