

Horticulture

Effect of different intercrops on yield, quality and shelf-life in mango cv. Himsagar (*Mangifera indica* L)

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Abstract

Field experiments were conducted during the period 2010-2012 to investigate the suitability and profitability with different intercrops of cowpea, frenchbean, arhar, soyabean, lentil, blackgram and chickpea in mango orchard (cv. Himsagar) was conducted at Central Research Farm, Gayeshpur, B.C.K.V., Nadia, West Bengal. The age of the plant is 7 years old with a spacing of 10x10m which provide the utilization of land space between the plants as an intercrop. Pooled data reveals that the maximum number of fruits 192.41 / tree and yield 46.09 kg / tree were found in Mango + Cowpea whereas maximum fruit weight (254.16 g) in Mango + Lentil. Most of the physical parameters such as fruit length and breadth maximum were recorded (8.20 cm and 7.21 cm respectively) in Mango + Cowpea. But, in case of peel weight (35.67 g) was highest in Mango + Soyabean whereas the higher stone weight (35.79 g) was in sole crop (Mango) only. Again, pulp weight and pulp: stone ratio (193.53 g and 5.80) were observed in Mango + Frenchbean respectively. The quality parameters such as TSS, reducing sugar, vitamin c, acidity and shelf-life showed non-significant variation among the different treatments.

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Keywords: Mango, Himsagar, intercrops, yield, quality, shelf-life

Mango (*Mangifera indica* L.) is one of the most luscious fruit of the world, which occupies a prime position in the international fruit processing industry of the world. It is the most choicest and popular fruit among the people of orient and is designated as the 'King of Fruits' (Purseglove, 1972) because of its excellent flavour, attractive fragrance, beautiful shades of colour and delicious taste with high nutritive value. Mango is part and parcel of the cultural heritage of India. West Bengal being a major mango producing state in India in terms of area and production new mango plantations is also necessary every year. However, the initial investment is very high to establish a mango orchard and beyond the economic reach of small and marginal farmers. In view of this, during the

young age of the plant, growing of intercrops has been advocated in order to get some additional income. Information regarding effects of different intercrops on the growth and yield of mango plants are lacking in alluvial zone of West Bengal. However, some studies were conducted in other parts of the country Sarkar *et al.* (2004), Jain *et al.* (2006), Ratha and Swain *et al.* (2006) and Raut (2006). Apart from giving good returns, intercropping prevents weed growth; reduce nutrient loss through leaching and surface run off as reported by Bose *et al.* (1999). Therefore, the present experiment was conducted with a view to study the suitability and profitability aspects of different intercrops for young mango orchard cv. Himsagar.

Materials and methods

The experiment was laid in randomised block design (RBD) with three replications during 2010-2011 and different intercrops such as blackgram, soyabean, cowpea, french bean, arhar and lentil were grown as intercrop in between the inner space of the plant with an age of 7 years old spacing 10 x 10 m which give sufficient space providing suitability for growing of intercrop. The site of the experiment Central Research Farm is situated at 22p 57¹N latitude and 89p 34^E longitudes with an average altitude 9.75 m above the mean sea level. The treatments details of the plant in each replication were intercrop with black gram given in Table 1. Before the initiation of intercrops in between the interspaced of the main crop mango cv. Himsagar (10 x 10 m) spacing, ploughing the soil and labelling was done and small plot 4x4 m was made in between the interspaced and the sowing of the intercrops was done according to the crops favourable date of sowing. The main crop mango plant used in the experiment was fertilized with inorganic fertilizer (1,000: 500: 500 g N: P: K /tree/ year). Half of it was applied after flowering at pea stage and the remaining was applied after harvesting of the crop (July month). Irrigation was given after fertilizer application and continued its application as and when required depending upon the rainfall and irrigation was stopped before flowering and 10 days before harvesting of the crop. As for the intercrops irrigation was given after the seed was sown and continue until maturity of the crops and after harvesting the crop residue was incorporated around the basin of the main crop mango to increase the soil fertility and organic matter.

