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Intercropping Japanese mint (*Mentha arvensis* L.) with maize, oilseed rape and onion during *rabi* season

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Abstract

A study was conducted at Ludhiana (Punjab) during *rabi* season to evaluate the performance of Japanese mint (*Mentha arvensis)* as an intercrop with maize (*Zea mays*), oilseed rape (*Brassica napus*) and onion (*Allium cepa*). The fresh herb yield was highest (204.3 q ha^{-1}) in sole Japanese mint treatment which was statistically on par with Japanese mint + one row of onion (192.4 q ha^{-1}). Oil yield was highest in sole Japanese mint (163.1 l ha^{-1}). Japanese mint equivalent oil yield was highest in Japanese mint + one row of onion (273.0 l ha^{-1}) which was on par with Japanese mint + two rows of onion (265.6 l ha^{-1}). The gross returns were also highest in Japanese mint + one row of onion (Rs 65,520 ha^{-1}).

Key words: intercropping, Japanese mint, maize, *Mentha arvensis,* oilseed rape, onion.

Introduction

Japanese mint (*Mentha arvensis* L.) offers good scope in diversification of cereal based cropping systems in Punjab. The crop is planted at a wider spacing during the second fortnight of January in Punjab and considerable space between the rows remain un-utilized during the initial crop growth period. This space can be better utilized for growing other intercrops which would help in enhancing the productivity of the cropping system. Gill *et al.* (2000) reported that spring planted sugarcane intercropped with Japanese mint is more remunerative as compared to sole crops. Kothari & Singh (2004) reported higher gross returns and net returns with intercropping systems involving *M. arvensis* and *M. spicata* with sugarcane than sole mint and sugarcane systems. The present study was undertaken to assess the feasibility of raising Japanese mint as an intercrop in various *rabi* crops such as maize (*Zea mays* L.), oilseed rape (*Brassica napus* L.) and onion (*Allium cepa* L.).

Materials and methods

The experiment was conducted at Research Farm, Department of Agronomy, Agrometeorology and Forestry, Punjab Agricultural University, Ludhiana (Punjab) for three years during *rabi* seasons of 2002–03 to 2004–05. The experiment was conducted in a randomized block design with three replications on loamy sand with normal soil pH (7.7) and EC (0.20 dS/m at 20°C), low organic carbon (0.15%) and available nitrogen (125.4 kg ha^{-1}). The treatments included: T_1-Winter maize (WM) (JH 6805) planted at 50 cm + one row of Japanese mint

(JM) at 50 cm, T_2-WM planted at 100 cm + two rows of JM 45 cm apart, T_3-Oilseed rape (OR) (PGSH 51) transplanted at 45 cm in mid December + one row of JM planted in mid December, T_4-OR transplanted at 45 cm in mid December + one row of JM at 45 cm planted in end January, T_5-JM planted at 45 cm + one row of onion (ON) with plant to plant spacing of 7.5 cm, T_6-JM planted at 45 cm + two rows of ON at 15 cm apart with plant to plant spacing of 7.5 cm, T_7-Sole WM planted at 50 cm, T_8-Sole OR transplanted at 45 cm, T_9-Sole ON planted at 15 cm x 7.5 cm and T_{10}-Sole JM planted at 45 cm.

All the crops were sown and fertilized and harvested as per the recommended practices. Japanese mint was harvested in the second week of June and essential oil content in fresh herb was determined and oil yield was calculated on the basis of fresh herb yield. The Japanese mint equivalent oil yield of various treatments was calculated using the prevailing market prices of different crops.

Results and discussion

Maximum fresh herb yield of Japanese mint (pooled data) was obtained in sole Japanese mint treatment (204.3 q ha^{-1}) which was statistically at par with Japanese mint + one row of onion treatment (192.2 q ha^{-1}) but was significantly higher than all other intercropping treatments (Table 1). The increase in row spacing of winter maize from 50 cm to 100 cm significantly increased the herb yield of Japanese mint from 22.2 q ha^{-1} to 68.7 q ha^{-1} which revealed that winter maize at closer row spacing of 50 cm has more adverse effect on Japanese mint herb yield than wider row spacing of 100 cm.

