



PRODUCTIVITY AND PROFITABILITY OF PAPAYA (*CARICA PAPAYA L.*) UNDER AGRI-HORTI SYSTEMS IN EASTERN UTTAR PRADESH

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ABSTRACT

An experiment was conducted during two continuous years of 2009-10 and 2010-11 at college research farm B. R. D. P. G. College Deoria (U.P.). The main objective of experiment was to assess the productivity and profitability of agri-horti system along with sole system. The Papaya (*Carica papaya L.*) cv. Pusa dwarf and field crops viz. barley (*Hordium vulgare*) cv. Karan, pea (*Pisum sativum L.*) cv. Aparna, mustard (*Brassica juncea L.*) cv. Varuna and wheat (*Triticum aestivum L.*) cv. PBW-343 were sown in interspacing of Papaya as well as sole. The highest number of fruit plant⁻¹ 40.30, yield plant⁻¹ 48.90 kg and yield ha⁻¹ 58.70 tonne of papaya was recorded under papaya + pea followed by sole papaya, papaya + wheat, papaya + barley and lowest under papaya + mustard agri-horti systems, while the magnitude reduction in the yield of inter crops was 21.83 and 17.43 % in barley, 20.48 and 17.08 % in pea, 21.59 and 20.22 % in mustard, and 25.62 and 20.22 % in wheat over sole system during 2009-10 and 2010-11, respectively. Under agri-horti systems, highest net return and B: C ratio Rs 281100 and 2.71 was found in papaya + pea followed by papaya + wheat Rs 253750 and 2.53, papaya + barley Rs 248900 and 2.52 and lowest under papaya + mustard Rs 244870 and 2.50. The earliest flowering, fruiting and maturity of papaya were recorded in sole system followed by papaya + pea, papaya + wheat, papaya + barley and papaya + mustard agri-horti systems, respectively. Under agri-horti systems, productivity and profitability were found to increase in first year and decrease in second year. The papaya + pea system was found better in growth, yield and profitability compared to other systems.

KEY WORDS: Agri-horti systems, Barley, Mustard, Papaya, Pea, Productivity, Profitability and Wheat

INTRODUCTION

In India, papaya is one of the most important fruit of tropical and sub tropical regions. The fruits are rich in source of vitamin-A and carbohydrates. It is use in preparation of drugs in pharmaceutical and various industrial products. Unripe fruits are use for extraction of papain, which has proteolytic enzymatic activities. Field crops like pea, mustard, barley and wheat are have more important in pulse, oil and cereal production, respectively. Under sole system such as sole papaya, pea, mustard, barley and wheat have low cropping intensity, productivity

and profitability of farm. Therefore, such situations inter space of papaya can be utilized to sown of field crops under agri-horti system.

MATERIALS & METHODS

The field experiment was conducted at research farm of Baba Raghav Das Post Graduate College, Deoria (U.P.) during two consecutive years of 2009-10 and 2010-11. The experiment was laid out in randomized block design consisting 9 treatment combinations with thrice replicated.

TABLE 1: Package of practices adopted for agri-horti system crops

Package of practices	Papaya	Pea	Mustard	Wheat	Barley
Sowing/transplanting time	10 Aug-2009	20 Octo-2009 & 22 Oct-2010	20 Oct-2009 & 19 Oct 2010	14 Nov-2009 & 12 Nov-2010	13 Nov-2009 & 14 Nov-2010
Seed rate kg ha ⁻¹	0.4	60	05	80	80
N. P. K. doses kg/plant or ha ⁻¹	0.250N, 0.300 P ₂ O ₅ & 0.250 K ₂ O	20N, 60 P ₂ O ₅ & 40 K ₂ O	120N, 60 P ₂ O ₅ & 40 K ₂ O	120N, 60 P ₂ O ₅ & 40 K ₂ O	60N, 40P ₂ O ₅ & 20 k ₂ O
Spacing	2x2m	40x20cm	40x20cm	22cm	22cm
No. of irrigations	25	02	02	06	02
Harvesting time	16 Aug-2010 and 12 Aug-2011	10 Feb-2010 & 11 Feb-2011	15 March-2010 & 12 March-2011	10 April-2010 & 12 April-2011	12 April-2010 & 11 April-2011

