

Production potential and economics of aonla based Agri-horti system under rainfed semi-arid ecosystem of western India

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Abstract

A field trial was carried out to find out the practicalities and economics of suitable and profitable cucurbitaceous vegetables as intercrops (bottle guard, pumpkin, bitter guard, cucumber, sponge guard) on 7 to 10 years aonla orchard during the year of 2007-2011 at the Experimental Farm of Central Horticultural Experiment Station (CIAH), Vejalpur, Panchmahals (Godhra), Gujarat under rainfed semi arid ecosystem of western India. Among the different cucurbitaceous vegetable tried as intercrops, aonla + bottle gourd combination fetched the maximum net economic return of Rs. 147312.80/ ha with the B: C ratio 4.44 followed by aonla + pumpkin (Rs. 100525.00/ha with the B: C ratio 3.11) whereas the lowest economic return was recorded in control followed by aonla + sponge gourd purely under rainfed conditions of semi-arid ecosystem of western India. Based on the results, it has been confirmed that the aonla + bottle gourd combination is most effective to generate substantial additional income without affecting the aonla yield when compared to other treatment combinations. In order to its remunerativeness as additional income, it needs to be popularized among the farmers which not only will enhance the system productivity but also the space left the aonla orchards will be utilized efficiently.

Keywords: *Aonla, intercrops, cucurbits, productivity, economic return.*

Introduction

Aonla (*Emblica officinalis* Gaertn) is an indigenous fruit of India. The fruit is richest source of vitamin C among all the fruits except Barbados cherry. It is very popular for its medicinal usage in different medicine system. The cultivation of crop is not very specific in its soil requirement and thrives well in fragile agro climatic conditions. It grows well in sandy loam to clay soils with pH range of 6 to 8.5. It is very remunerative to grow in varied agro-climatic conditions or wasteland of the dryland conditions without much care. The aonla variety NA-7 starts bearing on 3rd year after it's planting and reach their maximum capacity within 8 years of planting (Singh *et al*, 2010). Moreover, the aonla planted at distance of 10 m x 10 m. Due to less net return per unit area and time period to get economic yield from sole crop are not very encouraging to the farmers of arid and semi-arid region. To avoid such problems, an unoccupied space can be utilized efficiently by growing intercrops. An intercropping system is an age old practice which has attracted worldwide attention for yield advantages (Willey, 1979), where two or more crops share the same piece of land for part, or for all, of their growing

season. In aonla orchard, growing of ground storey intercrops of short duration which complete their life span during moisture availability period especially kharif season will be helpful to aonla growers to get more benefits (Singh *et al.*, 1996, Sarkar *et al.*, 2004), inhibit the soil erosion and improve the soil physico chemical properties (Bhatnagar *et al.*, 2007). The advantages of intercropping are commonly attributed to the complementarity of resources capture patterns by crops and better input management (Rodrigo *et al.*, 2001; Nedunchezhiyan *et al.*, 2010). To ensure the optimum productivity in intercropping system, one must ensure that the peak periods of growth of the two crops do not coincide with each other, so that one quick-maturing crop completes its life cycle before the main period of growth of the other crop starts (Saxena, 1972). Because of that short duration ephemeral cucurbits used as vegetable which is commonly used in such regions were selected as intercrops in aonla orchard. In western India, no systematic work has been conducted to determine the effect of different intercrops on productivity potential of NA-7 aonla orchard under rainfed conditions. Keeping these facts in background, the present study was carried out to find out the most suitable intercrops to maximize net profit under rainfed condition of semi- arid ecosystem of western India.