The effect of different intercropping treatments on oil yield of Japanese mint was significant (Table 2). The pooled analysis indicated that maximum oil yield (163.1 l ha^{-1}) was obtained in sole Japanese mint treatment which was significantly higher than all treatments. The low herb and oil yields of Japanese mint in winter maize might be due to the adverse effect of shade of winter maize plants on Japanese mint during March to May. The increase in row spacing of winter maize also resulted in differential response due to differences in shade. Oilseed rape was harvested during the first week of April and it had complete shade which had adverse effect on emergence of Japanese mint resulting in poor growth and yield of Japanese mint. Maximum winter maize grain yield (pooled data) was obtained in sole winter maize crop planted at 50 cm (78.1 q ha^{-1}) and the yield decreased as the spacing was increased from 50 cm to 100 cm due to decreased plant population (Table 3). Maximum seed yield (pooled data) of oilseed rape (14.9 q ha^{-1}) was recorded in sole oilseed rape and its seed yield

Table 1. Fresh herb yield of Japanese mint planted as intercrop in different *rabi* crops

Treatment	Fresh herb yield (q ha^{-1})			
	2002–03	2003–04	2004–05	Mean
WM 50 cm + 1 row of JM	27.0	6.4	33.3	22.2
WM 100 cm + 2 rows of JM	73.8	56.7	75.8	68.7
OR 45 cm + 1 row of JM (Dec)	165.4	6.6	22.6	64.8
OR 45 cm + 1 row of JM (Jan)	27.6	5.2	52.6	28.4
JM 45 cm + 1 row of ON	237.3	190.1	149.2	192.2
JM 45 cm + 2 rows of ON	231.9	150.6	127.3	169.9
WM sole crop 50 cm				
OR sole crop 45 cm				
ON sole crop 15.0 cm x 7.5 cm				
JM sole crop 45 cm	204.1	227.9	180.9	204.3
CD (P=0.05)	35.5	66.7	52.3	26.3

WM=Winter maize; JM=Japanese mint; OR=Oilseed rape; ON=Onion

Table 2. Oil yield of Japanese mint intercrop planted in different *rabi* crops

Treatment	Oil yield (l ha^{-1})			
	2002–03	2003–04	2004–05	Mean
WM 50 cm + 1 row of JM	16.3	6.3	26.1	16.2
WM 100 cm + 2 rows of JM	52.8	46.9	60.1	53.2
OR 45 cm + 1 row of JM (Dec)	145.1	7.2	15.9	56.0
OR 45 cm + 1 row of JM (Jan)	23.3	6.2	44.8	24.7
JM 45 cm + 1 row of ON	179.0	151.6	101.7	144.1
JM 45 cm + 2 rows of ON	175.0	129.7	86.7	130.4
WM sole crop 50 cm				
OR sole crop 45 cm				
ON sole crop 15.0 cm x 7.5 cm				
JM sole 45 cm	170.0	184.7	134.7	163.1
CD (P=0.05)	25.2	39.4	43.5	18.2

WM=Winter maize; JM=Japanese mint; OR=Oilseed rape; ON=Onion

was not affected due to Japanese mint intercropping. The onion bulb yield decreased in intercropping treatments as compared to sole onion. Onion bulb yield of 154.2 q ha^{-1} was obtained in sole onion as compared to 98.7 q ha^{-1} in Japanese mint + one row of onion and 103.3 q ha^{-1} in Japanese mint + two rows of onion treatments, respectively. The decreased onion yield in intercropping treatments might be due to decreased plant population of onion in these treatments.

