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Effect of different intercrops on yield and quality of mango production in new alluvial zone of West Bengal

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ABSTRACT : An experiment on the performance of intercropping in mango orchard (cv. HIMSAGAR) was conducted at Central Research Station, Gayeshpur, Bidhan Chandra Krishi Vishwavidyalaya, Nadia, West Bengal to study the suitability and profitability with different intercrops of cowpea, French bean, arhar, soyabean, lentil, blackgram and chickpea during the period 2010-2012. The age of the plant was 7 years old with a spacing of 10x10m which provide the utilization of land space between the plants as an intercrop. In respect of total number of fruits / tree, average fruit weight and fruit yield (kg/ha) were noticed a significant variation among the treatments. The 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 + French bean, respectively. The quality parameters showed non-significant variation among the different treatments in which highest TSS ((17.88 ° Brix) was observed in mango + lentil, where maximum reducing sugar (4.37 %) was in mango + soybean closely followed by mango + lentil (4.30 %). In case of acidity, the lowest acidity (0.14 %) was occurred in mango + lentil and mango + French bean. It was clear from the investigation that the more yield was from the main crop along the intercrop as compared with the clean cultivation.

• **KEY WORDS :** Mango, Intercrop, Yield, Quality

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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. No other fruit has such a remarkable records in literature, poetry, mythological, legendry, history, art and sculpture as that of mango. West Bengal being a major mango producing state in India in terms of area and production and 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, 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.

RESEARCH METHODS

The experiment was laid in Randomized Block Design (RBD) with four replications during 2010-2011 in which blackgram, soyabean, cowpea, frenchbean, 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 Station is situated at 22° 57' N latitude and 89°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 A. 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 (N, P and K) according to their ages. The N, P and K (1,000: 500: 500 g N: P: K / tree/ year) were provided in the form of urea (46% N), single super phosphate (16% P₂O₅) and mutriate of potash (60% K₂O), respectively. Irrigation was given after fertilizer application. Subsequently, irrigation was applied as and when required depending upon the rainfall and irrigation was stopped before flowering.

Table A : 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 + French bean (<i>Phaseolus vulgaris</i>)
T ₃ = Mango + Arhar (<i>Cajanus cajan</i>)
T ₄ = Mango + Soybean (<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)

RESEARCH FINDINGS AND DISCUSSION

The results from the experiment revealed that the yield parameters such a number of fruits/tree, average fruit weight and yield (kg/tree) (Table 1) increased with the intercrops combination with the main crop as compared to control and significantly maximum cumulative total number of fruits / tree was obtained in mango + cowpea, with highest average fruit weight in mango + lentil and maximum yield (kg/tree) in mango + cowpea but minimum in sole crop. 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 (Table 2, 3 and 4). Maximum fruit length and breadth was observed in mango + cowpea whereas the lowest fruit length was recorded in sole crop. Srivastava and Singh (2007) also observed that in citrus orchard with legume as intercrops (soybean 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 + soybean whereas the lowest was observed in mango + chickpea showing a narrow variation with the sole. Stone weight was recorded highest in sole crop which was statistically at par with mango + soybean, mango + cowpea and mango + chickpea whereas, the lowest stone weight was recorded in mango + lentil

Table 1 : Effect of different intercrops on total number of fruits/tree, average fruit weight and fruit yield (kg/tree) in mango cv. HIMSAGAR

Treatments	Total no. fruits/tree		Pooled data	Av. frt. wt. (g)		Pooled data	Fruit yield (kg/tree)		Pooled data
	2010	2011		2010	2011		2010	2011	
Mango +Cowpea (T ₁)	272.83	112.00	192.41	234.75	264.64	247.82	62.81	29.37	46.09
Mango +French bean (T ₂)	213.83	53.83	133.83	258.25	263.66	249.82	49.70	16.69	33.19
Mango +Arhar (T ₃)	256.50	72.33	164.41	228.25	274.82	250.99	58.02	19.73	38.87
Mango +Soybean (T ₄)	219.83	27.16	123.50	227.00	261.63	243.98	50.96	7.17	29.07
Mango +Lentil (T ₅)	262.00	99.66	180.83	232.75	276.32	254.16	60.40	27.65	44.03
Mango +Chickpea (T ₆)	229.50	27.16	128.33	233.00	258.42	244.79	52.98	7.01	29.99
Mango +Blackgram (T ₇)	236.00	26.16	131.08	232.25	267.17	250.41	55.46	6.77	31.11
Mango (Sole crop) (T ₈)	211.16	20.00	115.58	223.25	229.51	226.33	47.11	4.62	25.86
S.E.±	11.84	13.93	11.44	3.03	2.22	1.38	2.51	3.85	2.66
C.D. (P=0.05)	34.72	40.66	34.33	NS	6.49	4.15	7.32	11.24	8.00