The soil of experimental field was sandy loam in texture with pH 7.2, medium organic carbon (0.55%), phosphorus (17 kg ha⁻¹), Potassium (165 kg ha⁻¹) and low in available

nitrogen (215 kg ha⁻¹). The selected cultivars of component crops are Pusa dwarf (papaya), Varuna (mustard), Aparna (pea), Karan (barley) and PBW-343

(wheat). The recommended package of practices for agri-horti system is adopted (Table.1). Observation on growth, yield and quality of Papaya and intercrops were recorded at different stages. The productivity and profitability of agri-horti system was computed on the basis of prevailing market prices. The soil sample was analyzed through walkley and black rapid titration method given by Piper (1966) for organic carbon and Nitrogen, Olsen's and Flame photometer given by Muhr *et al.* (1963) for available phosphorus and potassium, respectively. The total soluble solid (TSS) was determined by hand refractometer (0-20%) with recorded in percentage and Vitamin-A (β -carotene) analyzed with the method given by Rangana (1978).

RESULTS & DISCUSSION

Productivity of Papaya and intercrops

The highest productivity of papaya was recorded under papaya+pea (58.70 and 38.70 t ha⁻¹) followed by sole

papaya (53.25 and 33.25 t ha⁻¹), papaya+ wheat (52.50 and 32.50 t ha⁻¹), papaya+ barley (52.10 and 32.10 t ha⁻¹) and lowest under papaya+ mustard (51.35 and 31.35 t ha⁻¹) agri-horti system during 2009-10 and 2010-11, respectively (Table-2). It might be due to less adverse effects, nitrogen fixing and soil improving ability of pea, while more adverse effects and poor soil improving ability under wheat, barley and mustard due to exhaustive nature. Productivity of intercrops to be found magnitude of reduction in yield of crops was 20.48 and 17.08 % in pea, 25.62 and 20.22 % in wheat, 21.83 and 17.44 % in Barley and 21.59 and 20.22 % in mustard over sole system during 2009-10 and 2010-11, respectively. The yield reduction of inter crops might be due to less plant population and more adverse effect of papaya on inter crops. Similar result on yield was observed by Singh *et.al.* (2008) under agri-horti system

TABLE 2: Productivity of component crops under agri-horti systems

Treatment	Productivity of component crops (t ha ⁻¹)			
	2009-2010		2010-2011	
	Papaya	Inter crops	Papaya	Inter crops
Papaya + Barley	52.10	3.40	32.10	3.55
Papaya + pea	58.70	1.63	38.70	1.65
Papaya + mustard	51.35	1.38	31.35	1.42
Papaya + wheat	52.50	3.25	32.50	3.47
Barley	----	4.35	----	4.30
Papaya	53.25	----	33.25	----
Pea	-----	2.05	-----	1.99
Mustard	-----	1.76	-----	1.78
Wheat	-----	4.37	----	4.35

Growth, yield and quality parameters of papaya under agri-horti systems

The plant height of papaya was found highest under papaya+ pea (136.25cm) followed by sole papaya (134.15 cm), papaya+ wheat (132.25 cm), papaya+ barley (132.50 cm) and lowest under papaya+ mustard (131.70cm). Significant increase in plant height of papaya occurs due to parallel and restorative growth habits of pea, while decrease is due to smothering and exhaustive growth habits of other crops. The early flowering (181.60 DAT), fruiting (185.25 DAT) and maturity (265.30 DAT) were taken in sole papaya followed by papaya+ pea, papaya+ wheat, papaya + barley and papaya+ mustard (Table-3). Days taken in flowering, fruiting and maturity of papaya

