

Studies on fruit drop dynamics of mango cv. Amrapali and influence of intercropping and fertilizer on fruit retention.

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ABSTRACT

The present investigation was conducted in the Govt. Progeny Orchard of Directorate of Horticulture, Govt. of Odisha during the years 2007 to 2009. The experiment was laid out in randomized block design with seven treatments and three replications. It is revealed that percentage of fruit drop was recorded maximum in ginger with application of biofertilizers during mustard stage to pea stage and minimum in turmeric with application of biofertilizers. Also minimum fruit drop was recorded between marble stage to final retention of fruits in case of turmeric. Maximum number of panicles, length of panicles, and breadth of panicles were recorded intercropping with ginger with application of biofertilizers. The final number of fruit per panicle (2.8) was recorded highest in turmeric with application of biofertilizers and minimum (1.5) in control. The number of fruit set per plant was also influenced by biofertilizers application and maximum was recorded in turmeric with application of biofertilizers (35.7) followed by pineapple (33.2) with application of biofertilizers and minimum in control.

Key words: Biofertilizer, intercrop, mango

Mango is a unique species with respect to growth, nature and diversity. It occupies relatively the same position as that enjoyed by apple in temperate regions. Among the mango cultivars the cultivation of 'Amrapali' is spread across the districts of Odisha due to its aroma, keeping quality and adaptability to the local climate. The demand for 'Amrapali' mangoes from specific pockets in coastal region of Odisha is high. However, in spite of all this, mango yield in Odisha is 5 to 6 tonnes per hectare as compared to the world yield of 25 tonnes per hectare. This gap in yield is due to poor management practices and post-harvest losses in the state. Considerably less attention has been paid to the several factors affecting the yield, the number of perfect flowers, extend of fruit drop and low fruit retention under high humid condition of Odisha. The most important factor to keep in mind is that the mango in general is one of the lowest performing fruit set of all fruits. A fraction of 1% of all flowers actually turn into fruit and then of those fruit that set, there is a drop of anywhere from 97 to 65% of the fruit.

Mango fruit crop provides opportunities of utilizing the land spaces to its maximum, particularly during the initial years of establishment. The available space between the rows of mango could be effectively utilized by growing some short duration crops like annual spices, vegetables, cereals etc. Hence, it is worthwhile to explore the possibilities of growing

compatible crops with mango and there is urgent need to find out the suitable intercrops for mango.

MATERIALS AND METHODS

The present investigation was carried out for a period of two years from 2007 to 2009 at progeny orchard of the Department of Horticulture, Government of Odisha situated at Bhubaneswar. The experimental site is located on east and south western coastal plain climatic zone, 20°11'N latitude and 85°40'E longitudes and an altitude of 25.5 m, above the mean sea level. It is 62.5 km away from the Bay of Bengal towards west. The soil of the experimental site is sandy loam in texture with acidic in nature. The summer months from March to May are hot and humid. The south west monsoon lashes Odisha in June. The month of July and August receive the maximum rainfall. The experiment was laid out in randomized block design with seven treatments and three replications. The treatments were, T₁:Control (without intercrop), T₂:Mango intercropping with pineapple (with biofertilizers), T₃:Mango intercropping with pineapple (with inorganic fertilizers), T₄ : Mango intercropping with turmeric (with biofertilizers), T₅ :Mango intercropping with turmeric (with inorganic fertilizers), T₆ : Mango intercropping with ginger (with biofertilizers), T₇ : Mango intercropping with ginger (with inorganic fertilizers). All the intercrops were planted as per the design and treatments in their respective plots. The

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seven years old main crop mango was fertilized each year with N, P and K (1,000: 500: 500 g N: P₂O₅: K₂O tree⁻¹ year⁻¹) in the form of urea (46% N), single super phosphate (16% P₂O₅) and muriate of potash (60% K₂O) respectively. In intercrop pineapple each plant was fertilized with 12 g of N, 4g of P₂O₅ and 12 g of K₂O per year. The intercrops were fertilized as per the recommended doses of fertilizer in scheduled time. The main crop was applied with biofertilizers (*Azospirillum* and *Azotobactor*) 6kg per hectare incubated with farm yard manure and applied with farm yard manure 1:25 ratio each year. In all the three intercrops (pineapple, turmeric and ginger) *Azospirillum* and *Azotobactor* incubated with farm yard manure were applied in the inter spaces mixed with farm yard manure @ 6kg per hectare. Timely harvesting of main crop and intercrops at mature stage was done as per the common farmer's practices. Observation on growth characters, flowering characters, fruit set and fruit drop characters, yield characters were recorded and the data were statistically analysed.

