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## Evaluation of performance of certain mango based intercropping systems in Krishna district of Andhra Pradesh

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### Abstract

An experiment was conducted in farmers fields to investigate the effects of intercrops on the yield of mango cultivar 'Baneshan' with the aim to maximize the production potential and economic returns from mango-based intercropping systems in various villages of Nuzvid mandal, Krishna District, Andhra Pradesh. The treatments include, Mango + Horsegram, Mango + Bhendi, Mango + Beans, Mango + Brinjal, Mango + Tomato, Mango + Tobacco, Mango + Paddy and Mango + Maize. All the intercrops were sown / transplanted during rainy season only (Kharif). Cultivation of tomato as an intercrop in mango orchard recorded significantly highest mango yield (6222.20 kg/ha) followed by brinjal (5951.37 kg/ha) than the other intercropping systems. The lowest yield (3791.64 kg/ha) was recorded with maize as an intercrop. The highest monetary net return (Rs. 143138.90/ha) and BCR of 2.72 was obtained with brinjal intercropping in mango orchard. Intercropping was effective in sustaining income and employment generation especially during the pre-production phase and "off" year especially for small and marginal farmers. Thus, intercropping in mango orchards can help farmers for year round production, employment, reduced cost of cultivation and increase monetary returns besides providing nutritional security.

**Keywords:** Evaluation, performance, certain mango based intercropping systems

### Introduction

The Indian agriculture is diversifying towards production of horticultural crops along with the increasing role of small and marginal farmers. Intercropping provides opportunity for diversification through judicious resource conservation and intensification for food and nutritional security with cultivation of high value short duration crops like vegetables in wide interspaces of the orchards. This improves resource use efficiency and farm profitability particularly in market driven peri-urban horticulture. Mango is most predominant fruit cultivated in the Indian subcontinent and is grown in all fruit growing states of India (Chadha, 1993) [2]. It comprises about 36.5% of total fruit area and 15% of India's total fruit production with 23.12 million ha area and 15.03 million tons in terms of production. Andhra Pradesh is the major producer of mango followed by Uttar Pradesh. Mango intercropping provides multiple benefits, including provision of micronutrients to the diet of the rural community and enhancement of on-farm biodiversity and environmental sustainability (Nath and Singh, 2013) [3]. Mango intercropping with various crops especially legumes, vegetables, maize and paddy has been gaining momentum. In the wake of adverse impact of climate change, the farmers face trouble to depend only on mango cultivation. The main aim of growing intercrops is to utilize the wide space of fruit plantations during their early stages. Intercropping not only increase total crop production but also help improve soil health and fertility with little or no negative effect on mango yield and quality. Rao and Willy (1980) [5] also showed that intercropping system increases the total productivity in addition to stability of the production under rainfed conditions. Furthermore, intercropping create additional job opportunity needed for intensive crop production. Even though intercrops and cover crops are important operations in the management of a good orchard, many growers in and around Nuzvid mandal of Krishna district, Andhra Pradesh do not pay much attention to it leading to low returns in mango cultivation. So the present study was taken up to evaluate the performance of various mango based intercropping systems, to record the additional benefits of intercropping in mango along with best intercrop suited for mango in this region in order to increase the income from mango orchards.

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## Materials and Methods

The field experiments were conducted in twenty four farmers fields in Nuzvid mandal, Krishna District of Andhra Pradesh during 2010 – 2012 in a Randomized Block Design with eight treatments. Farmers having ten years old bearing Baneshan mango gardens planted at a spacing of 10 x 10 m were selected. One farmer was treated as one replication. The treatments were T<sub>1</sub> – Mango + Horsegram, T<sub>2</sub> –Mango + Bhendi, T<sub>3</sub> – Mango + Beans, T<sub>4</sub> –Mango + Brinjal, T<sub>5</sub> – Mango + Tomato, T<sub>6</sub> –Mango + Tobacco, T<sub>7</sub> –Mango + Paddy and T<sub>8</sub> –Mango + Maize. The varieties utilized for intercrops were local, Syngenta 007, local, Gulabi, Lakshmi, local, MTU 1001 and Kaveri 50 of Horsegram, Bhendi, Beans, Brinjal, Tomato, Tobacco, paddy and Maize respectively. The mango plants were fertilized with 1 kg each of Urea, SSP and MOP during June- July and September months by basal ring method. The different intercrops during *kharif* were sown at recommended spacing and applied with recommended dose of fertilizers as basal and top dressing. The net plot size was one acre and soil type of the experimental plots was red soils. All the package of practices for intercrops and mango were followed as per the recommendations. The crops were harvested at maturity and marketed. The mango fruits were harvested from each plant and sold in the market. The monetary returns were computed by taking the market prices existing at the time of sale. The data pertaining to monetary returns like Net returns and Benefit: Cost ratio was analyzed statistically. The benefit-cost ratio (BCR) is an indicator of economics of investment. This ratio depicts the financial return for each rupee invested in cultivation. Mathematically,  $BCR = \text{gross returns} / \text{cost of cultivation}$ , where,  $\text{gross returns} = \text{yields} \times \text{price}$  and  $\text{cost of cultivation} = \text{cost on all the inputs and labour}$  (Panse and Sukhatme, 1985) [4].