Table 1: Treatment details of intercrops in between the interspaced of main crop mango cv. Himsagar

T ₁	= Mango + Cowpea (<i>Vigna unguiculata</i>)
T ₂	= Mango + Frenchbean (<i>Phaseolus vulgaris</i>)
T ₃	= Mango + Arhar (<i>Cajanus cajan</i>)
T ₄	= Mango + Soyabean (<i>Glycine max</i>)
T ₅	= Mango + Lentil (<i>Lens culinaris</i>)
T ₆	= Mango + Chickpea (<i>Cicer arietinum</i>)
T ₇	= Mango + Blackgram (<i>Vigna mungo</i>)
T ₈	= Mango only (Sole crop)

Results and discussion

The results from the effect of different intercrops revealed that the yield parameters such a number of fruits/tree, average fruit weight and yield (kg/tree) increased with the intercrops combination with the main crop as compared to control and significantly maximum cumulative total number of 192.41 fruits / tree was obtained in Mango + Cowpea, with highest average fruit weight 254.16g in Mango + Lentil and maximum yield (46.09 kg/tree) in Mango + Cowpea but minimum in sole crop

having 115.58 fruits/tree with an average weight of 226.33g and average yield of 25.86 kg/tree respectively. These finding corroborates with the findings of Jain *et al.* (2006), Ratha and Swain (2006) and Raut (2006). It might be due to increased in nitrogen status in the soil fixed by leguminous intercrop which attributed to better vegetative growth of treated plants which resulted in higher photosynthates and the translocation to fruits, thus increasing the various yield parameters as compared to sole crop. Similar result was also reported by Ghosh and Pal (2010) in Mosambi sweet orange intercrop with leguminous crop. Further, Sarkar *et al.* (2004) also found significant influence of leguminous intercrops on number of fruits / tree and yield of mango cv. Banishan under Deccan Plateau, indicating the increased in the yield of the main crop with the combination of the leguminous intercrops. Adoption of different intercrops combination with the main crops produced significant variation as compared to sole crop on physical parameters of fruit. Maximum fruit length (8.20 cm) and breadth (7.21 cm) was observed in Mango + Cowpea whereas the lowest fruit length (7.29 cm) and breadth (6.62 cm) was recorded in sole crop. Srivastava *et al.* (2007) also observed that in citrus orchard with legume as intercrops (soyabean and chickpea) produced significantly higher yield with better physical parameters of length and breadth as compared to sole crop. Peel weight was recorded highest in Mango + Soyabean (35.67g) whereas the lowest was observed in Mango + Chickpea (33.19g) respectively showing a narrow variation with the sole. Stone weight was recorded highest in sole crop (35.79g) which was statistically at par with Mango + Soyabean (34.66g), Mango + Cowpea (34.26g) and Mango + Chickpea (34.16g) respectively whereas, the lowest stone weight was recorded in Mango + Lentil (31.18g) indicating the stone weight was more or less similar among the treatments. In pulp weight maximum was recorded in Mango + Frenchbean (193.53g) whereas, the minimum pulp weight was recorded in sole crop (151.44g) respectively. The smaller size of the fruit and lower fruit weight in the sole crop resulted in the minimum pulp weight of fruit. Highest pulp: stone ratio was recorded in Mango + Frenchbean (5.80) whereas the lowest pulp: stone ratio was recorded in sole crop (4.31) respectively. The better size in the fruit from the mango intercropped with the leguminous crops when compared to sole crop might be due to better vegetative growth resulting more photosynthate and thereby increased the fruits size of the main crop. Pate *et al.* (1980) also advocated that leguminous crops like cowpea, frenchbean and soyabean transport large amounts of nitrogenous compounds called ureides which lead to the soil fertility by increasing available form of nitrogen to the soil. The quality attributes of fruits like TSS, total sugar, reducing sugar, acidity and vitamin C of different combination of intercrops with the main crop and sole crop showed non-significant variation, in which highest



Figure 1: Land preparation for the intercrops



Figure 2: Intercrops in the interspace of mango cv. Himsagar

TSS was recorded in Mango + Lentil (17.88⁰brix) and the lowest in sole crop (17.35⁰brix). The acidity content was recorded maximum in sole crop (0.17%) and the minimum in Mango + Frenchbean and Mango + Lentil (0.14%) whereas the highest reducing sugar content was observed in Mango + Soyabean (4.37%) and the lowest in sole crop (3.87%) respectively. In case of total sugar content in the fruit, higher total sugar content was recorded in Mango + Soyabean and Mango + Lentil (14.44%) and lower in Mango + Frenchbean (13.97%). Further, for vitamin C content in the fruit there was no significant variation in vitamin C content among the treatment in which the highest was recorded in Mango + Arhar (36.31 mg/100g)

and lowest in sole crop (32.22 mg/100g) respectively. The non-significant improvement in the fruit quality parameters might be due to increased nitrogen content of soil which resulted in better vegetative and yield and deficient of soil phosphorous and potassium with intercropping. Similar to the present investigation, report of increasing and improvement in soil nitrogen status and slight depletion of P and K resulting in non-significance in the quality parameters was also reported by Ghosh and Pal (2010) in Mosambi sweet orange intercropping with the leguminous crops. For the shelf life of number of days at room temperature was recorded maximum (9.00 days) in Mango + Soyabean combination however, there

