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Studies on Economic Feasibility and Suitability of Intercrops in Aonla (*Emblica officinalis* Gaertn L.) Plantation

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Authors' contributions

This work was carried out in collaboration between both authors. Author BD designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SM managed the analyses of the study and the literature searches. Two authors read and approved the final manuscript.

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ABSTRACT

The present investigation entitled "Studies on economic feasibility and suitability of intercrops in Aonla (*Emblica officinalis* Gaertn L.) plantation" was carried out during2018- 2019 at the Department of Horticulture, SHUATS, Prayagraj. The result of the present investigation, regarding the effect of inter crops in Aonla plantation on tree growth and fruit yield of Aonla. The experiment was laid out in Randomized Block Design (RBD), replicated thrice with the six intercropping system treatment combination of T_0: Sole crop, T_1:Spinach, T_2:Radish, T_3:Tomato, T_4:Coriander, T_5:Okra and T_6: Fenugreek. From the present investigation the treatment T_2 Radish is best maximum growth, fruit yield and quality of Aonla tree and was recorded. In the treatment T_1 is the best for Intercrop Yield (q/ha) (198.53) under Prayagraj agro-climatic condition.

Keywords: Aonla; growth; intercrops; quality and yield.

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1. INTRODUCTION

Aonla or Indian gooseberry (*Emblica officinalis* Gaertn L.) is an important indigenous fruit crop in India, which belongs to the family Euphorbiaceae and subfamily phyllanthoideae. It is native of Tropical South-East Asia. Its commercial cultivation is common in India, particularly in Uttar Pradesh, Haryana, Punjab and Gujarat etc. Gujarat occupies 12481 ha area with 121514 million tons [M.T.] productions, where as in Middle Gujarat cover 7197 ha area with the production of 75559 [M.T.] Anonymous, [1].

It is the richest source of vitamin C (400-1300 mg/100 g from pulp) among the fruits next to Barbados cherry Mandal et al. [2]. Soil type, fertility and nutrient management play an important role in obtaining higher growth and yields of Aonla. Inadequate nutrition has very often been attributed as the cause of lower yields in Aonla. Therefore, balanced nutrition is important, both for young growing plants as well as grown-up fruit-bearing trees. However, a bearing tree requires a balanced nutrient application for the maintenance of vegetative growth along with fruit production. Indiscriminate use of chemical fertilizers had adversely affected the soil fertility, water quality, yield and quality of the produce and increased level of resistance in pests Kalloo, [3].

The intercropping system is an integrated method of crop management system or organic farming system to balance the nutrient, water, land surface use and augmentation of additional farm returns. The intercropping of short duration seasonal crops under available interspace between Aonla plantation under wasteland conditions have shown significant impacts on soil and crop management. However, no information is available are available in literature as per the suitability of selective intercrops including, oilseed, cereals, such as pulses vegetable species, medicinal and aromatic crops and other short-duration fruit species. The crop management practices based on multitier cropping system has not yet been standardized to different bearing age of trees moisture level and fertility status of soils. The scientific studies son synergetic, bioaesthetic eco – friendly economic feasibility, nutrient availability and increasing activities are very much needed to study about perennial fruit trees Singh et al. [4].

2. MATERIALS AND METHODS

The experiment was laid out in Randomized Block Design (RBD), replicated thrice with the six intercropping system treatment combination of T_0: Sole crop, T_1: Spinach, T_2: Radish, T_3: Tomato, T_4: Coriander, T_5: Okra and T_6: Fenugreek. The observation was recorded on growth, yield and quality of Aonla crops *viz.,* Plant height (m), Plant spread (m), Fruit set (%), Fruit length (cm), Fruit width (cm), Fruit weight (g), Yield (kg / tree), T. S. S. (°Brix), Ascorbic acid (mg/100 g) and Acidity. The data recorded during investigation were subjected to statistical analysis as per the method of analysis of variance.