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Materials and Methods

The field experiment was conducted during four consecutive years of 2007- 2011 at Central Horticultural Experiment Station (CIAH) Vejalpur, Panchmahals (Godhra), Gujarat under rainfed semi-arid ecosystem of western India. The location of the experiment is 113 m above msl on latitude 22° 41' 38" N and longitude 73° 33' 22" E and is characterized by hot semi-arid climate. The annual rainfall is mainly confined to three months (July-September) and mean precipitation is about 750 mm, and the total average number of rainy days are 33. The mean summer temperature is 32.9° C while the mean winter temperature is 21.3° C indicating that the area falls under hyperthermic soil regime. The mean annual maximum and minimum temperatures vary from 42 - 44° C in May and 6 - 9° C in January, respectively. The soil is clay to clay loam, soil depth ranges from 0.75 to 1.0 meter. The intercropping trial was conducted on 7 to 11 years old NA-7 aonla plants spaced apart from 10m x 10m. Experiment was consisted of 6 treatments including control; T₁- bottle guard (*Lagenaria siceraria* (Mol.) Standl.), T₂- pumpkin (*Cucurbita moschata* Poir.), T₃- bitter guard (*Momordica charantia* L.), T₄- cucumber (*Cucumis sativus* L.), T₅- sponge guard (*Luffa cylindrica* Roem.) and T₆- control. All treatments were replicated four times in randomized block design. The intercrops were sown during rainy season each year under rainfed condition. The manure and fertilizers, irrigation and plant protection measures were given as per package of practices uniformly to each treatment. The data on fruit yield were recorded at harvest during all the four years from all the treatments were statistically analyzed. The yield of different inter crops and sole crops was recorded to evaluate the productive potential of different combination and their economic produce were harvested and quantified per hectare and their cost of cultivation was worked out as per prevailing nearby market rate.

Results and Discussion

Productivity

The perusal of the data from the Table 1 showed that the mean fruit yield of sole crop (aonla) per was recorded 64.65, 60.53, 59.50, 58.35, 56.03 and 52.85 q/ha in control (T₆), aonla + bottle guard (T₁), aonla + sponge gourd (T₅), aonla + pumpkin (T₂), aonla + bitter guard (T₃) and aonla+ cucumber (T₄), respectively. It is quite obvious that the higher fruit yield was obtained in control where aonla was taken alone. An increase in yield in control might be due to fulfilment of the acquired resources whereas the other treatments had division of resources with intercrops which might have reduced the yield of aonla plants. Singh *et al.* (1996) also reported that the higher yield in control (without intercrops) mango orchard. The mean yield of the intercrops was recorded the highest 79.95, 74.40, 72.82 and 68.61 q/ha in T₁ (aonla + bottle guard) followed by T₂ (aonla + pumpkin) and T₄ (aonla + cucumber), whereas same was the minimum (47.25) in T₃ (aonla + bitter guard). During the experiment, it was observed that the intercrops yield was subsequently reduced with the increase of the age of the aonla plants. Such effect may be owing to increase in tree size and their resource requirements, and competition for nutrients between the crops. Similar results were also reported by Das *et. al* (2011) in aonla in eastern India and Pareek *et al.* (2007) in Kinnow based production system. The results indicated that treatment (T₁) aonla + bottle guard had maximum yield of intercrop and slight reduction in fruit yield of sole crop. As far as the suitability with productivity of fruit yield and intercrop yield, treatments T₁ followed by T₄ and T₂ were performed better under rainfed condition of semi- arid ecosystem.

Economics

The economic analysis of intercropping system

Table 1. Yield of intercrops under aonla based cropping system of western India.

Intercrops	Yield of intercrops (q/ha)					Yield of aonla crops (q/ha)				
	2007-08	2008-09	2009-10	2010-11	Mean	2007-08	2008-09	2009-10	2010-11	Mean
Bottle gourd	83.25	81.78	78.09	76.62	79.95	45.28	56.91	64.15	75.58	60.53
Pumpkin	75.99	75.12	73.68	72.82	74.40	42.17	52.19	67.00	72.09	58.35
Bitter gourd	51.13	50.64	47.74	47.25	49.19	40.00	50.23	63.47	70.45	56.03
Cucumber	69.58	69.15	68.07	67.64	68.61	35.14	46.00	60.32	69.95	52.85
Sponge gourd	46.13	45.09	42.37	41.33	43.73	44.17	56.75	62.25	74.50	59.50
Control	-----	-----	-----	-----	-----	50.18	61.27	68.03	79.12	64.65
CD at 5%	14.25	13.03	11.27	11.10	-----	4.13	6.32	5.07	4.35	-----

Table 2 . Net income (Rs ha⁻¹) from aonla orchard with intercropping of cucurbitaceous vegetables.

