International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 594-597

Received: 15-07-2018
Accepted: 20-08-2018

Asha MR
M. Sc. scholar, Department of Plantation, Spices, Medicinal and Aromatic Crops, University of Horticultural Sciences, Bagalkot, Karnataka, India

Biradar IB
Professor and Head, Department of Agronomy, University of Horticultural Sciences, Bagalkot, Karnataka, India

Srikantaprasad D
Assistant Professor, Department of Plantation, Spices, Medicinal and Aromatic Crops, University of Horticultural Sciences, Bagalkot, Karnataka, India

Pushpa TN
Assistant Professor, Department of Plantation, Spices, Medicinal and Aromatic Crops, University of Horticultural Sciences, Bagalkot, Karnataka, India

Kulkarni MS
Professor of Plant Pathology and Directorate of student welfare, University of Horticultural Sciences, Bagalkot, Karnataka, India

Desai S
M. Sc. scholar, Department of Plantation, Spices, Medicinal and Aromatic Crops, K.R.C. College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot, Karnataka, India

Shalini RM
M. Sc. scholar, Department of Plantation, Spices, Medicinal and Aromatic Crops, K.R.C. College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot, Karnataka, India

Correspondence
Asha MR
M. Sc. scholar, Department of Plantation, Spices, Medicinal and Aromatic Crops, University of Horticultural Sciences, Bagalkot, Karnataka, India

Effect of different weed management methods on yield and quality of menthol mint (*Mentha arvensis* L.)

Asha MR, Biradar IB, Srikantaprasad D, Pushpa TN, Kulkarni MS, Desai S and Shalini RM

Abstract
Menthol mint is a major source of natural menthol and dementholized oil. It has high economic importance among the crops grown in India. Menthol mint shows very slow growing at initial stages which makes it a poor competitor with weeds. During the experiment both monocot and dicot weeds get emerge and compete with the crop it leading to considerable yield loss. Effect of weed management methods on production of herb, oil yield and quality of menthol mint was evaluated. The study was initiated at KRCCH, Arabhavi during the year 2017-18 to standardize the integrated weed management in menthol mint to obtained high herbage and quality essential oil yield to fulfill the needs of farmers of northern dry zone of Karnataka. The experiment was laid out in Randomized Complete Block Design having three replications with 12 treatments. The different weed management methods were tried as treatments. The results showed that all weed management treatments significantly reduced weed density (05.66 and 33.66/m^2, respectively) and weed dry weights (7.94 and 23.66 g/m^2, respectively) at 30 and 60 DAP were recorded in pre-emergent spray of oxyfluorfen 23.5 EC 0.25 kg a.i./ha and un-weeded condition recorded maximum of these values. Among the different weed management treatments pre-emergent spray of oxyfluorfen 23.5 EC 0.25 kg a.i./ha recorded significantly maximum fresh herb (17.69 t/ha), shade dried herb (14.63 t/ha) and essential oil yield (107.62 kg/ha) and un-weeded recorded significantly minimum fresh herb (5.95 t/ha), shade dried herb (4.16 t/ha) and essential oil yield (38.99 kg/ha). The yield per plot is highest in pre-emergent spray of oxyfluorfen due to minimum weed density and weed dry weight per square meter.

Keywords: menthol mint, weed management methods, herbicides

Introduction
Menthol mint (*Mentha arvensis* L.), belonging to family Lamiaceae, a group of aromatic herbs of considerable economic importance. It is commercially cultivated for its essential oil, which is the main source of natural menthol (Croteau *et al*., 2005) [2] and dementholized oil. India is the largest producer and exporter of mentha oil in the world. India supply 75-80 per cent of world demand of menthol. Menthol mint shows very slow growing at initial stages which makes it a poor competitor with weeds. Both monocot and dicot weeds emerge and compete with the crop and the yield losses due to weeds could be up to 74 per cent (Walia *et al*., 2006) [9]. Weeds not only reduces the yield also deteriorate the quality of crop produce as separating out weed plants from crop produce during oil extraction is not possible. Manual weeding is arduous, costly and time consuming and is not possible on a large scale. Under such situations, use of herbicides for weed control holds a great promise. Integrated weed management plays a key role in reducing the weed density and weed dry weight helps to obtain the maximum herb and oil yield without deteriorating the quality of oil. The weed management treatments on weed dynamics and crop performance is lacking for Arabhavi conditions. The herb and oil yield of menthol mint depends largely on the extent of its freeness from weeds. The present investigation was planned to study the performance of different weed management methods on weed dynamics, growth and development of menthol mint.