## Results and Discussion

Data from Table 1 revealed that mango intercropped with tomato and horse gram recorded highest mango yield of 6250 kg/ha which was significantly superior than Tobacco, Paddy and maize and on par with others. Mango intercropped with brinjal recorded significantly higher mango equivalent yield of 8697.3 kg/ha and net returns of Rs 1,42,500/ha than rest of the intercrops. This may be due to the higher yields recorded in brinjal as compared to other intercrops and also good quality of mango fruits which fetched better price in the market. Highest BCR of 2.68 was recorded when mango was intercropped by brinjal and was on par with rest of the treatments except when intercropped with horsegram and tobacco.

Data from Table 2 revealed that mango intercropped with tomato recorded highest mango yield of 6833.3 kg/ha which was significantly superior than bhendi, tobacco and maize and on par with rest of the intercrops. Mango intercropped with tobacco recorded significantly higher mango equivalent yield of 33404.7 kg/ha than rest of the intercrops which might be due to higher price for tobacco / bale this year and also due to less price of mango fruits / ton which are grown under tobacco intercropped conditions which had poor quality due to high pest and disease incidence as compared to other

mango fruits which are grown under other intercrops. Highest net returns of Rs 126916.7/ha was recorded when mango was intercropped with brinjal which was significantly higher than rest of the treatments except when intercropped with tomato. Highest BCR of 2.59 was recorded when mango was intercropped by brinjal followed by mango intercropped with paddy (2.51) and tomato (2.29) and was on par with rest of the treatments except when intercropped with horsegram, tobacco and maize.

Data from Table 3 revealed that mango intercropped with tomato recorded highest mango yield of 5583.33 kg/ha which was significantly superior than horse gram, bhendi, tobacco, maize and on par with rest of the intercrops. Mango intercropped with brinjal recorded significantly higher mango equivalent yield of 2634.0 kg/ha than rest of the intercrops. Highest net returns of Rs 160000/ha was recorded when mango was intercropped with brinjal which was significantly higher than rest of the treatments except when intercropped with tomato. Highest BCR of 2.87 was recorded when mango was intercropped by brinjal which was on par with rest of the treatments except when intercropped with tobacco and maize. Pooled analysis from Table 4 revealed that mango intercropped with tomato recorded significantly highest mango yield (6222.2 kg/ha) than other intercrops but was on par with brinjal intercropping. Mango equivalent yield was found to be non-significant among various intercropping systems. Highest net returns of Rs 143138.90 / ha was recorded when mango was intercropped with brinjal which was significantly higher than rest of the treatments followed by tomato (Rs 112491.70 / ha) and paddy (Rs 81773.40 / ha). Similar findings were also given by V. K. Singh *et al.* (2015) [7], Sarkar *et al.* (2004) [6] and Awasthi and Saroj (2004) [1]. Highest BCR of 2.72 was recorded when mango was intercropped by brinjal followed by mango intercropped with paddy (2.57) and bhendi (2.42) which were on par and significantly higher than rest of the intercrops.

Even though tomato intercropping gave highest mango yield and net returns, due to high expenditure on plant protection measures and high market fluctuation in tomatoes cost, farmers got low BCR. Paddy intercropping in spite of getting second best should not be adopted since the paddy intercropping adversely affects the life span of mango trees. Getting high net returns and BCR under low mango yield and low mango equivalent yield conditions may be attributed to the early mango crop obtained in all the years of study under paddy intercropping which fetched high price in the market. The early crop might be due to the exposure of mango plants to water logged conditions created for raising paddy which resulted in induction of artificial drought situations that stimulates early flowering in mango roughly to an extent of one month. This early crop brought high returns to the farmers. Sucking pest incidence on mango was more when intercropped with paddy and tobacco compared to other intercrops. The BCR of bhendi was more due to low cost of cultivation and more net returns. Intercropping with maize decreased mango yields because maize is an exhaustive crop that depletes availability of soil nutrients hence should not be recommended as intercrop in mango orchards.