was significantly affected by inter crops, which might be due to more moisture conservation in the soil and growth habit of various inter crops. The present observation is in conformity to the finding reported by Shanker (1996) and Ram *et al.* (2010). The maximum number of fruits plant⁻¹ (40.30) and fruit yield plant⁻¹ (48.0 kg) were recorded under papaya+ pea and lowest under papaya+ mustard agri-horti system. Number of fruits plant⁻¹ and fruit yield plant⁻¹ increase in papaya+ pea due to optimum moisture status and more nutrient uptake, while decrease under others system due to poor moisture status with less nutrient uptake. The total soluble solids (TSS) and vitamin-A (β -carotene) of papaya fruit were not significant influenced under agri-horti systems.

TABLE 3: Growth, yield and quality parameters of Papaya under agri-horti systems (2009-10)

Treatment	Plant height (cm)	DTF ₁	DTF ₂	DTM	No. of fruits plant ⁻¹	Fruit yield kg plant ⁻¹	TSS (%)	Vitamin-A (IU 100g ⁻¹)
Papaya + barley	132.50	185.10	191.30	271.50	34.50	44.50	9.15	1999.10
Papaya + pea	136.25	182.50	187.70	267.25	40.30	48.90	9.85	2000.70
Papaya + mustard	131.70	186.35	192.67	272.70	32.60	41.35	8.88	1995.50
Papaya + wheat	133.25	184.65	190.25	270.25	33.50	43.50	9.05	1999.50
Sole papaya	134.15	181.60	185.25	265.30	35.10	45.37	9.50	2001.00
CD (P=0.05)	2.66	0.80	0.86	1.02	0.84	0.96	NS	NS

DTF₁=Days taken in flowering, DTF₂=Days taken in fruiting, DTM= Days taken in maturity

Profitability of agri-horti systems

Profitability under agri-horti system, the highest net return (Rs 281100 ha⁻¹) with high benefit: cost ratio (2.71) was

found in papaya+ pea followed by papaya+ wheat (Rs 253750 and 2.53), papaya+ barley (Rs 248900 and 2.52) and lowest under papaya+ mustard (Rs 244870 and 2.50)

during Ist year, while IInd year it is found Rs 193370 and 2.61 in papaya+ pea, Rs 164270 and 2.34 in papaya+ wheat, Rs 158010 and 2.33 in papaya+ barley and Rs 157080 and 2.32 in papaya+ mustard, respectively (Table-4). Similar pattern result was observed by Kanaujia *et al.* (2009) under agri-horti system. Maximum net return and benefit: cost ratio in papaya+ pea system significantly increase due to high productivity of component crops,

compared to other systems. During second year profitability from papaya and inter crops was lesser than first year sole crop of papaya. It might be due to poor yield of papaya during second year. Under agri-horti system, productivity and profitability were found to increase in first year and decrease in second year. The papaya+ pea system was found better in growth, yield and profitability compared to other systems.

TABLE 4: Profitability of treatments under agri-horti systems

Treatment	2009-10			2010-11		
	Cost of cultivation (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	Benefit : cost ratio	Cost of cultivation (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	Benefit : cost ratio
Papaya + barley	95700	248900	2.52	65750	158010	2.33
Papaya + pea	103700	281100	2.71	73830	193370	2.61
Papaya + mustard	97730	244870	2.50	67270	157080	2.32
Papaya + wheat	100250	253750	2.53	70130	164270	2.34
Papaya	91250	218250	2.39	61210	138290	2.25
Barley	15710	27790	1.79	15710	27290	1.73
Pea	16650	28350	1.70	16650	28150	1.69
Mustard	16350	27650	1.69	16350	26150	1.59
Wheat	17300	35140	2.03	17300	34900	2.01
CD (P=0.05)	--	1290	0.12	---	1080	0.11

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