Material and Methods
The present investigation was carried out during 2017 for *kharif* season in the Department of Plantation, Spices, Medicinal and Aromatic Crops, Kittur Rani Channamma College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot, Karnataka, India,

situated in northern dry zone (Zone No. 3; Region-2) of Karnataka at 16°15' N latitude and 74°45' E longitude, at an altitude of 612 m above mean sea level.

Climatic condition and soil characteristics of the experimental site

The experimental site is considered to have the benefit of both south-west and north-east monsoons. During experiment, crop received about 359.6 mm rainfall (April 2017–November 2017), the mean temperature of 26.20 °C and mean relative humidity (RH) of 88.70 per cent. The soil of experimental site is sandy clay loam (vertisols) with alkaline pH (8.79).

Experimental details

Research experiment was conducted in the Department of Plantation, Spice, Medicinal and Aromatic crops, K R C College of Horticulture, Arabhavi, during 2017. The experiment was laid out in a randomized complete block design with 12 treatments and replicated thrice. The experimental site was brought to fine tilth by ploughing deeply with tractor drawn reversible double mouldboard plough followed by passing rigid tyne cultivator and rotovator for clod crushing and weed removal. Then the plots of 3.6 m width and 4.5 m length were laid out and separated by bunds of 60 cm width as per the plan making provision for irrigation channels. The planting was done on July 08th, 2017. The plants were uprooted and white stolons of uniform thickness were separated. They were cut into of 7.0 to 10.0 cm long cuttings having 2-3 nodes and dipped in 0.3 per cent COC for 5-10 minutes before planting. The furrows were opened at 45 cm interval in each plot. Prepared stolons were placed horizontally in mid of furrows at 30 cm spacing, at a depth of 2.5 to 4.0 cm and later covered with soil. The seed rate followed was 400 kg of stolons per hectare. The experimental plots were provided with the calculated quantity of fertilizers. FYM was applied (@ 32.40 kg/plot) during land preparation. Phosphorous and potassium fertilizers at the rate of 60 kg each per hectare in the form of SSP and MOP respectively were uniformly applied to all the plots as basal dose. Nitrogen fertilizer at the rate of 150 kg per hectare in the form of urea top dressed in three split doses at 30, 60 and 90 days after planting. Oxyfluorfen and metribuzin was sprayed as pre-emergent herbiced (2 DAP) on 10th July, 2017 and metribuzin and quizalofop-ethyl was sprayed as post-emergence (30 DAP) on 08th August, 2017. The spraying was done with knapsack sprayer fitted with flood-jet type nozzle. The quantity of water used was 1000 litres per hectare. The organic mulch of sugarcane trash (5 t/ha) was applied to plots according to treatments 30 days after planting (DAP). Irrigation was given immediately after planting and subsequent irrigations were given at eight to ten days intervals depending on the rainfall and soil moisture. Hand weeding was done at an interval of 15 days intervals from planting to harvest. Inter-cultivation is done manually at 15 days intervals up to 45 days. The crop was harvested at 120 days after planting when the crop was at fifty per cent flowering. The plants were cut 1 to 4 cm from the ground level by using sharpe sickle in the late morning to get more percentage of oil in the leaves. The species-wise number of weeds were counted from two randomly selected spots (100 cm × 100 cm quadrets) in each plot. Count were taken before first hand weeding (30 DAP), 45, 60, 90 days after planting and at harvest. Dry weights of weeds taken at 30 and 60 DAP from two randomly selected spots (100 cm × 100 cm quadrets) in each plot. The weed samples were collected in separate bags and were weighed for fresh weight and then dried in oven at 60 ºC till constant weight. Known weight of fresh herbage from each plot was taken and withered for few hours in shade. The plant material was chopped into small pieces and essential oil extraction was done by hydro-steam distillation method. Essential oil content was estimated on fresh weight basis and expressed in per cent. All the data were subjected to Fisher method of analysis of variance as given by Panse and Sukhatme (1967) [6] for analysis and interpretation of data. The level of significance used in 'F' test was at P = 0.05 and critical difference (CD) values were worked out wherever 'F' test was significant. The data on weed density and dry weight have shown high degree of variation. Therefore, the data on these weed parameters were subjected to square root transformation ($\sqrt{x+0.5}$). Transformation is done to make analysis of variance more valid as suggested by Chandel (1984) [1].