Table 2: Effect of different intercrops on total number of fruits/tree, average fruit weight and fruit yield (kg/tree) in mango cv. Himsagar

Treatment	Total no. fruits/tree		Pooled data		Av. Frt. Wt. (g)		Pooled data (kg/tree)		Fruit yield		Pooled data	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Mango +Cowpea (T ₁)	112	272.83	192.41	234.75	264.64	234.75	247.82	247.82	29.37	62.81	46.09	46.09
Mango +Frenchbean (T ₂)	53.83	213.83	133.83	258.25	263.66	258.25	249.82	249.82	16.69	49.7	33.19	33.19
Mango +Arhar (T ₃)	72.33	256.5	164.41	228.25	274.82	228.25	250.99	250.99	19.73	58.02	38.87	38.87
Mango +Soyabean (T ₄)	27.16	219.83	123.5	227	261.63	227	243.98	243.98	7.17	50.96	29.07	29.07
Mango +Lentil (T ₅)	99.66	262	180.83	232.75	276.32	232.75	254.16	254.16	27.65	60.4	44.03	44.03
Mango +Chickpea (T ₆)	27.16	229.5	128.33	233	258.42	233	244.79	244.79	7.01	52.98	29.99	29.99
Mango +Blackgram (T ₇)	26.16	236	131.08	232.25	267.17	232.25	250.41	250.41	6.77	55.46	31.11	31.11
Mango(Sole crop) (T ₈)	20	211.16	115.58	223.25	229.51	223.25	226.33	226.33	4.62	47.11	25.86	25.86
SE±m	13.93	11.84	11.44	3.03	2.22	3.03	1.38	1.38	3.85	2.51	2.66	2.66
CD at 5%	40.66	34.72	34.33	NS	NS	NS	4.15	4.15	11.24	7.32	8	8

Table 3: Effect of different intercrops on fruit length (cm) and breadth (cm) in mango cv. Himsagar

Treatment	Fruit length (cm)		Pooled	Fruit breadth (cm)		Pooled
	2010	2011		2010	2011	
Mango +Cowpea (T ₁)	6.96	9.44	8.2	5.96	8.46	7.21
Mango +Frenchbean (T ₂)	6.65	8.83	7.74	6.18	7.70	6.94
Mango +Arhar (T ₃)	6.75	9.23	7.99	6.20	7.91	7.05
Mango +Soyabean (T ₄)	6.16	9.09	7.62	6.23	7.81	7.02
Mango +Lentil (T ₅)	6.41	9.16	7.78	5.96	7.72	6.84
Mango +Chickpea (T ₆)	6.38	8.93	7.65	5.90	7.76	6.83
Mango +Blackgram (T ₇)	6.41	9.14	7.77	6.06	7.76	6.91
Mango(Sole crop) (T ₈)	6.06	8.53	7.29	5.73	7.52	6.62
SE±m	0.39	0.06	0.22	0.14	0.11	0.04
CD at 5%	NS	0.17	0.67	NS	0.32	0.12

Table 4: Effect of different intercrops on peel weight (g), pulp weight (g) and stone weight (g) in mango cv. Himsagar

Treatment	Peel weight (g)		Pooled	Pulp weight (g)		Pooled	Stone weight(g)		Pooled
	2010	2011		2010	2011		2010	2011	
Mango +Cowpea (T ₁)	28.84	38.90	33.87	170.47	191.64	180.22	34.82	33.71	34.26
Mango +Frenchbean (T ₂)	30.50	36.50	33.50	193.01	195.29	193.53	34.62	31.87	33.24
Mango +Arhar (T ₃)	30.06	38.75	34.40	161.93	203.31	182.93	33.07	32.87	32.97
Mango +Soyabean (T ₄)	31.92	39.43	35.67	159.70	187.64	174.01	34.83	34.50	34.66
Mango +Lentil (T ₅)	28.64	38.00	33.32	168.70	205.32	186.74	29.36	33.00	31.18
Mango +Chickpea (T ₆)	28.51	37.87	33.19	166.15	187.05	178.09	34.82	33.50	34.16
Mango +Blackgram (T ₇)	30.15	37.62	33.88	167.65	213.92	192.26	32.98	34.84	33.91
Mango(Sole crop) (T ₈)	29.16	40.33	34.85	158.69	143.14	151.44	34.24	37.33	35.79
SE±m	1.43	0.65	0.86	2.86	2.86	2.02	1.09	0.65	0.59
CD at 5%	NS	1.90	2.53	8.35	8.35	5.89	3.19	1.89	1.73

