Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(6): 1355-1358
Received: 19-09-2018
Accepted: 21-10-2018

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Effect of organic treatments and spacing on yield parameters of Kalmegh (*Andrographis paniculata*) var. cim-megha

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Abstract
A field experiment was conducted on the effect of organic treatments and spacing on yield parameters of Kalmegh under Rabi season 2017-18 at college of Horticulture, Rajendranagar. The results revealed that interaction between organic treatments and spacing significantly influenced yield parameters. The treatment M_1S_1 - (FYM (30 t/ha) + AMC (7.5 l/ha) with spacing S_1 (15 x 15 cm) recorded maximum fresh herb yield per plot (3.12 kg), dry herb yield per plot (1.56 kg), fresh herb yield per hectare (69.4 q/ha), dry herb yield per hectare (34.73 q/ha), number of capsules per plant (301.52), seed yield per plot (6.80 g) at harvest, followed by M_3S_1- Neem cake (7.5 t/ha) + AMC (7.5 l/ha) with spacing S_1(15 x 15 cm). Minimum was recorded in the treatment M_5S_3- Control with spacing S_3 (30 x 45 cm).

Keywords: Kalmegh, FYM, neem cake, spacing, yield parameters

Introduction
Kalmegh (*Andrographis paniculata*) belonging to family Acanthaceae is one of the nineteen species of the genus Andrographis which is indigenous to India and has been in Indian systems of medicine since time immemorial.

The herb is having a preventive effect from many diseases, due to its powerful immune strengthening benefits. The entire plant is used to treat snake bite. The hot water extract of the whole plant is used for acute jaundice. The decoction of the dried leaf is used against high blood pressure. The plant has properties like laxative, antipyretic, anti-inflammatory, anti-viral, anti-malarial, anti-cancer (Kumar *et al*., 2004, Shen *et al*., 2002) [9, 15]. Calabrese *et al*., (2000) [5] has conducted a trial on HIV patients and found effective.

Continuous use of inorganic fertilizers, pesticides and fungicides without any organic manure cause environmental pollution especially, in soil thereby affecting its fertility on long term basis (Subramaniyan *et al*., 2001) [18]. Hence, organic manures can serve as alternative to mineral fertilizers for improving soil structure (Dauda *et al*., 2008) [7] and microbial biomass. For maintaining optimum productivity of the land and building up of soil fertility, the use of organic manures along with biofertilizers (AMC) to crops has been suggested. It is a well-known fact that the availability of organic manures is very much limited in the present day agriculture (Annadurai *et al*., 2001) [3].

Spacing is an important factor for better growth and yield of the plant. Optimum number of plants is required per unit area to utilize efficiently the available production factors such as water, nutrient, light and CO_2. Maximum exploitation of these factors is achieved when the plant population puts forth maximum pressure on all the factors of production. As a result, individual plants are put under severe stress because of inter-plant competition. Normally maximum yields are obtained from plant populations which do not allow plants to achieve their individual maximum potential. Thus, the entire community of plants considered for higher production rather than individual plant performance.

Resources and Research Methods
The field experiment was conducted at College of Horticulture, Rajendranagar during rabi 2017-18. The soil type was loamy sand having pH 6, EC 0.06 dSm^{-1}, low in available N (175.61 kg ha^{-1}), low in available P (7.77 kg ha^{-1}) and medium in available potash (182.56 kg ha^{-1}). The experiment was laid out in Factorial randomized block design (FRBD) in three replications with 15 treatment combinations comprised of five levels of organic treatments *viz*., M_1 – FYM (30t/ha) + AMC (7.5 l/ha), M_2 – Vermicompost (6t/ha) + AMC (7.5 l/ha), M_3 – Neem cake (7.5t/ha) + AMC (7.5 l/ha), M_4 – Sheep manure (10t/ha) + AMC (7.5 l/ha), M_5 – Control and three levels of spacing *viz*., S_1 – 15x15 cm, S_2 – 30x30 cm, S_3 – 30x45 cm.

The treatment combinations include M_1S_1: FYM (30 t/ha) + AMC (7.5 l/ha) with spacing S_1 (15 x 15 cm), M_1S_2: FYM (30 t/ha) + AMC (7.5 l/ha) with spacing S_2 (30 x 30 cm), M_1S_3: FYM (30 t/ha) + AMC (7.5 l/ha) with spacing S_3 (30 x 45 cm), M_2S_1: Vermicompost (6 t/ha) + AMC (7.5 l/ha) with spacing S_1 (15 x 15 cm), M_2S_2: Vermicompost (6 t/ha) + AMC (7.5 l/ha) with spacing S_2 (30 x 30 cm), M_2S_3: Vermicompost (6 t/ha) + AMC (7.5 l/ha) with Spacing S_3 (30 x 45 cm), M_3S_1: Neem cake (7.5 t/ha) + AMC (7.5 l/ha) with spacing S_1 (15 x 15 cm), M_3S_2: Neem cake (7.5 t/ha) + AMC (7.5 l/ha) with spacing S_2 (30 x 30 cm), M_3S_3: Neem cake (7.5 t/ha) + AMC (7.5 l/ha) with spacing S_3 (30 x 45 cm), M_4S_1: Sheep manure (10 t/ha) + AMC (7.5 l/ha) with spacing S_1 (15 x 15 cm), M_4S_2: Sheep manure (10 t/ha) + AMC (7.5 l/ha) with spacing S_2 (30 x 30 cm), M_4S_3: Sheep manure (10 t/ha) + AMC (7.5 l/ha) with spacing S_3 (30 x 45 cm), M_5S_1: Control (without organic treatments) with spacing S_1 (15 x 15 cm), M_5S_2: Control (without organic treatments) with spacing S_2 (30 x 30 cm), M_5S_3: Control (without organic treatments) with spacing S_3 (30 x 45 cm).