Results and Discussion

Weed density

The data on weed density as influenced by different weed management practices in menthol mint are presented in table 1. The weed density differs significantly at 30 and 60 DAP as influenced by different weed management methods. Among all the different weed management methods pre-emergent application of oxyfluorfen @ 0.25 kg a.i/ha (T_5) recorded significantly the lowest weed density (05.66 and 33.66/m^2 30 and 60 DAP, respectively) due to reduced weed germination, weed growth and their photosynthetic activity that was found *on par* with PE application of oxyfluorfen @ 0.25 kg a.i./ha followed by inter-cultivation (T_{10}) (06.00 and 37.00/m^2 30 and 60 DAP, respectively) which involved in loosening of soil favouring the crop growth. Similar result was recorded by Walia *et al*., (2006) [9] in menthol mint. Organic mulch of sugarcane trash (T_3) (06.33 and 39.33/m^2 30 and 60 DAP, respectively) also reduced the weed density owing to mechanical hindrance for weed emergence by restricting solar radiations reaching below. Similar observation was recorded by Dyck and Liebman (1994) [3]. Un-weeded treatment recorded significantly higher number of weeds per square meter at 30 and 60 DAP (90.00 and 157.00/m^2, respectively).

Dry weight of weeds (g/m^2)

The data on dry weights of weeds (Table 1) shows significant reduction in dry weights as compared with un-weeded control at 30 and 60 DAP.

The minimum dry weights of weeds (7.94 and 23.66 g/m^2 30 and 60 DAP, respectively) were observed in (T_5) PE application of oxyfluorfen @ 0.25 kg a.i./ha due to reduced weed density and persistent effect of herbicide apart from reduced photosynthetic activity of different weed species. Mulch helps in suppressing weeds to a greater extent. Mulching with sugarcane trash at 5 t/ha (T_3) (10.76 and 25.00 g/m^2 30 and 60 DAP, respectively) which was *on par* with (T_5) and reduced weed density and weed biomass. A very little weed growth occurred under the sugarcane trash as the mulches prevent penetration of light facilitated better stolen production, crop dry matter accumulation, fresh herbage and mint oil yield. The results are in line with the findings of Singh and Saini (2008) [7] in menthol mint. Maintaining the crop weed-free up to the first 60 days could not suppress weeds that emerged thereafter. During later stages the crop covered sufficient surface area and the late-emerging weeds failed to compete with the crop. Whereas un-weeded treatment recorded significantly higher dry weights of weeds at 30 and 60 DAP (36.85 and 109.66/m^2, respectively).

Table 1: Weed density and weed dry weights of menthol mint as influenced by different weed management methods.

