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EFFECT OF SOURCES AND LEVELS OF NITROGEN ON PHYSIOLOGICAL PARAMETERS, CONTENTS AND UPTAKE OF NUTRIENT IN KALMEGH

VISHNUKANT TIWARI, ABHILASHA SHRIVASTAVA, K.N. NAMDEO* AND M.MANOJ KUMAR**
Department of Botany, Government Science College, Rewa – 486 001 (M.P.)
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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 physiological parameters, content and uptake of nutrients in kalmegh. Leaf area, leaf area index and chlorophyll "a" and "b" in leaves and herbage yield (34.03 q ha^{-1}) were found highest with FYM, followed by vermicompost and poultry manure. The contents and uptake nutrients by herbage were in the higher range with FYM, vermicompost and poultry manure compared to other sources of nitrogen. Nitrogen applied through urea resulted in the lowest performance in respect of physiological parameter. Application of nitrogen upto 60 kg ha^{-1} enhanced all these parameters including contents and uptake of nutrients significantly as against the preceding N levels.

Keywords: Nitrogen, physiological parameters, uptake of nutrients, kalmegh

INTRODUCTION

The long-term use of chemical fertilizers is known to degrade physico-chemical and biological properties of soil. Moreover, the nutrients requirement of crops cannot be met through fertilizers alone. Besides, the escalating prices of fertilizers and their inadequacy call for supplementation of nutrients through organic sources. The uptake of nutrients by intensive cropping and use of high-yielding varieties is generally greater than their additions in the soil. Balanced nutrition for sustainable crop production is a challenging task before the nation. Now-a-days farmers are taking keen interest in cultivating medicinal crops to raise their economic status. Kalmegh (*Andrographis paniculata* Nees.) is one of the important medicinal crops which is gaining popularity because of its high market value for the preparation of Ayurvedic medicines. It is essential to know as to how much kalmegh would give yield response to the applied nitrogen through organic sources. So far such work has not been done in this region; therefore the present study was taken up.

MATERIALS AND METHODS

A field experiment was conducted during rainy seasons of 2009 and 2010 on a Private Research Farm, Beena-Semaria Road, Rewa (M.P.). The soil was silty clay-loam in texture having pH 7.5, electrical conductivity 0.32 dSm^{-1}, organic carbon 8.6 g kg^{-1}, available N, P_2O_5 and K_2O 230 13.8 and 372 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. An uniform dose of 40 kg P_2O_5 and 30 kg K_2O ha^{-1} was applied to all the plots. 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. Chlorophyll content "a" and "b" in leaves was determined at 120 days stage by acetone extraction method (Witham *et al.*, 1971). Nitrogen, phosphorus and potassium contents were determined in plants by adopting standard procedures (Jackson 1973).

RESULTS AND DISCUSSION

Physiological parameters and yield: The data (Table 1) indicate that among the organic sources of nitrogen, leaf area, leaf area index and total chlorophyll content in leaf were increased upto maximum extent due to FYM. This was followed by vermicompost and poultry manure.

**Ex-Professor (Agronomy), College of Agriculture, Rewa 486001 (Madhya Pradesh)*
*** Krishi Vigyan Kendra, Aron (Guna) – 473101 (Madhya Pradesh*

The minimum effect was noticed due to urea source of nitrogen. The better performance of organic sources may be attributed to their role in improving the physical, chemical and microbiological properties of the soil compared to urea which supplied only nitrogen. Among the organic sources, FYM played superior role in supplying multi-nutrients in balanced proportion at a proper time which is apparent from the increased leaf area, leaf area index and chlorophyll content in leaves upto maximum extent. Consequently the increased photosynthetic surface brought about the maximum growth and development of plants and finally the highest herbage yield (34.03 q ha^{-1}). The significant variation in herbage yield response to applied organic sources of nitrogen might be due to variations in their nutrient composition, decomposition of organic residues, C:N ratio, nutrient release pattern, climate and soil characteristic. Dwivedi *et al.* (2008) also supported the present finding by pointing out that in addition to multifarious role of FYM, its contribution towards controlled release of nitrogen is unique when applied in combination with urea. According to Sanwal *et al.* (2007) addition of poultry manure, FYM and Neem Shield had significantly higher photosynthetic rates as compared to other treatments. This may be due to the higher nitrogen content, since nitrogen is a constituent of chlorophyll, amino acids etc. and has a significant role in photosynthesis. The results are in the line with the findings of Sinclair (1990), Sanjutha *et al.*, (2008) and Pandey *et al.* (2011). Application of nitrogen upto 60 kg ha^{-1} increased all these physiological parameters, thereby herbage yield of kalmegh. The increased nitrogen application might have translocated maximum photosynthate accumulation towards leaf biomasss because during initial stage, leaf is the most powerful sink than any other plant parts in most of the crops. The present results corroborate with those of Chauhan *et al* (2002) and Maheshwari *et al.* (2002).