Inter crops	Details of cost and benefits from inter crops					Details of cost benefits from sole crop aonla					B:C ratio		
	Produce of intercrop (q/ha)	Rate (Rs/kg)	Cost of cultivation (Rs ha ⁻¹)	Gross income (Rs ha ⁻¹)	Net income (Rs ha ⁻¹)	Produce of main crop (q/ha)	Rate (Rs/kg)	Cost of cultivation (Rs ha ⁻¹)	Gross income (Rs ha ⁻¹)	Net income (Rs ha ⁻¹)	Input costs (Rs ha ⁻¹)	Total net return (Rs ha ⁻¹)	B:C ratio
Bottle gourd	79.95	15.00	18142.20	119925.00	101782.80	60.53	10	15000	60530.00	45530.00	33142.20	147312.80	4.44
Pumpkin	74.40	10.00	17225.00	74400.00	57175.00	58.35	10	15000	58350.00	43350.00	32225.00	100525.00	3.11
Bitter gourd	49.14	15.00	18035.50	73521.00	55485.50	56.03	10	15000	56030.00	41030.00	33035.50	96515.00	2.92
Cucumber	68.61	10.00	16054.83	68610.00	52555.17	52.85	10	15000	52850.00	37850.00	31054.83	90405.17	2.91
Sponge gourd	43.73	10.00	15147.57	43730.00	28582.43	59.50	10	15000	59500.00	44500.00	30147.57	73082.43	2.42
Control	-----	-----	-----	-----	-----	64.65	10	15000	64650.00	49650.00	15000.00	49650.00	-----

presented in Table 2 shows that aonla + bottle gourd combination (T₁) performed better in the terms of productivity thereby enhancing the net return rather than other combinations. The net economic return was obtained to the tune of Rs. 147312.80, 100525.00, 96704.50, 90405.17 and 73082.43 with aonla + bottle gourd (T₁), aonla + pumpkin (T₂), aonla + bitter gourd (T₃), aonla + cucumber (T₄) and aonla + sponge gourd combinations (T₅), respectively. Considering the total cost and monetary benefits from sole and intercrops, the treatment T₁ (aonla + bottle gourd) had the maximum income (Rs.101782.80/ha) followed by T₂ (Rs 57175.00/ha) and T₃ (Rs 55485.50/ha). The B : C ratio was calculated highest (4.44) in T₁ (aonla + bottle gourd) followed by T₂ and T₃. The similar returns from intercrop and main crop combinations have also been reported by earlier workers in aonla-based cropping system (Kumar *et al.*, 2008 and Awasthi *et al.*, 2009). The minimum cost of cultivation (Rs.18142.20/ha) was recorded in aonla + bottle gourd (T₁) followed by T₃- aonla + bottle gourd (Rs.18035.50/ha) and the same was minimum with T₅, aonla + sponge gourd (Rs.15147.57/ha) combinations. There was increase in the cultivation cost in T₁ aonla + bottle guard, but less labour intensive, pest free, and highest net returns per ha as compared to rest of the combinations.

Thus, based on above results from the four years intercropping with different cucurbits proved conducive and profitable under rainfed conditions, but the practice of intercropping with bottle gourd in aonla orchard was found to be more profitable and fetched more additional income (Rs.101782.80/ha) with highest benefit cost ratio (4.44) than other combinations under rainfed conditions which was found to be economically profitable and viable preposition under aberrant agro-climatic conditions. Based on the results, it can be concluded that the maximum additional income can be generated with aonla+ bottle guard combination under rainfed conditions.

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