3. RESULTS AND DISCUSSION

As per the data recorded in Table 1 and Fig. 1 shows the tallest Aonla trees (5.66 m) was observed due to intercropping of T_2 Radish crop followed by T_5 Okra, T_6 Fenugreek and T_1 Spinach and the shortest height of Aonla tree (3.83 m) was recorded in T_0 Sole crop. similar findings were reported by Swain et al. [5] in mango.

As per the data recorded in Table 1 and Fig. 1 shows the maximum plant spread (5.49 m) was observed due to intercropping of T_2 Radish crop followed by T_5 Okra, T_6 Fenugreek and T_1 Spinach and the minimum plant spread of Aonla tree (4.04 m) was recorded in T_0 Sole crop. Similar findings were reported by Singh et al. [6] in mango.

As per the data recorded in Table 1 and Fig. 1 shows the fruit set was varied from T_2 Radish 74.64 to T_0 Sole crop 67.73. The maximum fruit set (74.64) was recorded in T_2 Radish intercropping system followed by T_5 Okra, T_3 Tomato and T_6 Fenugreek and the minimum fruit set (67.73) was found in T_0 Sole crop. Similar findings were reported by Gill et al. [7] in Mandarin and Subradeep et al. [8] in Tomato.

As per the data recorded in Table 1 and Fig. 1 shows the fruit length (cm) was varied from T_2 Radish 3.70 to T_0 Sole crop 2.14. The maximum fruit length (cm) (3.70) was recorded in T_2 Radish intercropping system followed by T_4 Coriander, T_1 Spinach and T_6 Fenugreek and the minimum fruit length (cm) (2.14) was found in T_0 Sole crop. Similar findings were reported by Singh et al. [4] in Aonla.

Table 1. Effect of intercrops in Aonla plantation on growth

Treatments combination		Plant height (m)	Plant spread (m)	Fruit set (%)	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)
T_0	Sole crop	3.83	4.04	67.73	2.14	2.20	30.47
T_1	Aonla+Spinach	4.53	4.83	71.52	2.84	2.72	38.31
T_2	Aonla+Radish	5.66	5.49	74.64	3.70	3.45	42.42
T_3	Aonla+Tomato	4.24	4.72	68.77	2.64	2.51	36.34
T_4	Aonla+Coriander	4.41	4.30	72.35	3.15	2.79	32.30
T_5	Aonla+Okra	5.14	5.14	70.43	2.63	3.08	38.20
T_6	Aonla+Fenugreek	4.88	4.90	71.63	2.75	2.63	36.32
F-test		S	S	S	S	S	S
C. D. at 0.5%		0.185	0.450	0.960	0.424	0.214	0.733
S.Ed. (+)		0.085	0.206	0.441	0.195	0.098	0.336