RESULTS AND DISCUSSION

The results revealed that the flowering and fruiting of mango plants were influenced by intercrops combination with main crop as compared to control and significant variation also recorded among treatments. The number of panicles, length of panicle, breadth of panicle, flowering duration, number of flowers per panicle and sex ratio were also influenced due to intercrops. The pool analysis also showed (Table 1 and 2) significant variations among the treatments. The production of more numbers of flowers resulted better retention of fruits and contributed to the yield factor. The mango intercropped with ginger produced significantly more number of flowers per panicle with better sex ratio followed by turmeric, pineapple and control. The present findings corroborated with the findings of Kumar and Singh(2011), Hassan *et al.* (2009), Jain *et al.*(2008), Rath and Swain(2006), Satpathy (2002). It was due to the better intercultural operation in intercrops and addition of organic matter. The intercrops attributed for better vegetative growth and flowering of treated plants which produced better carbohydrates and increased the yield parameters. Rout (2006) also recorded more number of panicle per branch in mango cv. Langra and Dashehari. Pawar *et al.* (2006) also observed better growth and flowering

in mango cultivars. Jain *et al.*(2008) also observed maximum number of panicles intercropping with variety Baiganpali and Totapuri. Satpathy and Banik (2002) reported better flowering quality of mango cv. Amrapali. The highest female to male flowers ratio was also observed due to the effect of intercrops.

The yield attributing characters such as number of fruits per panicle at mustard stage, pea stage, marble stage and number of fruits per plant found significant during the course of investigation(Table-3). More numbers of retention of fruits were recorded intercropping with ginger, turmeric, pineapple and minimum in control. The final retention of fruits per panicle during the course of investigation was found highest in turmeric followed by ginger and minimum in control. The number of fruits during 2007 was highest in ginger (28.0) and minimum in control (13.3). During 2008 the number of fruits ranged from 24.0 in T₁ (control) to 51.7 in T₄ (turmeric with application of biofertilizers). The yield per plant which is the indication of productivity of a plant revealed that during 2007, the fruit yield per plant was minimum in T₁ (control) 4kg per plant and maximum in T₆ (ginger with application of biofertilizers) 7.3kg per plant and during 2008 the yield was highest in T₄ (turmeric with application of biofertilizers) 13.27kg per plant followed by pineapple with application of biofertilizers and minimum in control 7.03kg per plant (Table-4). The effect of intercrops on mango yield quintal per hectare was found significant and the yield quintal per hectare varied from 16 quintal in control and maximum 29.20 quintal in T₆ (ginger with application of biofertilizers), but in 2008 it ranges from 28.13 quintal to 53.07 quintal (Table-4) and an average of the two years maximum yield was recorded in T₄ (turmeric with application of biofertilizers) 36.87quintal and minimum in control 22.07quintal with a 40% increase in yield over control. Usha (2011) reported that mango production was boosted due to turmeric as intercrop as it checks the soil born diseases and paste. It is interesting to note that though vegetative characters were better in intercropping with turmeric and ginger along with fruit setting characters but the total yield was highest in pineapple in second year. In the first year the growth of pineapple was comparatively less and picked up the growth in the second year. Pineapple acted as a soil and water conserving plant and enriches the soil by checking the erosion. Similar findings were also found Kumar and Singh (2011), Jain *et al.* (2008), Rout *et al.* (2006), Rath and Swain (2005).

Table 1 : Effect on flowering characters of mango cv. Amrapali due to intercropping and fertilization.

Treatments	No. of panicles per sq.m		Length of panicle (cm)		Breadth of panicle (cm)		Flowering duration (days)					
	2007-08	2008-09	Mean	2007-08	2008-09	Pool	2007-08	2008-09	Pool			
T ₁ Control (without intercrop)	28.8	27.5	28.2	23.13	24.27	23.70	20.90	21.43	21.17	49.0	51.0	50.0
T ₂ Pineapple with biofertilizers	30.7	32.3	31.5	24.73	25.43	25.08	22.20	22.93	22.57	54.0	55.7	54.8
T ₃ Pineapple with inorganic fertilizers	30.3	31.0	30.7	23.67	24.67	24.17	21.43	21.60	21.51	52.0	54.0	53.0
T ₄ Turmeric with biofertilizers	32.0	33.7	32.8	25.17	26.03	25.60	22.43	23.10	22.77	55.0	56.0	55.5
T ₅ Turmeric with inorganic fertilizers	33.7	32.0	32.8	23.83	25.23	24.53	21.80	22.10	21.95	52.7	53.3	53.0
T ₆ Ginger with biofertilizers	35.0	33.3	34.2	25.83	29.83	27.83	23.80	24.17	23.98	55.7	57.0	56.3
T ₇ Ginger with inorganic fertilizers	33.5	33.7	33.6	25.17	29.33	27.25	23.27	23.63	23.45	54.0	55.7	54.8
Mean	32.0	31.9	31.9	24.50	26.40	25.45	22.26	22.71	22.49	53.2	54.7	53.9
LSD(0.05)	2.3	2.1	1.49	1.10	1.52	0.89	1.13	1.01	0.72	1.76	2.14	1.31

Table 2 : Effect on flowering characters of mango cv. Amrapali due to intercropping and fertilization.