Treatments	Dose (kg a.i./ha)	Weed density (number/m2)		Weed dry weight (g/m2)	
		30 DAP	60 DAP	30 DAP	60 DAP
T_1: Hand weeding	15 DI	12.66 (3.55)	42.66 (6.53)	14.77 (2.54)	25.66 (5.06)
T_2: Inter-cultivation	15 DI	14.33 (3.77)	41.33 (6.42)	15.14 (2.60)	27.66 (5.25)
T_3: Sugarcane trash mulch	5 t/ha (30 DAP)	06.33 (2.50)	39.33 (6.27)	10.76 (1.86)	25.00 (4.98)
T_4: Metribuzin (PE)	0.70	39.33 (6.24)	91.66 (9.57)	29.52 (4.92)	68.66 (8.28)
T_5: Oxyfluorfen (PE)	0.25	05.66 (2.35)	33.66 (5.79)	7.94 (1.38)	23.66 (4.85)
T_6: Oxyfluorfen (Pre) + Metribuzin (POE)	0.25 and 0.70	14.00 (3.74)	59.00 (7.67)	12.28 (2.12)	31.00 (5.56)
T_7: Metribuzi (PE) + Quizalofop-ethyl (POE)	0.70 and 0.05	27.00 (5.19)	86.66 (9.30)	25.09 (4.24)	57.33 (7.56)
T_8: Oxyfluorfen (PE) + Quizalofop-ethyl (POE)	0.25 and 0.05	16.66 (4.07)	63.00 (7.93)	16.02 (2.75)	33.00 (5.73)
T_9: Oxyfluorfen (PE) + Metribuzin (POE) + Quizalofop-ethyl (POE)	0.25, 0.70 and 0.05	20.33 (4.48)	65.33 (8.08)	17.44 (2.99)	38.00 (6.15)
T_{10}: Oxyfluorfen (PE) + Intercultivation	0.25 + At 45 DAP	06.00 (2.44)	37.00 (6.08)	9.35 (1.62)	24.66 (4.95)
T_{11}: Metribuzin (PE) + Inter-cultivation	0.70 + At 45 DAP	19.00 (4.35)	78.66 (8.86)	21.96 (3.74)	45.66 (6.75)
T_{12}: Un-weeded (control)	-	90.00 (9.48)	157.00 (12.47)	36.85 (5.99)	109.66 (10.45)
S.Em ±		02.27 (0.21)	06.64 (0.28)	1.15 (0.18)	3.05 (0.18)
CD at 5%		06.66 (0.63)	19.48 (0.84)	3.38 (0.55)	8.96 (0.53)

PE- Pre-emergent (2DAP) POE- Post-emergent (30 DAP)
DAP: Days after planting ; DI : days intervals
Figures in parenthesis are indicating transformed values (√x+1).

Fresh herbage and shade dried herbage yield (t/ha)

In mentha, fresh and dry herbage yield is the most important parameter which decide essential oil yield (Table 2). PE application of oxyfluorfen @ 0.25 kg a.i./ha was significantly superior in terms of fresh herb yield (17.69 t/ha) and shade dried herb yield (14.63 t/ha). This may be due to increased plant height, number of branches, plant spread and higher dry matter accumulation per plant as a result of suppressed weed growth and development. Similar result was obtained by Kaur (1999) [5] in pepper mint. The significantly minimum fresh herbage yield (5.95 t/ha) and shade dried herbage yield (4.16 t/ha) were recorded in un-weeded control due to luxuriant weed growth competing with crop for soil moisture, nutrient, light and space leading to lower fresh and dry herbage yield as reported by Singh (2009) [8] in menthol mint.

Essential oil content (%)

The essential oil content of menthol mint was recorded at harvest are calculated on fresh weight basis (%). The data on essential oil content of menthol mint with respect to different weed management practices did not showed any significant differences. The range of essential oil content is 0.61 to 0.72 per cent respectively.

Essential oil yield (Kg/ha)

The data regarding essential oil yield on fresh weight basis are influenced by different weed management practices (Table 2). PE application of oxyfluorfen @ 0.25 kg a.i./ha recorded significantly higher essential oil yield (107.62 kg/ha) which was *on par* with PE application of oxyfluorfen followed by with inter-cultivation (104.46 kg/ha) and organic mulch with sugarcane trash (90.21 kg/ha). The higher oil yield was due to better fresh & dry herbage yield and essential oil content of different weed management treatments and the similar results were obtained by Walia *et al.* (1980) [10] and Jaidev *et al.* (1993) [4] in menthol mint. Lower essential oil yield recorded in un-weeded control (38.99 kg/ha) due to reduced fresh and dry herbage of crop.

Table 2: Fresh herb, shade dried herb and essential oil yield of menthol mint as influenced by different weed management methods.