Table 5: Effect of different intercrops on TSS °Brix, acidity (%) and reducing sugar (%) in mango cv. Himsagar

Treatment	TSS °Brix		Pooled	Acidity (%)		Pooled	Reducing sugar (%)		Pooled
	2010	2011		2010	2011		2010	2011	
Mango +Cowpea (T ₁)	18.10	17.43	17.76	0.16	0.15	0.15	4.35	3.98	4.16
Mango +Frenchbean (T ₂)	17.66	17.28	17.47	0.16	0.14	0.14	4.16	4.15	4.16
Mango +Arhar (T ₃)	17.76	17.37	17.56	0.17	0.13	0.15	4.51	3.92	4.22
Mango +Soyabean (T ₄)	17.98	17.37	17.67	0.15	0.16	0.15	4.83	3.92	4.37
Mango +Lentil (T ₅)	18.40	17.37	17.88	0.15	0.14	0.14	4.71	3.90	4.30
Mango +Chickpea (T ₆)	17.70	17.38	17.54	0.17	0.16	0.16	4.53	4.00	4.26
Mango +Blackgram (T ₇)	17.73	17.31	17.52	0.16	0.15	0.15	4.21	4.14	4.18
Mango(Sole crop) (T ₈)	17.66	17.03	17.35	0.18	0.16	0.17	3.83	3.73	3.78
SE±m	0.25	0.10	0.13	0.006	0.006	0.005	0.20	0.12	0.14
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 6: Effect of different intercrops on total sugar (%) and vitamin C (mg/100g) in mango cv. Himsagar

Treatment	Total sugar (%)		Pooled	Vitamin C(mg/100g)		Pooled
	2010	2011		2010	2011	
Mango +Cowpea (T ₁)	14.58	14.07	14.32	32.8	35.76	34.28
Mango +Frenchbean (T ₂)	14.03	13.92	13.97	32.8	34.2	33.5
Mango +Arhar (T ₃)	14.51	13.80	14.16	40.7	31.92	36.31
Mango +Soyabean (T ₄)	14.90	13.99	14.44	35.31	35.36	35.33
Mango +Lentil (T ₅)	14.83	14.06	14.44	32.16	32.88	32.52
Mango +Chickpea (T ₆)	14.23	13.78	14.00	34.40	34.56	34.48
Mango +Blackgram (T ₇)	14.43	14.16	14.29	32.60	33.96	33.28
Mango(Sole crop) (T ₈)	14.15	13.89	14.02	31.80	32.64	32.22
SE±m	0.42	0.17	0.25	2.72	0.87	2.68
CD at 5%	NS	NS	NS	NS	NS	NS

Table 7: Effect of different intercrops on shelf-life in mango cv. Himsagar

Treatment	Shelf life (Number of days at room temperature)		Pooled
	2010	2011	
Mango + Cowpea (T ₁)	6.60	8.33	8.66
Mango + Frenchbean (T ₂)	6.20	8.00	8.66
Mango + Arhar (T ₃)	6.60	8.66	8.50
Mango + Soyabean (T ₄)	6.80	9.00	9.00
Mango + Lentil (T ₅)	7.00	8.66	8.00
Mango + Chickpea (T ₆)	7.00	8.33	8.50
Mango + Blackgram (T ₇)	7.20	8.66	8.00
Mango (Sole crop) (T ₈)	7.00	9.00	8.00
SE±m	0.36	0.41	0.25
CD at 5%	NS	NS	NS

was non-significant variation between the treated fruit and control. Therefore, under the new alluvial zone of West Bengal the performance of different intercrops in young mango orchard appeared to be economical without affecting the yield of the main crop mango cv. Himsagar. From the performance of different leguminous intercrops, cowpea intercrop has shown better yield on the main crop as compared with the other leguminous intercrops which can be recommended as an intercrop for the young mango orchard in the new alluvial zone of West Bengal in the future.

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