Table 1: Physiological parameters and herbage yield, nutrient contents and their uptake of kalmegh as influenced by organic and inorganic sources of nitrogen (mean of two years)

Treatments	Leaf area/ plant (cm^2)	Leaf area index	Chlorophyll content in leaves (µ mole/g fresh weight)			Herbage yield (q ha^{-1})	Nutrient contents (%)			Nutrient uptake (kg ha^{-1})		
			"a"	"b"	Total		N	P	K	N	P	K
Sources of nitrogen												
FYM	2495	6.12	0.875	0.620	1.495	34.03	2.03	0.180	2.76	48.2	4.2	65.2
Vermicompost	2367	5.73	0.840	0.585	1.425	33.27	2.12	0.205	2.80	49.4	4.7	65.4
Poultry manure	2237	5.58	0.800	0.560	1.360	32.39	2.16	0.230	2.90	48.7	5.2	65.7
Urban compost	2091	5.09	0.750	0.515	1.265	32.04	2.00	0.150	2.68	44.8	3.3	60.4
Castor cake	1948	4.85	0.715	0.460	1.175	31.36	1.86	0.123	2.54	40.8	2.6	56.1
Urea	1770	4.17	0.675	0.410	1.085	29.12	1.87	0.118	2.48	38.6	2.3	51.3
CD (P=0.05)	**100.8**	**1.00**	**0.18**	**0.09**	**0.21**	**0.98**	**0.13**	**0.017**	**0.04**	**0.30**	**0.59**	**3.05**
Nitrogen (kg ha^{-1})												
15	1738	3.85	0.685	0.430	1.115	29.02	1.88	0.136	2.51	39.2	2.8	51.9
30	2009	4.51	0.750	0.480	1.230	31.07	1.95	0.161	2.63	42.6	3.5	57.6
45	2330	5.72	0.790	0.540	1.330	32.63	2.04	0.175	2.74	46.1	3.9	62.3
60	2529	6.95	0.875	0.650	1.525	35.41	2.15	0.197	2.89	52.6	4.8	70.8
CD (P=0.05)	**82.3**	**0.81**	**0.15**	**0.08**	**0.17**	**0.80**	**0.11**	**0.015**	**0.03**	**0.24**	**0.48**	**2.49**
Interaction	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**

Nutrient contents: Among the organic sources of nitrogen, poultry manure registered almost significantly higher N, P and K contents in herbage. This was followed by vermicompost and FYM. Castor cake and urea recorded the lowest NPK contents. So much difference among the beneficial effect of organic sources of nitrogen on these nutrient contents might be due

to the differences in these organic sources with respect to the nutrient reserves, biological activities in the soil, nutrients absorption by the plants and biochemical reactions in the soil and plants (Chaurasia *et al.,* 2009). The increasing nitrogen levels from 15 kg to 60 kg ha^{-1} increased all these nutrient contents in herbage almost significantly. This might be due to the fact that plants absorbed proportionately higher amount of N and other nutrients as the pool of available multi-nutrients increased in the soil by adding higher doses of organic sources of nitrogen (Reddy *et al.*, 2008; Chaurasia *et al.*, 2009 and Ramesh *et al.*, 2011).

Uptake of nutrients: Amongst the organic sources of nitrogen, vermicompost recorded significantly higher N uptake (49.46 kg ha^{-1}), poultry manure almost significantly higher P uptake (5.225 kg ha^{-1}) whereas FYM, vermicompost and poultry manure recorded equally higher K uptake by kalmegh herbage (65.29 to 65.71 kg ha^{-1}). On the other hand, urea source of nitrogen resulted in significantly lowest N, P and K uptake by herbage. The overall improvement in N, P and K uptake may be owing to the increased N, P and K contents in herbage as well as increased crop biomass or per hectare yield. The increased nutrients uptake by isabgol by increased N level through FYM has been reported by Dwivedi *et al*.(2008). These results are in consonance with the findings of Sanjutha *et al*. (2008) in kalmegh. The uptake of nutrients increased significantly with each increase in N level from 15 kg to 60 kg ha^{-1}. Thus, the maximum N, P and K uptake at 60 kg N ha^{-1} was 52.64, 4.827 and 70.86 kg ha^{-1}, respectively. The higher uptake of nutrients under highest N level might be owing to increased herbage yield and N, P and K contents in herbage. These findings agree with those of Ramesh *et al.* (2011) in kalmegh.

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