Treatments	Number of flowers per panicle						Sex ratio					
	Total		Perfect		Male		2007-08	2008-09	Pool			
	2007-08	2008-09	Pool	2007-08	2008-09	Pool	2007-08	2008-09	Pool			
T ₁ Control (without intercrop)	3775.0	3995.0	3885.0	865.7	905.3	885.5	2909.3	3089.7	2999.5	3.36	3.41	3.38
T ₂ Pineapple with biofertilizers	4116.0	4225.0	4170.5	933.0	940.7	936.8	3183.0	3284.3	3233.7	3.40	3.49	3.45
T ₃ Pineapple with inorganic fertilizers	3971.7	3985.0	3978.3	891.0	892.0	891.5	3080.7	3093.0	3086.8	3.46	3.47	3.46
T ₄ Turmeric with biofertilizers	4229.0	4278.3	4253.7	957.7	942.0	949.8	3271.3	3336.3	3303.8	3.41	3.53	3.48
T ₅ Turmeric with inorganic fertilizers	4013.3	4048.3	4030.8	881.3	902.3	891.8	3132.0	3146.0	3139.0	3.54	3.49	3.52
T ₆ Ginger with biofertilizers	4482.3	4566.7	4524.5	979.7	966.0	972.8	3502.7	3600.7	3551.7	3.58	3.72	3.65
T ₇ Ginger with inorganic fertilizers	4158.3	4130.0	4144.2	917.3	920.7	919.0	3241.0	3209.3	3225.2	3.53	3.48	3.50
Mean	4106.5	4175.5	4141.0	917.9	924.1	921.0	3188.6	3251.3	3219.9	3.47	3.51	3.59
LSD(0.05)	100.9	182.4	98.7	14.2	33.4	17.2	95.9	151.4	84.9	0.10	0.07	0.06

Table - 3 : Effect on fruit set character of mango cv. Amrapali due to intercrops and fertilization.

Treatments	Number of fruits per panicle										No. of fruits per plant				
	Mustard Stage		Pea Stage		Marble Stage		Final Retention								
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	Mean		
T ₁ Control (without intercrop)	115.6	132.2	123.9	49.5	57.3	53.4	9.8	12.8	11.3	1.6	1.5	1.5	13.3	24.0	18.7
T ₂ Pineapple with biofertilizers	142.1	139.2	140.6	61.3	58.3	59.8	15.3	12.1	13.7	2.4	2.3	2.3	24.3	42.0	33.2
T ₃ Pineapple with inorganic fertilizers	128.1	134.4	131.3	53.7	59.1	56.4	10.6	13.6	12.1	2.0	2.2	2.1	21.7	37.7	29.7
T ₄ Turmeric with biofertilizers	143.2	151.7	147.5	62.2	64.6	63.4	12.9	14.0	13.5	2.9	2.7	2.8	19.7	51.7	35.7
T ₅ Turmeric with inorganic fertilizers	131.5	148.1	139.8	56.3	64.2	60.3	12.5	14.6	13.6	2.0	2.0	2.0	16.0	31.3	23.7
T ₆ Ginger with biofertilizers	144.4	152.4	148.4	60.5	63.1	61.8	14.2	13.5	13.9	2.8	2.7	2.7	28.0	37.7	32.8
T ₇ Ginger with inorganic fertilizers	136.5	143.8	140.2	59.4	58.4	58.9	12.0	12.4	12.2	1.7	2.0	1.9	23.3	33.0	28.2
Mean	134.5	143.1	138.8	57.6	60.7	59.1	12.5	13.3	12.9	2.2	2.2	2.2	20.9	36.8	28.8
LSD(0.05)	8.4	6.7	5.1	NS	NS	4.5	2.2	NS	1.4	0.8	NS	0.5	4.7	6.8	3.9

Table 4 : Effect on yield of mango cv. Amrapali due to intercrops and fertilization.

Treatments	Yield plant ⁻¹ (kg)			Yield hectare ⁻¹ (q)		
	2007-08	2008-09	Mean	2007-08	2008-09	Mean
T ₁ Control (without intercrop)	4.00	7.03	5.51	16.00	28.13	22.07
T ₂ Pineapple with biofertilizers	6.53	10.43	8.48	26.13	41.73	33.93
T ₃ Pineapple with inorganic fertilizers	5.63	9.47	7.55	22.53	37.87	30.20
T ₄ Turmeric with biofertilizers	5.17	13.27	9.22	20.67	53.07	36.87
T ₅ Turmeric with inorganic fertilizers	4.27	7.93	6.10	17.07	31.73	24.40
T ₆ Ginger with biofertilizers	7.30	9.93	8.62	29.20	39.73	34.47
T ₇ Ginger with inorganic fertilizers	6.37	8.23	7.30	25.47	32.93	29.20
Mean	5.61	9.47	7.54	22.43	37.88	30.16
LSD(0.05)	1.18	2.01	1.104	4.72	8.04	4.42

Table 5 : Effect on fruit drop dynamics of mango cv. Amrapali due to intercrops and fertilization.