Research Findings and Discussion

1. Fresh herb yield per plot

Interaction between organic treatments and spacing had significant effect on fresh herb yield per plot at Harvest. Among all the interactions M_1S_1 - FYM (30t/ha) + AMC 7.5 l/ha with spacing S_1 - 15 x 15 cm recorded the maximum (3.12) followed by M_3S_1 - Neem cake 7.5 t/ha + AMC 7.5 l/ha with spacing S_1 - 15 x 15 cm (2.96). Minimum fresh herb yield per plot was observed in M_5S_3 - Control with spacing S_3 - 30 x 45 cm (1.22).

The application of organic manures before planting *Mentha longifolia* plants provide a beneficial effects on plant growth, due to their availability to supply macro and micro nutrients in available forms and improving soil structure (Dauda *et al*. 2008) [7] and microbial biomass (Dhull *et al*. 2004) [8]. The positive effect of organic manures and biofertilizers on the fresh herb yield per plot was emphasized by (Al-Fraihat *et al*. 2011) [1] on marjoram, (Bajeli *et al*. 2016) [4] on Mentha arvensis and (Trivedi *et al*. 2017) [19]. Among different spacing levels, more number of plants per unit area was observed under 15 x 15cm spacing compared to other spacing. Such a phenomenon of higher yield at closer spacing has also been reported by Singh and Nand (1979) [16] in *Mentha spicata*.

2. Dry herb yield per plot

Interaction between organic treatments and spacing had significant effect on dry herb yield per plot at Harvest. Among all the interactions M_1S_1 - FYM 30t/ha + AMC 7.5 l/ha with spacing S_1 - 15 x 15 cm recorded the maximum (1.56) followed by M_3S_1 - Neem cake 7.5 t/ha + AMC 7.5 l/ha with spacing S_1- 15 x 15 cm (1.48). Minimum dry herb yield per plot was observed in M_5S_3 Control with spacing S_3 - 30 x 45 cm (0.61).

The increment in plant dry weight may be attributed to the increase in fresh weight. The obtained results are in agreement with (Al-Fraihat *et al*. 2011) [1] on marjoram, (Bajeli *et al*. 2016) [4] on *Mentha arvensis* and (Amooaghaie & Golmohammadi. 2017) [2] on *Thymus vulgaris*. The increase in dry yield might be due to optimum plant population, better nourishment and less population in wider spacing, (30 cm x 45 cm) could have caused this. The results are in conformity with those of reported by Ramchandran and Subbian (1981) [13].

3. Fresh herb yield per hectare

Interaction between organic treatments and spacing had significant effect on fresh herb yield per hectare at Harvest. Among all the interactions M_1S_1 (FYM (30t/ha) + AMC (7.5 l/ha) with spacing S_1 (15 x 15 cm) recorded the maximum fresh herb yield per hectare (69.4) followed by M_3S_1 (Neem cake (7.5 t/ha) + AMC (7.5 l/ha) with spacing S_1 (15 x 15 cm) - (65.0). Minimum fresh herb yield per hectare was observed in M_5S_3 Control with spacing S_3 (30 x 45 cm) - (27.03).

The availability of the major nutrients which are actively involved in vital processes was enhanced by application of organic manures and biofertilizer inoculations which ultimately resulted in higher yield. The results confirm the findings of Panchabhai *et al*. (2005) [11] and Yadav *et al*. (2013) [20] in ashwagandha. Singh and Singh (2006) [17] and Patidar *et al*. (2011) [12] have also recorded highest fresh herbage yield per hectare from closer spacing in kalmegh. Randhawa and Singh (1996) [14], obtained similar findings.

4. Dry herb yield per hectare

Interaction between organic treatments and spacing had significant effect on dry herb yield per hectare at Harvest. Among all the interactions M_1S_1 - FYM 30t/ha + AMC 7.5 l/ha with spacing S_1 - 15 x 15 cm recorded the maximum dry herb yield per hectare (34.73) followed by M_3S_1 - Neem cake 7.5 t/ha + AMC 7.5 l/ha with spacing S_1- 15 x 15 cm (32.88). Minimum dry herb yield per hectare was observed in M_5S_3- Control with spacing S_3 - 30 x 45 cm (13.55).