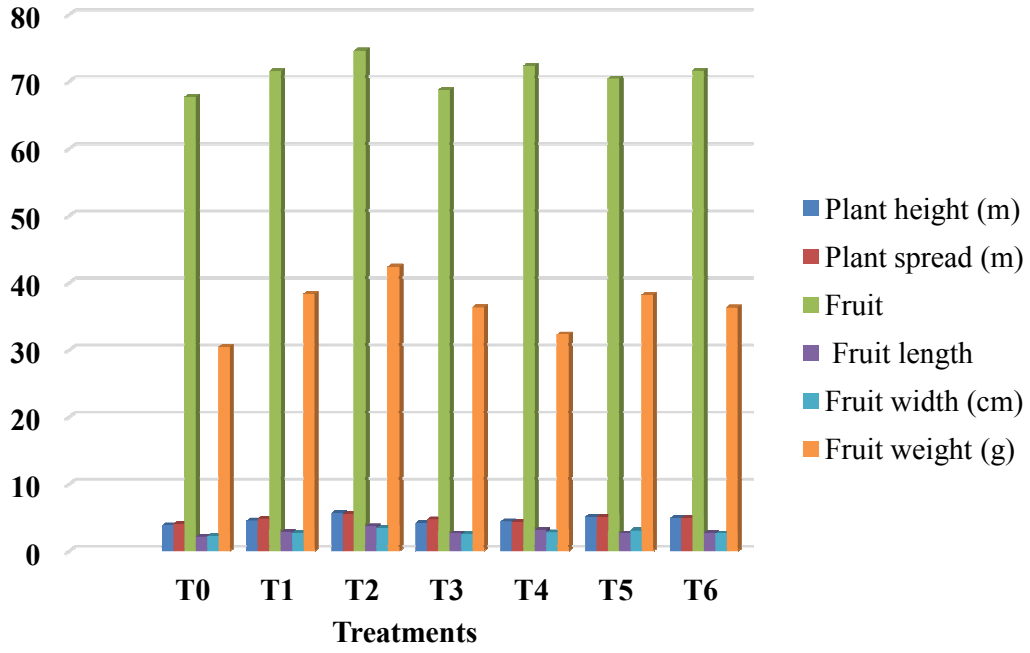

Fig. 1. Effect of intercrops in Aonla plantation on growth characters

As per the data recorded in Table 1 and Fig. 1 shows the fruit width (cm) was varied from T_2 Radish 3.45 to T_0 Sole crop 2.2. The maximum fruit width (cm) was recorded in T_2 Radish (3.45) intercropping system followed by T_5 Okra, T_4 Coriander and T_1 Spinach and the minimum fruit width (cm) (2.20) was found in T_0 Sole crop. Similar findings were reported by Chiranjeevi [9] in Aonla.

As per the data recorded in Table 1 and Fig. 1 shows the fruit weight (g) was varied from T_2 Radish 42.42 to T_0 Sole crop 30.47. The maximum fruit weight (g) was recorded in T_2 Radish (42.42) intercropping system followed by T_1 Spinach, T_5 Okra and T_3 Tomato and the minimum fruit weight (g) (30.47) was found in T_0 Sole crop. Similar findings were reported by (Swain 2014) in Mango and Gosh et al. [10] in Arecanut.

As per the data recorded in Table 2 and Fig. 2 shows the yield (q ha^{-1}) was varied from T_1 Spinach 198.53 and to T_0 Sole crop 0.00. The maximum intercrop yield (q ha^{-1}) was recorded in T_1 Spinach (198.53) intercropping system

followed by Coriander (148.67), Radish (164.41) and the minimum intercrop yield (0.00) was found in T_0 Sole crop. Similar findings were reported by Kumar. [11] in Anola Ashish et al. [12] in Maize.

As per the data recorded in Table 2 and Fig. 2 shows the fruit yield (q ha^{-1}) was varied from T_2 Radish (189.38 q ha^{-1}) T_0 Sole crop (129.01 q ha^{-1}). The maximum intercrop fruit yield (189.18 q ha^{-1}) was recorded in T_2 Radish followed by T_1 Spinach, T_5 Okra and T_6Fenugreek and the minimum fruit yield (129.01 q ha^{-1}) was found in T_0 Sole crop. Similar findings were reported by Atallah & Abbas [13] in Turnip.

As per the data recorded in Table 3 and Fig. 3 shows that the TSS content of fruit were significantly different in TSS content of fruit due to intercropping of vegetable crops. However, the maximum T. S. S. content of fruit (9.10) was found in T_2 Radish followed by T_3 Tomato, T_1Spinach and T_6 Fenugreek and minimum T. S. S. content of fruit (7.71) was recorded in T_0 Sole crop. Similar findings were reported by Kumar et al. [14] in Aonla and Kulkarni et al. [15] in Turnip.