Treatments	Fruit drop								
	Mustard to pea			Pea to marble			Marble to final retention		
	2007-08	2008-09	Mean	2007-08	2008-09	Mean	2007-08	2008-09	Mean
T ₁ Control (without intercrop)	57.20	56.68	56.94	34.40	33.48	33.94	7.12	8.61	7.87
T ₂ Pineapple with biofertilizers	56.84	58.11	57.48	32.39	33.16	32.77	9.11	7.07	8.09
T ₃ Pineapple with inorganic fertilizers	58.12	56.05	57.09	33.58	33.83	33.71	6.72	8.44	7.58
T ₄ Turmeric with biofertilizers	56.61	57.38	57.00	34.33	33.39	33.86	7.06	7.44	7.25
T ₅ Turmeric with inorganic fertilizers	57.14	56.62	56.88	33.34	33.45	33.40	7.96	8.55	8.26
T ₆ Ginger with biofertilizers	58.12	58.62	58.37	32.02	32.57	32.30	7.91	7.10	7.51
T ₇ Ginger with inorganic fertilizers	56.48	59.36	57.92	34.78	32.02	33.40	7.49	7.23	7.36
Mean	57.22	57.55	57.38	33.55	33.13	33.34	7.62	7.78	7.70
LSD(0.05)	NS	NS	NS	NS	NS	NS	NS	NS	0.96

Similarly the application of biofertilizers and inorganic fertilizers was also found non significant in case of fruit drop at various stage of growth of mango (Table-5 and Fig.-1). But the number of fruit per plant during the final stage of harvesting found significant. Singh (1961) reported that the fruit drop percentage varies from 95.5% to 99% in mango cv. Langra. The tree cannot take up load to retain maximum number of fruits per tree despite of fertilizer application and application of growth hormones. The pre mature fruit drops at mustard, pea and marble stage are higher

shown in Fig.-1. As the fruit develops the retention capacity increases and abscission reduced. The fruit drops in various stages were also reported by Roemer *et al.* (2011), Sinde *et al.* (2006) and Singh (1961). The yield per plant was recorded highest due to application of biofertilizers followed by inorganic fertilizers and control. The increase in yield was about 60%. The yield per hectare also increased considerably. The application of biofertilizers is responsible for microbial activities in soil which finally induced better plant growth, flowering and mango yield per hectare.

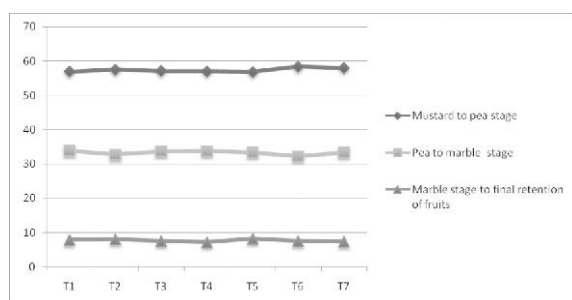


Figure 1 : Fruit drop dynamics of mango cv. Amrapali at different stage.

imilar findings were also found Dutta and Kundu (2012), Ahmad *et al.* (2004) and Sivakumar (2001).

Growing of intercrops like ginger, turmeric and pineapple with biofertilizers and inorganic fertilizers in mango orchard revealed that maximum mango yield was recorded intercropping with turmeric with of biofertilizers (36.87 quintal per hectare) followed by intercropping with ginger with application of biofertilizers (34.47 quintal per hectare) and minimum was recorded in control (22.07 quintal per hectare) where no intercrop was grown over the two years of investigation. The percentage increase in yield of turmeric with application of biofertilizers (T_4) over control is 40%. The application of biofertilizers also increased the yield of T_4 over control and inorganic fertilizers to the tune of 48% and 20% respectively. It was found that in case of final retention of fruits per plant turmeric with application of biofertilizers (T_4) recorded maximum followed by ginger with application of biofertilizers (T_6). It is interesting to note that fruit drop at different stages of fruit development turmeric as intercrop with application of biofertilizers recorded lowest percentage of fruit drops. Thus, it is concluded that growing of intercrops in mango (cv. Amrapali) plantation recorded maximum benefit under East and South Western coastal plain climatic zone of Odisha.

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