5. Number of capsules per palnt

Interaction between organic treatments and spacing had significant effect on number of capsules per plant at Harvest. Among all the interactions M_1S_1 - FYM 30t/ha + AMC 7.5 l/ha with spacing S_1 - 15 x 15 cm recorded the maximum number of capsules per plant (310.45) followed by M_3S_1 - Neem cake 7.5 t/ha + AMC 7.5 l/ha with spacing S_1- 15 x 15 cm (301.52). Minimum number of capsules per plant was observed in M_5S_3 - Control with spacing S_3 - 30 x 45 cm (214.06).

The organic manures improved the availability of nutrients and balanced supply of N throughout the life cycle of crop thereby reducing leaf senescence and increased assimilate demand, which resulted in higher number of capsules (Choudhary *et al*. 2011). The maximum number of pods per plant were registered under the plant geometry 30 cm x 45 cm. similar results were also reported by Kumar *et al*. (2015) [10] in fenugreek.

6. Seed yield per plot

Interaction between organic treatments and spacing found non-significant on seed yield per plot at Harvest.

Table 1: Effect of organic treatments and spacing on yield parameters of kalmegh at harvest

Treatments	Fresh herb yield per plot	Dry herb yield per plot	Fresh herb yield per hectare(q/ha)	Dry herb yield per hectare(q/ha)	Number of capsules per plant	Seed yield per plot(g)
M_1S_1	3.12	1.56	69.40	34.73	310.45	6.80
M_1S_2	1.86	0.93	41.25	20.66	236.03	4.53
M_1S_3	1.46	0.73	32.44	16.22	225.80	3.40
M_2S_1	2.43	1.21	53.99	26.96	298.24	5.90
M_2S_2	1.75	0.88	38.81	19.48	228.03	3.76
M_2S_3	1.34	0.71	29.08	15.85	224.04	3.30
M_3S_1	2.96	1.48	65.00	32.88	301.52	6.36
M_3S_2	1.79	0.90	39.77	19.92	229.34	3.76
M_3S_3	1.38	0.73	30.65	16.14	225.16	3.40
M_4S_1	1.91	0.95	42.37	21.18	247.35	5.20
M_4S_2	1.63	0.82	36.21	18.14	227.14	3.70
M_4S_3	1.28	0.64	28.41	14.22	221.02	3.00
M_5S_1	1.64	0.82	36.44	18.29	236.68	4.90
M_5S_2	1.45	0.68	32.29	15.03	226.02	3.50
M_5S_3	1.22	0.61	27.03	13.55	214.06	2.93
SE m±	0.02	0.04	1.61	0.36	4.46	0.22
C.D	0.70	0.10	4.67	1.05	12.93	NS

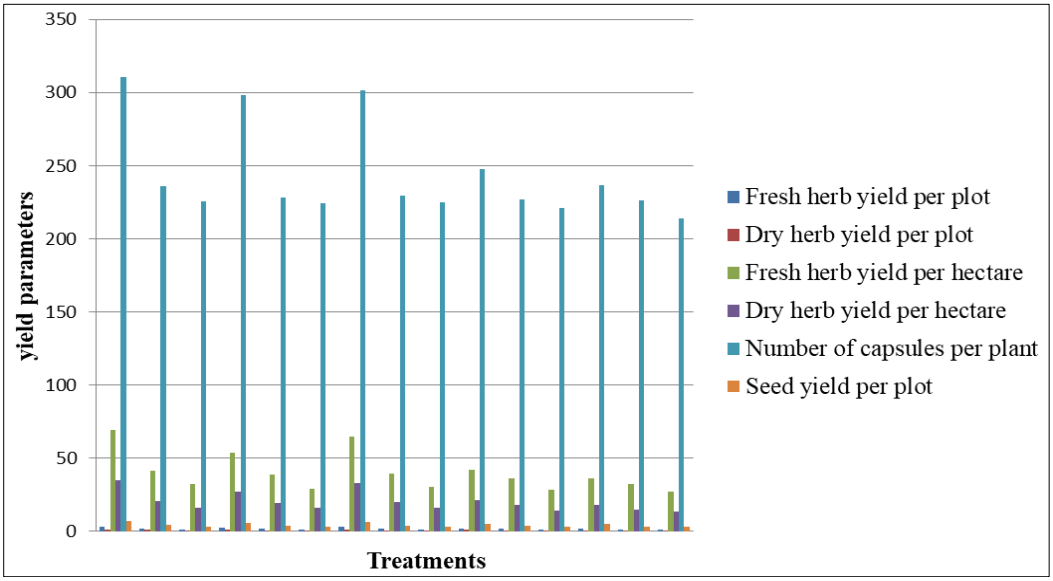

Fig 1: Effect of organic treatments and spacing on yield parameters of kalmegh at harvest

Conclusion

Interaction between organic treatments and spacing significantly influenced yield parameters. Among all the interactions M_1S_1- FYM (30 t/ha) + AMC (7.5 l/ha) with spacing 15 x 15 cm recorded maximum herb yield.

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