Treatments	Dose (kg a.i./ha)	Yield parameters (At harvest)				Quality parameter
		Fresh herb (t/ha)	Shade dried herb (t/ha)	Oil content (%)	Oil yield (kg/ha)	Menthol content (%)
T_1: Hand weeding	15 DI	12.08	8.46	0.69	79.13	72.270
T_2: Inter-cultivation	15 DI	12.18	8.90	0.70	82.30	70.553
T_3: Sugarcane trash mulch	5 t/ha (30 DAP)	13.40	10.55	0.65	90.21	70.916
T_4: Metribuzin (PE)	0.70	7.64	5.56	0.61	47.48	72.270
T_5: Oxyfluorfen (PE)	0.25	17.69	14.63	0.60	107.62	70.553
T_6: Oxyfluorfen (Pre) + Metribuzin (POE)	0.25 and 0.70	8.24	7.38	0.72	56.97	70.916
T_7: Metribuzi (PE) + Quizalofop-ethyl (POE)	0.70 and 0.05	7.81	5.78	0.72	53.81	72.270
T_8: Oxyfluorfen (PE) + Quizalofop-ethyl (POE)	0.25 and 0.05	8.65	7.76	0.70	56.97	70.553
T_9: Oxyfluorfen (PE) + Metribuzin (POE) + Quizalofop-ethyl (POE)	0.25, 0.70 and 0.05	8.73	7.17	0.69	58.55	70.916
T_{10}: Oxyfluorfen (PE) + Intercultivation	0.25 + At 45 DAP	13.68	11.80	0.76	104.46	72.270
T_{11}: Metribuzin (PE) + Inter-cultivation	0.70 + At 45 DAP	8.10	6.45	0.68	55.39	70.553
T_{12}: Un-weeded (control)	-	5.95	4.16	0.63	38.99	70.916
S.Em ±		1.16	0.80	0.04	6.86	1.06
CD at 5%		3.41	2.36	NS	20.14	NS

PE- Pre-emergent (2DAP) POE- Post-emergent (30 DAP)
DI : days intervals

Menthol content (%)

The data on menthol content of menthol mint did not differ significantly as influenced by different weed management practices.

Conclusion

Pre-emergent application of oxyfluorfen @ 0.25 kg a.i./ha proved effective in controlling most of the weed species and recorded significantly higher fresh herbage, dry herbage and essential oil yield. The oil quality was also not affected due to above treatment. The next best treatments are PE application of oxyfluorfen @ 0.25 kg a.i./ha followed by inter-cultivation and organic mulch with sugarcane trash @ 5 t/ha. The treatment PE application of oxyfluorfen @ 0.25 kg a.i./ha followed by inter-cultivation can be adopted by the farmers as a integrated method of weed management in menthol mint. The treatment organic mulch with sugarcane trash @ 5 t/ha recorded significantly reduced weed density, weed dry weight and recorded good herbage and oil yield and this treatment can be adopted by the farmers as a non-chemical method of weed management in menthol mint.

References

1. Chandel SRS. Analysis of variance. A hand book of Agricultural Statistics, 7th Ed., 1984, 358-359.
2. Croteau R, Davis EM, Ringer KL, Wildung MR. Menthol biosynthesis and molecular genetics. Naturwiss. 2005; 92(5):62-77.
3. Dyck E, Liebman M. Soil fertility management as a factor in weed control: the effects of crimson clover residue, synthetic nitrogen fertilizer and their interactions on emergence and early growth of lambsquater and sweet corn. Pl. Soil. 1994; 67(2):27-37.
4. Jaidev Singh JN, Singh G. Chemical weed control in Japanese mint (*Mentha arvensis* Linn.). Indian J Weed Sci. 1993; 25(1):50 -54.
5. Kaur M. Studies on weed management in peppermint (*Mentha piperita* Linn.). M.Sc. Thesis, Punjab Agric. Univ., Ludhiana, India. 1999, 82.
6. Panse VG, Sukhatme PV. Statistical methods for agricultural workers, ICAR, Publication New Delhi. 1967, 359.
7. Singh MK, Saini SS. Planting date, mulch, and herbicide rate effects on the growth, yield, and physicochemical properties of menthol mint (*Mentha arvensis* Linn.). Weed Tech. 2008; 22(6):91-98.
8. Singh S, Walia US, Nayyar S. Performance of oxyfluorfen (Goal 23.5 EC) for the control of weeds in Japanese Mint (*Mentha arvensis*). Proc. National Workshop on Spices and Aromatic plants, held at Kerala, 2009.
9. Walia US, Brar LS, Singh B. Recommendations for weed control in field crops. Research Bulletin. Department of Agronomy, PAU, Ludhiana, 2006, 32(1).
10. Walia US, Sandhu KS, Saini SS, Samra JS. Studies on chemical weed control in menthol mint (*Mentha arvensis* Linn.). Indian J Weed Sci. 1980; 12(1):81-85.