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Improvement in the Growth and Yield of Kalmegh influenced by Pruning and Nutrition levels

J. Cheena[1*], V. Krishna Veni[1], M. Padma[2] and M. Sreenivas[3]

[1]Medicinal and Aromatic Plant Research Station, Rajendranagar, Hyderabad,
[2]Department of Horticulture, Mulugu, Siddipet, India
[3]Department of Horticulture, Mojerla, Wanaparthy, Sri Konda Laxman Telangana State Horticultural University, Mulugu(V & M), Siddipet dist., Telangana, India

**Corresponding author*

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A B S T R A C T

An investigation was carried out at Medicinal and Aromatic Plant Research Station Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Mulugu (V & M), Siddipet Dist., Telangana State during the period of 2017-20 to determine the Improvement in the growth and yield of kalmegh influenced by pruning and nutrition levels. The study was conducted with the different levels of pruning i.e, P_1- 0 Pruning, P_2- Pruning once at 6 weeks after sowing, P_3- Pruning twice at 6 and 8 weeks after sowing and different sources of Nutrition i.e, N_1- 75:75:50 NPK ha^{-1} + FYM 10 t/ha, N_2 - 100:75:50 NPK ha^{-1} + FYM 5 t/ha, N_3 - 100:75:50 NPK ha^{-1} + Vermicompost 2.5t/ha. The parameters in terms of fresh herbage yield, seed yield were significantly differed with respect to the different pruning and nutrition sources. The maximum plant height (56.56cm), no. of branches (23.12), fresh herbage yield (65.42 q/ha), dry herbage yield (23.62 q/ha) and seed yield (1.98 q/ha) were found in P_3N_3 while the minimum plant height, no. of branches, fresh herbage yield, dry herbage yield and seed yield were found in P_1N_1.

Introduction

Kalmegh (*Andrographis paniculata* Nees) known as 'King of bitters' belonging to the family Acanthaceae, is an erect annual herb indigenous to India and cultivated in many parts of Asia (Kumar *et al.*, 2012). In India it is widely cultivated in the tropical and moist regions, including Uttar Pradesh (Patidar *et al.*, 2011). The genus *Andrographis* is of particular significance in India, as 25 out of 28 species occur in the Indian subcontinent only. Kalmegh is one of the most important medicinal plant, known for its preventive and curative properties. The fresh and dried leaves of kalmegh and juice extracted from herb are

official drugs in Indian pharmacopoeia. In Thailand, the decoction of the dried leaf is used against high blood pressure. It forms the principle ingredient of household medicine called "Alui", extensively used in West Bengal. Common ayurvedic drugs are "Kalmeghasava" and "Kalmeghnamayas Haub" (Sanjutha *et al.*, 2008). In India, the entire plant is used to obtain andrograpolide (Randa and Sharma, 1990). *A. paniculata* is an important source of diterpenoids, the most important one being andrographolide (Arpana and Bagyaraj 2007). The above ground parts of *A. paniculata,* particularly the leaves contain the higher concentrations of the pharmacologically active chemical constituents (Jarukamjorn and Nemoto 2008; Akbar 2011).

The leaves contain the maximum andrographolide (2.5%), while the stem contains lesser amount (2.0%) of this active principle (Chakravarti and Chakravarti, 1952 Moktader and Sirchar, 1939). Pruning is an important cultural practice that has been shown to enhance both productivity and quality of plant. A study by Yilmaz *et al.,* (2004) on tea shown that pruning affected the composition and quality of tea leaves. Calatayud *et al.*, (2008) reported that pruned plant has higher capacity to promote the photosynthetic light reaction, a large number of metabolic sinks and a higher turgor pressure compared to unpruned plant. If plants are pruned the starch reserves in the roots are utilized for shoot growth to maintain equilibrium (Zeing, 2003). Nutrient management is critical issue that determine quantity and quality of harvested produce. Nishchitha *et al.*, (2018) reported that with the application of 100:75:50 kg NPK per ha + *Azatobacter* (1 q) enriched in FYM (5 t ha-1) + vermicompost 1 t per ha the yield and quality of kalmegh has increased and with no significant variation in andrographolide content in plants. Pruning and sources of nutrition affects the growth and yield of the plant therefore, the present investigation was carried out.

Materials and Methods

The experiment entitled "Improvement in the growth and yield of Kalmegh influenced by Pruning and Nutrition levels" was carried out for three years (2017-2020) at Medicinal and Aromatic Plant Research Station Rajendranagar, SKLTSHU, Mulugu, Siddipet district. The meteorological data was collected from the Agricultural Research Institute, Rajendranagar for the experimental period of three years (2017-2020). It comes under sub tropical zone and is situated at latitude of $17^{0}30^{1}$ N and longitude of $78^{0}42^{1}$ E. It was normal weather data on total rainfall, maximum and minimum temperature, relative humidity, that prevailed during the period of experimentation. The land used under the experimental layout was red with good drainage and low water holding capacity with uniform texture. The soil characteristics were, pH 7.20, electrical conductivity 0.67 dSm-1, organic carbon 0.32%, Available Nitrogen 120 kg/ha, Available Phosphorus 48 kg/ha and Available Potassium 60 kg/ha. Good soil fertility management ensures adequate nutrient availability to plant and improve their growth.