Maximum Japanese mint equivalent oil yield (273.0 l ha^{-1}) was recorded in Japanese mint + one row of onion which was statistically on par with Japanese mint + two rows of onion (265.6 l ha^{-1}) and both these treatments were significantly better than all other sole and intercropping treatments. Though the onion bulb yield and oil yield of Japanese mint decreased in intercropping treatments as compared to sole treatments, the comparative performance of both crops (Japanese mint and onion) in intercropping treatments has resulted in higher productivity of the system. The gross returns (on basis of pooled data with sale price of Japanese mint @ Rs. 240 l^{-1}) of Rs. 65,520 ha^{-1} and Rs. 63,744 ha^{-1} were recorded in Japanese mint + one row of onion and Japanese mint + two rows of onion as compared to Rs. 39,144 ha^{-1} and Rs. 48,216 ha^{-1} of sole Japanese mint and sole onion

Table 3. Yield of different *rabi* crops in association with Japanese mint

Treatment	Component crop yield (q ha^{-1})			
	2002–03	2003–04	2004–05	Mean
WM 50 cm + 1 row of JM	83.1	98.0	39.3	73.4
WM 100 cm + 2 rows of JM	32.4	58.9	14.9	35.4
OR 45 cm + 1 row of JM (Dec)	15.1	19.1	7.8	14.0
OR 45 cm + 1 row of JM (Jan)	13.4	21.9	7.3	14.2
JM 45 cm + 1 row of ON	125.0	84.2	86.9	98.7
JM 45 cm + 2 rows of ON	127.9	109.2	72.9	103.3
WM sole crop 50 cm	71.2	98.0	65.3	78.1
OR sole crop 45 cm	14.6	17.7	12.5	14.9
ON sole crop 15.0 cm x 7.5 cm	183.2	130.1	149.3	154.2
JM sole crop 45 cm*	170.0	184.8	134.7	163.1

*Oil yield (l ha^{-1}); WM=Winter maize; JM=Japanese mint; OR=Oilseed rape; ON=Onion

Table 4. Japanese mint equivalent oil yield and gross returns under different intercropping systems

Treatment	Equivalent yield (l ha^{-1})				Gross returns (Rs. ha^{-1})
	2002–03	2003–04	2004–05	Mean	
WM 50 cm + 1 row of JM	160.0	230.0	130.6	173.5	41640
WM 100 cm + 2 rows of JM	108.8	181.3	99.8	129.9	31176
OR 45 cm + 1 row of JM (Dec)	220.5	143.2	69.3	144.3	34632
OR 45 cm + 1 row of JM (Jan)	90.3	162.0	95.1	115.8	27792
JM 45 cm + 1 row of ON	347.4	261.4	210.3	273.0	65520
JM 45 cm + 2 rows of ON	347.0	272.2	177.7	265.6	63744
WM sole crop 50 cm	123.2	223.6	173.4	173.4	41616
OR sole crop 45 cm	73.0	126.4	85.9	95.1	22824
ON sole crop 15.0 cm x 7.5 cm	246.6	169.7	186.6	200.9	48216
JM sole crop 45 cm*	170.0	184.8	134.7	163.1	39144
CD (P=0.05)	38.2	45.5	54.9	22.1	-

WM=Winter maize; JM=Japanese mint; OR=Oilseed rape; ON=Onion
Sale price (during 2002–03, 2003–04 and 2004–05):
Japanese mint oil (Rs l^{-1}) = 350, 230, 240
Oilseed rape (Rs q^{-1}) = 1500, 1635, 1650
Winter maize (Rs q^{-1}) = 520, 525, 638
Onion (Rs q^{-1}) = 404, 300, 300

treatments, respectively, and gross returns decreased drastically in all other treatments.

The study indicated that Japanese mint planted at 45 cm and one row of onion (plant to plant spacing of 7.5 cm) as intercrop gave maximum Japanese mint equivalent oil yield and gross returns as compared to sole Japanese mint or sole onion and other treatments.

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