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Effect of Nutrient Levels on Growth, Yield, Quality and Economics of Second Ratoon Crop in Kalmegh (*Andrographis paniculata* Nees.)

Dhanush S. L.[1], Mallikarjuna Gowda A. P.[2], Anand. Jaganath. Kademani[3*], Anilkumar, S.[4] and G. ChandramohanReddy[5]

[1]M.Sc (Hort), College of Horticulture, GKVK post, Bengaluru, -560065

[2]Assistant Professor, Department of PSMAC, College of Horticulture, GKVK post, Bengaluru, -560065

[3]M.Sc (Hort), College of Horticulture, GKVK post, Bengaluru, -560065

[4]Assistant Professor, RHREC, Department of Soil Science and agri Chemistry, GKVK post, Bengaluru, -560065

[5]M.Sc (Hort), College of Horticulture, GKVK post, Bengaluru, -560065

*Corresponding Author E-mail: kademani.anu92@gmail.com

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ABSTRACT

India with a rich biodiversity supports many systems of medicines by producing and exporting various medicinal and aromatic crops. Kalmegh (Andrographis paniculata) is one of the most important medicinal plant using since time immemorial for treating fever, liver diseases, diabetes, snake bite, common cold, bronchitis and variety of ailments. The kalmegh exhibits ratooning character and it is necessary to standardise the cultivation practices for ratoon crop. The experiment was laid out in a Factorial Randomized Complete Block Design (FRCBD) with 9 treatments and 3 replication. The application of FYM @ 25 t ha^{-1} along with 75 per cent nitrogen and 100 per cent potassium recorded maximum plant height, number of primary branches, plant spread, herb yield, andrographilide content and yield which were at par with 50 per cent nitrogen and potassium and the highest B:C ratio and maximum net returns in the second ratoon crop of kalmegh.

Key words: *Andrographis paniculata, FRCBD, Andrographilide.*

INTRODUCTION

India is a meadow of medicinal plants where, most of the plant species are exploited for traditional system of medicine. Kalmegh is one such upcoming medicinal plant with bunch of medicinal properties. The herb is known to have anti-inflammatory, anti-biotic, anti-malarial, anti-hepatitic and anti-pyretic properties, besides its general use as an immune stimulant agent and is useful in curing dysentry, diarrhoea, cholera, fever, diabetes, bronchitis, itches, hypertension, piles and gonorrhoea. A recent study has been documented regarding its anti-HIV properties due to presence of important active constituent Andrographolide[6]. Due to its diversified uses, demand and popularity, there is an increasing trend in its cultivation on a commercial scale.

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Presently, cultivation of this crop is mainly confined to tropical rain forest and small scale in Assam, Kerala, Tamil Nadu, Karnataka and Andhra Pradesh. However, due to its usage, there is a need to expand the area of this valuable medicinal crop.

Looking into the medicinal importance of kalmegh and its ratoonabilty, the present investigation on "Influence of nutrient levels on growth, yield and quality of second ratoon crop in kalmegh (*Andrographis paniculata* Nees.)" is carried out.

MATERIAL AND METHODS

The field experiment was carried at College of Horticulture, University of Horticultural Sciences Campus, Gandhi Krishi Vignana Kendra, Bengaluru, during August, 2015 to February, 2016. The experiment was laid out in a Factorial Randomized Complete Block Design (FRCBD) with 9 treatments viz., T_1 (N_1K_0), T_2 (N_1K_1), T_3 (N_1K_2), T_4 (N_2K_0), T_5 (N_2K_1), T_6 (N_2K_2), T_7 (N_3K_0), T_8 (N_3K_1), T_9 (N_3K_2) and replicated thrice. The 'IIHR local' variety was raised in nursery and seedlings of 45 days old were transplanted at a spacing of 30 x 20 cm in 1.8 x 1.4 m plots. The recommended dosage of fertilizers and manures (75:75:50 kg N: P_2O_5: K_2O ha^{-1} and 25 t FYM ha^{-1}) was applied for main crop and protective irrigation was given through drip system The main crop was harvested at 60 days after transplanting when, 50 per cent of plant population attained flowering. The first ratoon crop was harvested at 45 days after first harvest when plants attained 50 per cent flowering. The Rec. dosage of FYM 25 t FYM ha^{-1} along with nitrogen in the form of urea at 3 levels (N_1: 75 per cent, N_2: 50 per cent, N_3: 25 per cent) and potassium in the form muriate of potash at 3 levels (K_0: no potassium, K_1: 50 per cent, K_2: 100 per cent) was given to raise second ratoon crop as per treatment with no phosphorous.