Table 2. Effect of intercrops in Aonla plantation on yield characters

Notation	Treatments combination	Intercrop yield (q/ha)	Aonla yield (q ha^{-1})
T_0	Sole crop	0.00	129.01
T_1	Aonla+Spinach	198.53	171.43
T_2	Aonla+Radish	164.41	189.38
T_3	Aonla+Tomato	28.57	138.65
T_4	Aonla+Coriander	148.67	146.20
T_5	Aonla+Okra	94.66	156.45
T_6	Aonla+Fenugreek	165.69	158.57
F-test		S	S
C. D. at 0.5%		0.733	0.252
S.Ed. (+)		0.336	0.116

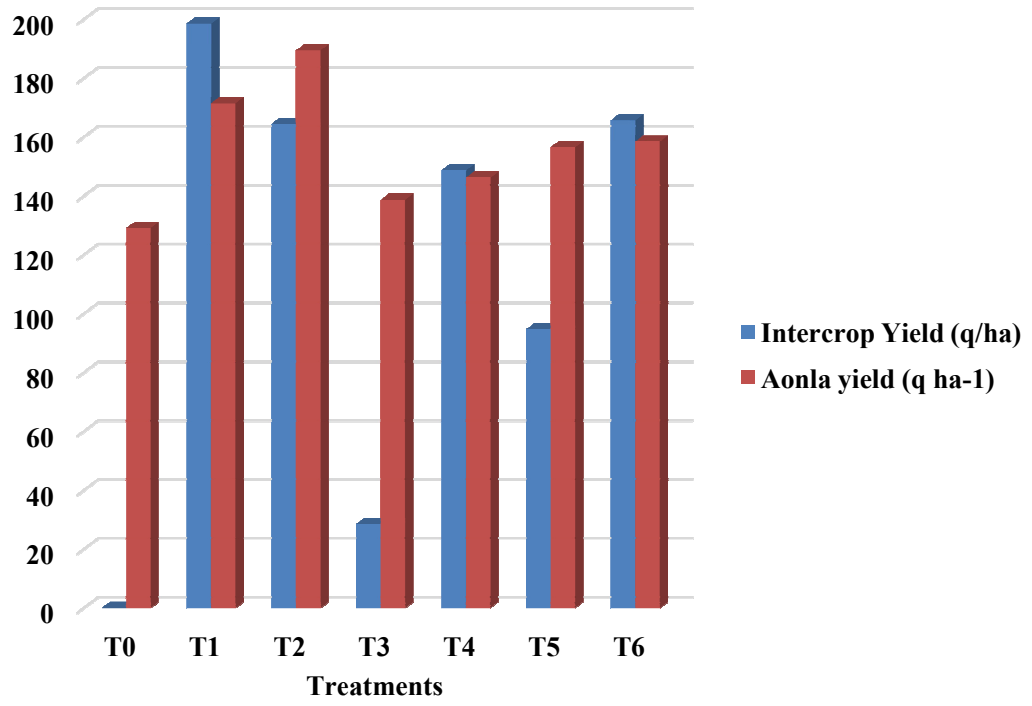

Fig. 2. Effect of intercrops in Aonla plantation on yield characters

Table 3. Effect of intercrops in Aonla plantation on quality characters

Notation	Treatments combination	T. S. S.	Ascorbic acid (mg/100 g)	Acidity
T_0	Sole crop	7.71	496.28	1.38
T_1	Aonla+Spinach	8.56	520.80	1.92
T_2	Aonla+Radish	9.10	525.56	1.99
T_3	Aonla+Tomato	8.57	510.48	1.90
T_4	Aonla+Coriander	8.24	505.33	1.88
T_5	Aonla+Okra	8.26	518.42	1.88
T_6	Aonla+Fenugreek	8.33	501.37	1.86
F-test		S	S	S
C. D. at 0.5%		0.389	3.449	0.062
S.Ed. (+)		0.179	1.606	0.028