The experiment was designed in Factorial Randomised Block Design with three replications with the spacing of 30*30 cm. Complete dosage of farmyard manure and vermicompost were applied at the time of final ploughing. Nitrogen, Phosphorus and Potassium were applied in the form of Urea, Single super phosphate and Murate of potash respectively. Nitrogen was applied in three split doses, before transplanting add 50% of Nitrogen and full dose of phosphorous and potassium to the field, remaining 50% of Nitrogen was applied as top dressing at 6 and 8 weeks after sowing i.e, after 1^{st} and 2^{nd} pruning. The plant height was recorded before each harvest from ground level to the tip of

plant with the help of measuring tape and was expressed in centimeters (cm)**.** Fresh herbage yield was estimated by harvesting the crop with sickle 15cm above the ground level and immediately weighted for obtaining plot yield. Then plot yield was transformed to yield per hectare which was expressed in terms of quintals. After recording the fresh herbage yield, the plants were placed under shade for 4-5 days and obtained dry herbage yield which was again expressed in terms of quintals and then seeds are collected by threshing to obtain seed yield.

Results and Discussion

The plant height was significantly influenced by pruning and nutrition levels at all stages of crop growth (Table 1). Pruning twice at 6 and 8 weeks after sowing showed maximum plant height (44.25 cm). During initial stages of crop, nutrients are readily available through inorganic fertilizers, whereas during later stages of crop the nutrients are supplied by both inorganic as well as organic forms due to decomposition, thus making higher availability of nutrients. Moreover the nutrient concentration of vermicompost is higher when compared to FYM and hence highest plant height (43.58 cm) was recorded with application of 100:75:50 NPK ha^{-1} + Vermicompost 2.5t/ha. The interaction effect of pruning and nutrition levels showed significant variation on plant height.

The highest plant height (52.34 cm) was recorded with pruning twice at 6 and 8 weeks after sowing and application of 100:75:50 NPK ha^{-1} + vermicompost 2.5t/ha (P_3N_3) which was on par (48.19) with pruning twice at 6 and 8 weeks after sowing and application of 100:75:50 NPK ha^{-1} + FYM 5t/ha (P_3N_2). Plants grow taller by ensuring that their basic needs includes water, sunlight, warmth and nutrients. By utilizing more nutrients plants grow bigger and healthier. FYM, vermicompost around rhizosphere create the favourable environment to help in better availability and uptake of nutrients by plants. Similar results of increased plant height due to combined application of bio-fertilizer, vermicompost and inorganic fertilizers have been reported by Hemalatha and Suresh (2012), Mishra and Jain (2014) in kamegh. Several research results suggest that plant height depends on stem elongation (Liu *et al.,* 2016; Nagashima and Hikosaka, 2011).

A significant difference was observed on number of branches due to pruning and nutrition levels (Table 1). The maximum number of branches (18.81) was recorded with pruning twice at 6 and 8 weeks after sowing. Application of 100:75:50 NPK ha^{-1} + Vermicompost 2.5t/ha has recorded maximum number of branches (18.48). The interaction effect of pruning and nutrition levels showed significant variation on number of branches.

The maximum number of branches (23.12) was recorded with pruning twice at 6 and 8 weeks after sowing and application of 100:75:50 NPK ha^{-1} + vermicompost 2.5t/ha (P_3N_3). The increase in number of branches may be due to increase in number of pruning practice. Pruning thus encourages more number of branches thus increases the herbage yield intern increases seed yield. The number of branches $plant^{-1}$ might depend on the height of the plant which favored formation of more lateral buds, a taller plant yielded a higher number of branches $plant^{-1}$. This phenomenon was also reported by Singh *et al.,* (2011) and Sunil Kumar *et al.,* (2011).

Fresh herbage yield per hectare showed a significant difference due to pruning and nutrition levels (Table 2). The maximum fresh herbage yield (56.82 q/ha) was recorded with pruning twice at 6 and 8 weeks after sowing.