Table 2 : Effect of different intercrops on fruit length (cm) and breadth (cm) in mango cv. HIMSAGAR

Treatments	Fruit length (cm)		Pooled	Fruit breadth (cm)		Pooled
	2010	2011		2010	2011	
Mango + Cowpea (T ₁)	6.96	9.44	8.20	5.96	8.46	7.21
Mango + French bean (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 + Soybean (T ₄)	6.16	9.09	7.63	6.23	7.81	7.02
Mango + Lentil (T ₅)	6.41	9.16	7.79	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	7.78	6.06	7.76	6.91
Mango (Sole crop) (T ₈)	6.06	8.53	7.79	5.73	7.52	6.62
S.E.±	0.39	0.06	0.22	0.14	0.11	0.04
C.D. (P=0.05)	NS	0.17	0.67	NS	0.32	0.12

NS=Non-significant

Table 3 : Effect of different intercrops on peel weight (g), pulp weight (g) and stone weight (g) in mango cv. HIMSAGAR

Treatments	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 + French bean (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 + Soybean (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
S.E.±	1.43	0.65	0.86	2.86	2.86	2.02	1.09	0.65	0.59
C.D. (P=0.05)	NS	1.90	2.53	8.35	8.35	5.89	3.19	1.89	1.73

NS=Non-significant

Table 4 : Effect of different intercrops on pulp: stone ratio in mango cv. HIMSAGAR

Treatments	Pulp: stone ratio		Pooled
	2010	2011	
Mango + Cowpea (T ₁)	4.95	5.68	5.31
Mango + French bean (T ₂)	5.47	6.12	5.8
Mango + Arhar (T ₃)	4.96	6.17	5.57
Mango + Soybean (T ₄)	4.78	5.43	5.10
Mango + Lentil (T ₅)	4.96	6.23	5.60
Mango + Chickpea (T ₆)	4.78	5.57	5.17
Mango + Blackgram (T ₇)	5.24	6.16	5.70
Mango (Sole crop) (T ₈)	4.78	3.84	4.31
S.E.±	0.26	0.10	0.11
C.D. (P=0.05)	NS	0.30	0.34

indicating the stone weight was more or less similar among the treatments. In pulp weight maximum was recorded in mango + French bean whereas, the minimum pulp weight was recorded in sole crop. 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 + French bean whereas the lowest pulp: stone ratio was recorded in

sole crop. 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, French bean and soybean transport large amounts of nitrogenous compounds called

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

Treatments	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 + French bean (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 + Soybean (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
S.E.±	0.25	0.10	0.13	0.006	0.006	0.005	0.20	0.12	0.14
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS=Non-significant

ureides which lead to the soil fertility by increasing available form of nitrogen to the soil.

The quality attributes of fruits like TSS, reducing sugar and acidity (Table 5) of different combination of intercrops with the main crop and sole crop showed non-significant variation, in which highest TSS was recorded in mango + lentil and the lowest in mango + French bean. The acidity content was recorded maximum in sole crop and the minimum in mango + lentil whereas the highest reducing sugar content was observed in mango + lentil and the lowest in sole crop. 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 phosphorus 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. 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 had shown better yield on the main crop as compared with the other leguminous intercrop which revealed that in the future farmer can grow cowpea as an intercrop for the young mango orchard in the new alluvial zone of West Bengal.

Conclusion:

It can be concluded from the present investigation that the fruit yield (kg/ha) was significantly maximum in mango + cowpea combination followed by mango + lentil and minimum in sole crop. However, there was no significant improvement in the quality of the fruits with combination with the leguminous intercrops. Thus, for the improvement of mango production for yield, incorporation of the main crop with leguminous intercrops will be of benefit for the new alluvial zone of West

Bengal in the future.

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