**Table 1:** Performance of mango based intercropping systems in Krishna District (2009 -10)

Variety/Hybrid	Mango Yield (kg/ha)	Mango Equivalent Yield of Intercrops (kg/ha)	Net Returns (Rs)	BCR
Mango + Horsegram	6250.0	630.0	27666.6	1.85
Mango + Bhendi	5416.6	2114.3	53500.0	2.27
Mango + Beans	5416.6	3579.3	71833.3	2.36
Mango + Brinjal	5833.3	8697.3	142500.0	2.68
Mango + Tomato	6250.0	6355.3	101041.7	2.28
Mango + Tobacco	5000.0	5742.6	16958.3	1.13
Mango + Paddy	5250.0	599.6	70076.6	2.59
Mango + Maize	4583.3	4261.6	63250.0	2.33
SEM ±	317.90	468.4	10738.4	0.149
CD	964.2	1420.8	32570.08	0.453

**Table 2:** Performance of mango based intercropping systems in Krishna District (2010 -11)

Variety/Hybrid	Mango Yield (kg/ha)	Mango Equivalent Yield of Intercrops (kg/ha)	Net Returns (Rs)	BCR
Mango + Horsegram	5416.7	2502.9	25584.3	1.77
Mango + Bhendi	5000.0	12375.0	66229.0	2.16
Mango + Beans	6333.3	8296.7	74333.3	2.27
Mango + Brinjal	6750.0	16576.7	126916.7	2.59
Mango + Tomato	6833.3	15092.7	105266.7	2.29
Mango + Tobacco	4833.3	33404.7	80270.0	1.68
Mango + Paddy	6250.0	1635.8	83579.0	2.51
Mango + Maize	3833.3	11152.7	56666.7	1.89
SEM ±	558.1	2206.8	9756.3	0.19
CD	1692.8	6693.4	29591.3	0.59

**Table 3:** Performance of mango based intercropping systems in Krishna District (2011 -12)

Variety/Hybrid	Mango Yield (kg/ha)	Mango Equivalent Yield of Intercrops (kg/ha)	Net Returns (Rs)	BCR
Mango + Horsegram	3750.00	105.47	38812.33	2.29
Mango + Bhendi	3875.00	999.06	110029.20	2.84
Mango + Beans	4458.33	1068.94	89575.00	2.55
Mango + Brinjal	5270.83	2634.00	160000.00	2.87
Mango + Tomato	5583.33	1972.71	131166.70	2.58
Mango + Tobacco	3750.00	370.08	85565.98	1.73
Mango + Paddy	4791.67	141.47	91664.59	2.62
Mango + Maize	2958.33	925.78	64958.33	2.02
SEM ±	383.04	143.29	9509.48	0.21
CD	1161.78	434.61	28842.54	0.64

**Table 4:** Pooled Analysis of mango based intercropping systems in Krishna District (2009-12)

Variety/Hybrid	Mango Yield (kg/ha)	Mango Equivalent Yield of Intercrops (kg/ha)	Net Returns (Rs)	BCR
Mango + Horsegram	5138.90	1394.45	30687.74	1.97
Mango + Bhendi	4763.86	6219.96	76586.07	2.42
Mango + Beans	5402.74	6104.65	78580.53	2.39
Mango + Brinjal	5951.37	13651.33	143138.90	2.72
Mango + Tomato	6222.20	10984.57	112491.70	2.38
Mango + Tobacco	4527.76	16043.83	60931.43	1.51
Mango + Paddy	5430.55	1092.14	81773.4	2.57
Mango + Maize	3791.64	7577.56	61625.01	2.08
SEM ±	257.19	3275.47	8474.11	0.10
CD	780.07	NS	25702.23	0.32

### Conclusion

The best intercrop combination in terms of net returns was mango + brinjal followed by tomato and paddy where as for BCR it was mango + brinjal followed by paddy and bhendi. Brinjal, bhendi and tomato intercrop was effective in sustaining income especially during pre-production phase and “off” year when mango is not in bearing under nuzvid conditions resulting in sustainable income generation and year round employment to the farmers.

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