Table.1 Improvement in the growth and yield of Kalmegh influenced by Pruning and Nutrition levels (2017-2020)

	Plant height (cm)				No. of branches				Days to first harvest			
	P1	**P2**	**P3**	**Mean**	**P1**	**P2**	**P3**	**Mean**	**P1**	**P2**	**P3**	**Mean**
N1	34.07	36.70	38.79	36.52	11.91	12.19	12.12	12.07	120.14	130.26	134.91	128.43
N2	38.00	44.14	52.42	44.85	12.20	15.40	21.20	16.26	129.12	132.02	135.17	132.10
N3	40.09	46.70	56.56	47.78	14.20	18.12	23.12	18.48	132.16	132.80	136.20	133.72
Mean	37.38	42.51	49.25		12.77	15.23	18.81		127.14	131.69	135.42	
Factors	**SE(M)+-**		**C.D at 5%**		**SE(M)+-**		**C.D at 5%**		**SE(M)+-**		**C.D at 5%**	
N	1.71		3.1		0.81		1.21		3.4		1.70	
P	0.86		5.6		0.46		2.20		3.8		2.42	
N*P	1.92		4.8		1.20		3.20		4.2		1.90	

Table.2 Improvement in the growth and yield of Kalmegh influenced by Pruning and Nutrition levels (2017-2020)

	Fresh Herbage Yield/ha (q/ha)				Dry herbage Yield/ ha (q/ha)				Seed yield/ha (q/ha)			
	P1	**P2**	**P3**	**Mean**	**P1**	**P2**	**P3**	**Mean**	**P1**	**P2**	**P3**	**Mean**
N1	41.25	46.17	44.98	44.13	15.04	17.98	17.22	16.74	1.24	1.37	1.56	1.39
N2	48.18	51.26	60.08	53.17	18.35	19.22	21.70	19.75	1.25	1.68	1.85	1.59
N3	49.20	57.23	65.42	57.26	18.51	20.03	23.62	20.72	1.34	1.78	1.98	1.7
Mean	46.21	51.53	56.82		17.3	19.07	20.84		1.27	1.61	1.79	
Factors	**SE(M)+-**		**C.D at 5%**		**SE(M)+-**		**C.D at 5%**		**SE(M)+-**		**C.D at 5%**	
N	3.20		3.80		1.36		1.30		0.76		0.95	
P	2.90		4.20		0.98		NS		0.26		0.92	
N*P	4.20		8.20		2.10		NS		0.97		0.82	

Factor I : Pruning P_1- 0 Pruning, P_2- Pruning once at 6 weeks after sowing, P_3- Pruning twice at 6 and 8 weeks after sowing

Factor II : Source of Nutrition N1. 75:75:50 NPK ha^{-1} + FYM 10 t/ha

N2. 100:75:50 NPK ha^{-1} + FYM 5 t/ha

N3. 100:75:50 NPK ha^{-1} + Vermicompost 2.5t/ha

Application of 100:75:50 NPK ha^{-1} + Vermicompost 2.5t/ha has recorded maximum fresh herbage yield (57.26 q/ha). The interaction effect of pruning and nutrition levels showed significant variation on fresh herbage yield.

The maximum fresh herbage yield (65.42 q/ha) was recorded with pruning twice at 6 and 8 weeks after sowing and application of 100:75:50 NPK ha^{-1} + Vermicompost 2.5t/ha (P_3N_3) which was on par (57.23 q/ha) with pruning once at 6 weeks after sowing and application of 100:75:50 NPK ha^{-1} + Vermicompost 2.5t/ha (P_2N_3). Whereas one time and two times of pruning gave higher herbage yield compared to unpruned plants.

The reason for the increased herbage yield might be due to FYM and vermicompost aiding mineralization of immobalized nutrients. These findings are in agreement

with the results reported by Divya *et al.,* (2017), Hemalatha and Suresh (2012), Sanjutha *et al.,* (2008) in kalmegh.

In case of dry herbage yield, significant difference was shown in nutrition levels (Table 2). The maximum dry herbage yield was recorded in 100:75:50 NPK ha^{-1} + Vermicompost 2.5t/ha (N_3) whereas significant difference was not shown in case of pruning practice and their interaction.

Seed yield significantly influenced the pruning and nutrition levels (Table 2). The maximum seed yield (1.79 q/ha) was recorded with pruning twice at 6 and 8 weeks after sowing. Application of 100:75:50 NPK ha^{-1} + Vermicompost 2.5t/ha has recorded maximum seed yield (1.70 q/ha). The interaction effect of pruning and nutrition levels showed significant variation on seed yield.

The maximum seed yield (1.98 q/ha) was recorded with pruning twice at 6 and 8 weeks after sowing and application of 100:75:50 NPK ha^{-1} + Vermicompost 2.5t/ha (P_3N_3) which was on par (1.78 q/ha) with pruning once at 6 weeks after sowing and application of 100:75:50 NPK ha^{-1} + Vermicompost 2.5t/ha (P_2N_3). The positive response with the application of FYM, vermicompost due to increased plant growth, increase in number of branches, through improvement in soil conditions and increased availability of nutrients favoured higher seed yields.

From this investigation, the highest fresh herbage yield and seed yield was recorded in the treatment combination of pruning twice at 6 and 8 weeks after sowing and application of 100:75:50 NPK ha^{-1} + Vermicompost 2.5t/ha (P_3N_3). From the above results, it may be stated that the practice of pruning and use of chemical fertilizers along with vermicompost in integrated manner is beneficial in improving the growth of kalmegh.

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