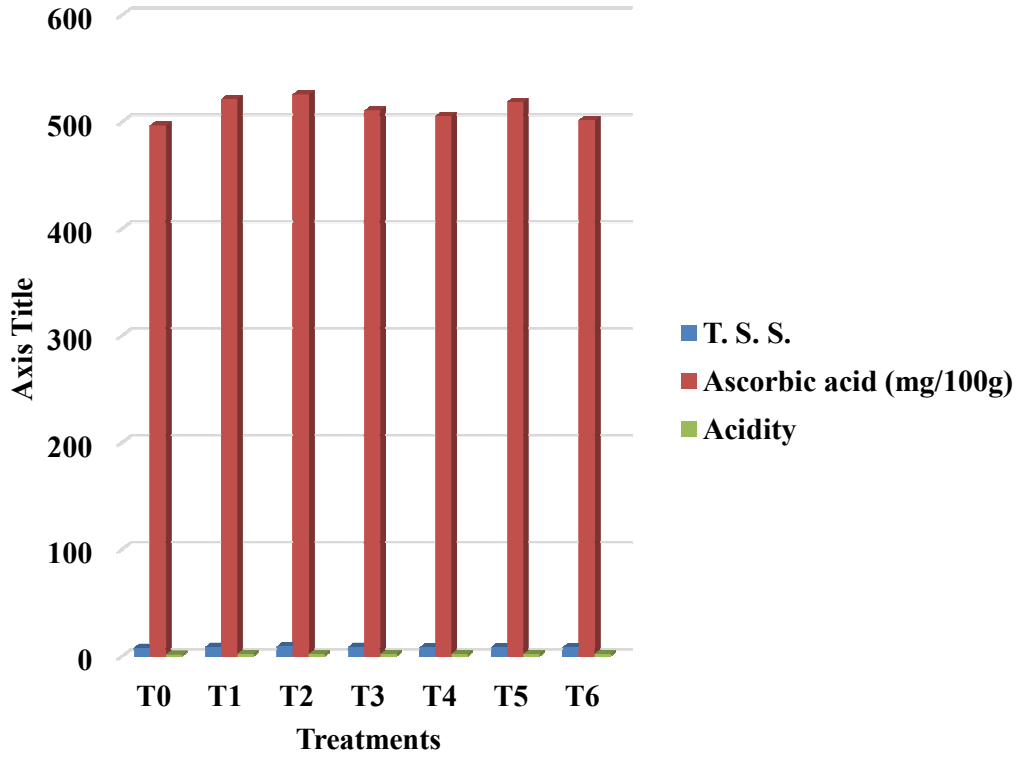

Fig. 3. Effect of intercrops in Aonla plantation on quality characters

As per the data recorded in Table 3 and Fig. 3 shows that the ascorbic acid (mg/100 g) content of fruit were significantly different in ascorbic acid (mg/100 g) content of fruit due to intercropping of vegetable crops. However, the maximum ascorbic acid (mg/100 g) content of fruit (525.56) was found in T_2 Radish followed by T_1 Spinach, T_5 Okra and T_3 Tomato and minimum ascorbic acid (mg/100 g) content of fruit (496.28) was recorded in T_0 Sole crop. Similar findings were reported by Mudit et al. [16] in Anola, Kumar et al. [14] in Guava and Singh et al. [4] in Anola.

As per the data recorded in Table 3 and Fig. 3 shows that the acidity content of fruit were significantly different in acidity content of fruit due to intercropping of vegetable crops. However, the maximum acidity content of fruit (1.99) was found in T_2 Radish followed by T_1 Spinach, T_3 Tomato, T_4 Coriander and T_5 Okra and minimum acidity content of fruit (1.38) was recorded in T_0 Sole

crop. Similar findings were reported by Praveen & Khatkar [17] in Aonla.

4. CONCLUSION

From the present investigation it is concluded the treatment T_2 Radish is the best maximum growth, fruit yield and fruit quality of Aonla tree. It may be concluded that the treatment T_2 and T_5 recorded better growth and yield of Radish and Aonla tree.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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