Five representative plants in each treatment and in each replication, were randomly selected, tagged and observation was recorded. The mean data recorded on five plants from each treatment was used for statistical analysis. The Andrographolide content was analysed by using Soxhlet apparatus with analytical grade methanol, determined in HPLC (High Performance Liquid Chromatography) equipment using HPLC grade methanol and andrographolide standard[1]. The cost of cultivation was worked out by considering market price of different inputs used, the labour charges and miscellaneous expenditures that were prevailing at the time of conducting the experiment.

RESULTS AND DISCUSSION

The plants supplied with 75 per cent nitrogen for the second ratoon crop, recorded significantly taller plants (25.71 cm), maximum number of primary branches (15.95), plant spread (450.31 cm^2) which were *at par* with 50 per cent nitrogen (Table 1). Similar results have been reported in sweet basil, fennel and solanum by Aliezera *et al*.[3], Khalid and Mohmoud[4] and Venkatesan and Arumugam[8], respectively. The enhanced growth with 75 and 50 per cent nitrogen might be due to increased availability of nitrogen supply which would have promoted protein synthesis from reserved carbohydrate source, leading to enhancement of growth.

The 100 per cent potassium recorded significantly maximum plant height (25.60 cm), number of primary branches (14.40), plant spread (396.91 cm^2) in second ratoon crop which were *at par* with 50 per cent potassium (Table 1). These results are in confirmity with Rasmia Ali *et al*.[5] in periwinkle.

Nitrogen and potassium at all levels showed non-significant differences with respect to days to initiation of blooming and days to 50 per cent flowering. It may be attributed to flowering is a genetic behavior regulated by climatic situations and may not influenced by levels of nutrients.

The plants fertilized with 75 per cent nitrogen and 100 per cent potassium has recorded significantly maximum fresh and dry weight of leaves, stem and herb yield, andrographolide content and andrographolide

yield which were *on par* with 50 per cent nitrogen and potassium (Table 2). This may be due to the fact that, nitrogen is an essential constituent of chlorophyll, which helps in capturing the solar energy and production of more photosynthates. Hence, more herb yield is observed with 75 per cent nitrogen. Potassium application at appropriate time and required concentration is known to increase the abscisic acid content, rendering closure of stomata causing reduction in transpiration rate which maintains higher water potential leading to increased fresh weight.

The nitrogen and potassium levels had a significant influence on quality parameters. Optimum dosage of N and K, might have resulted in better accumulation of assimilates, leading to improved quality. Potassium is responsible for energy production in the form of ATP and NADPH in chloroplasts by maintaining balanced electric charges. The higher the production of photosynthates may be attributed for increased andrographolide content and yield in kalmegh. These results are in conformity with findings of Sanjutha *et al*.[7] in kalmegh.

Table 1: Influence of nutrient levels (N & K) on growth attributes of kalmegh under second ratooning

	Plant height (cm)	Number of primary branches	Plant spread (cm^2)	Days to initiation of blooming	Days to 50 % flowering
Treatment					
N_1	25.71	15.95	450.31	29.56	43.39
N_2	23.47	14.63	407.51	29.12	43.89
N_3	19.56	12.84	351.40	29.82	44.19
S.Em. ±	0.70	0.41	13.46	1.14	1.69
CD (P=0.05)	2.10	1.22	40.35	NS	NS
K_0	21.42	13.69	374.56	29.76	44.67
K_1	22.10	13.86	390.69	29.29	43.20
K_2	24.40	15.18	431.98	29.46	43.54
S.Em. ±	0.70	0.41	13.46	1.14	1.69
CD (P=0.05)	2.10	1.22	40.35	NS	NS
N_1K_0	24.13	14.93	414.53	29.63	44.00
N_lK_1	26.07	16.32	445.13	29.07	42.73
N_1K_2	26.93	16.60	491.27	28.67	42.67
N_2K_0	21.67	14.07	380.33	29.73	44.20
N_2K_1	23.40	15.20	405.80	29.47	43.80
N_2K_2	25.33	15.53	433.40	29.47	43.67
N_3K_0	18.47	12.07	328.80	29.90	44.40
N_3K_1	19.27	13.07	354.13	29.83	44.47
N_3K_2	20.93	13.40	371.27	29.73	44.30
S.Em. ±	1.21	0.70	23.31	1.98	2.93
CD (P=0.05)	NS	NS	NS	NS	NS
CV	9.18	8.37	10.02	11.63	11.58

Table 2: Effect of nutrient levels (N & K) on yield parameters in second ratoon crop of kalmegh

Treatment	Fresh weight of leaves (g)	Dry weight of leaves (g)	Fresh weight of stem (g)	Dry weight of stem (g)	Fresh herb yield (t ha^{-1})	Dry herb yield (t ha^{-1})	Andrographolide content (%)	Andrographolide yield (kg ha^{-1})
N_1	37.55	13.45	19.61	9.50	5.32	2.13	2.21	47.31
N_2	33.40	11.30	16.58	8.17	4.83	1.87	1.82	42.55
N_3	31.14	10.06	14.23	6.23	4.10	1.64	1.70	33.83
S.Em. ±	1.34	0.37	0.56	0.22	0.15	0.08	0.11	1.51
CD (P=0.05)	4.02	1.09	1.67	0.67	0.44	0.23	0.33	4.53
K_0	31.65	9.47	15.61	7.26	4.22	1.69	1.83	33.30
K_1	32.19	10.73	16.28	7.75	4.53	1.79	1.90	41.38
K_2	36.26	11.93	17.99	8.46	5.03	2.01	2.28	45.98
S.Em. ±	1.34	0.37	0.56	0.22	0.15	0.08	0.11	1.51
CD (P=0.05)	4.02	1.09	1.67	0.67	0.44	0.23	0.33	4.53
N_1K_0	35.50	11.20	17.52	8.55	4.89	1.95	1.96	38.22
N_1K_1	37.97	11.45	19.34	9.00	5.23	2.09	2.32	48.48
N_1K_2	39.17	11.69	21.98	9.45	5.85	2.34	2.36	55.22
N_2K_0	33.70	10.40	15.92	7.50	4.38	1.75	1.89	33.07
N_2K_1	36.57	10.64	16.83	7.91	4.86	1.94	2.24	43.45
N_2K_2	37.13	10.86	17.00	8.20	4.96	1.98	2.28	45.14
N_3K_0	28.76	9.82	13.39	5.74	3.98	1.59	1.80	28.62
N_3K_1	32.20	10.10	14.30	6.12	4.06	1.62	2.18	35.31
N_3K_2	32.47	10.25	15.00	6.83	4.27	1.70	2.21	37.57
S.Em. ±	2.32	0.63	0.96	0.38	0.25	0.10	0.19	2.62
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
CV	11.55	10.23	9.92	8.66	9.34	9.32	15.59	11.17

Table 3: Economics of kalmegh under second ratooning as influenced by nutrient levels

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C ratio
T_1 (N_1K_0) – Rec. dosage of FYM + 75%N + 0%K	39834	117000	77166	1.93
T_2 (N_1K_1) – Rec. dosage of FYM + 75%N + 50%K	40626	125400	84774	2.08
T_3 (N_1K_2) – Rec. dosage of FYM + 75%N + 100%K	41417	140400	**98983**	**2.38**
T_4 (N_2K_0) – Rec. dosage of FYM + 50%N + 0%K	39589	105000	65411	1.65
T_5 (N_2K_1) – Rec. dosage of FYM + 50%N + 50%K	40381	116400	76019	1.88
T_6 (N_2K_2) – Rec. dosage of FYM + 50%N + 100%K	41172	118800	77628	1.88
T_7 (N_3K_0) – Rec. dosage of FYM + 25%N + 0%K	39345	95400	56055	1.42
T_8 (N_3K_1) – Rec. dosage of FYM + 25%N + 50%K	40136	97200	57064	1.42
T_9 (N_3K_2) – Rec. dosage of FYM + 25%N + 100%K	40927	102000	61073	1.49

❖ Cost of dry leaf of kalmegh per kg : Rs. 60.

The highest B:C ratio of 2.38 net return of Rs 98,983 was recorded when plants were supplied with 25 tonnes FYM $ha^{-1.}$ + 75 per cent N + 100 per cent K. (Table 3). The increase in the return may be attributed enhanced herb yield due to optimum level of

nutrients supplied to meet the required demand of the crop. These findings are in line with results of Aladakatti *et al*.[2] in stevia.

CONCLUSION

The application of 75 per cent nitrogen and 100 per cent potassium along with 25 tonnes FYM ha^{-1} may be recommended in kalmegh to take up second ratooning.

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