Crop Diversification for Sustainable Production in Irrigated Hot Arid Eco-System of Rajasthan

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Abstract- To meet the diversified need of the farmers, field experiments on fruit based cropping system with ber (Z. mauritiana) and aonla (E. officinalis) were initiated at Central Institute for Arid Horticulture, Bikaner, Rajasthan, India. Preliminary results revealed that during the pre-establishment phase of ber orchard, Indian aloe (Aloe barbadensis) and cluster bean-mustard (Cynopsis tetragonoloba - Brassica campestris) are the low input and high returning crops giving net returns of Rs 65,802 and Rs 26,144/ha. While, in aonla based multistory cropping system, moth bean (Phaseolus acconitifolius) and brinjal (Solanum melongena) were identified as the potential crops giving an average net returns of Rs 850 and Rs 26, 144/ha. By growing these crops, farmer could generate income over a period of six months while from Indian aloe round the year.

Keywords: Crop diversification, hot arid ecosystem, multistorata farming, sustainable production

1. Introduction

The arid region, which covers nearly 12% of the total geographical area of the country, are characterised by fragile eco-system. Production system in these region faces several biophysical constraints (high solar radiation, low and erratic rainfall of <300mm, high wind velocity, poor soil conditions etc.). Despite these constraints, it has also been realized that the arid agro-climate also helps to develop high quality in certain horticultural and agricultural crops and ensure better economic return to the growers. With the increase in irrigation facilities, area under fruit crops has almost tripled from 4749 ha (1985-86) to 11761 ha (2001-02), likewise area under vegetable crops has increased from 48350 ha (1985-86) to 97019 ha (2001-02). Productivity/unit area however, continues to be abysmally low. Some of the reasons for lower productivity are indigenous cropping system, monocropping/mono orcharding, high input/low returning crops, indiscriminate use of irrigation water in the dominating rotations of cotton-wheat and groundnut-wheat. Subsistence farmers who face famine would consider a technology to be one that produces some yield in the worst year than the one that produces some yield in best. Under such situation crop diversification integrating multiple crop combination on the same land management unit is considered the most ideal strategy for economizing the productivity, generating employment opportunities, improving economic conditions of farmers and entrepreneurs, increasing export and nutritional security to the people.

For sustainable production and ecological restoration, ground storey and multistorata cropping system integrating perennial fruit and forest trees, annuals (vegetables, pulses, oilseeds, spices, cereals and medicinal plants), grasses/fodder crops (annuals and perennials) must be judiciously adopted. Through this approach, more area can be placed under available resources by partial shifting of existing high input requiring rotations to low input requiring system so as to meet the diversified need of the farmers, known as 4F’s, which stands for food, fruit, fuel and fodder (Chundawat, 1993, Pareek, 1999 and Chadha, 2002). The paper discusses the practically untouched almost virgin area of multiple cropping in hot arid eco-system of Thar Desert (Bikaner), of Rajasthan, India.

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2. Experimental set up

2.1 Ber (Ziziphus mauritiana) based cropping system: The ber based cropping systems were initiated in the year 2000 by integrating ber, cultivar Gola as necessary component and groundnut-wheat (Arachis hypogea-Triticum aestivum), cluster bean-mustard (Cyanopsis tetragonoloba-Brassica campestris) and Indian aloe (Aloe barbadensis) as ground storey component. The ber plantation was established in situ with three spacings i.e. 16X4m, 8X8m and 6X6m. The systems were established in sandy soil having poor organic matter content. The components were maintained under sprinkler irrigation system and recommended dose of manures and fertilizers.

After three years of experimentation, it was observed that the ground storey crops had positive influence on the vigour of ber plants as compared to sole plantation of ber. However, the growth of ber plant was directly proportion to the frequency and amount applied to the ground storey crops. Therefore, the growth of ber plants was maximum with Indian aloe and minimum under sole plantation. The plant spacing did not have any impact on growth parameters of ber.

Based on average data of two years, the yield of ground storey crops viz., groundnut, cluster bean, wheat, mustard and Indian aloe 3.46q/ha (dried pods), 50.65q/ha (green pods), 10.28q/ha (grain), 11.56 q/ha (grain), and 21.45q/ha (leaf pads) respectively. Indian aloe besides being used as vegetable, suckers were also harvested and sold as planting material. From the same set of combinations; 21.75, 18.26, 20.17 and 24.08q/ha biomass was also harvested from groundnut, cluster bean, wheat and mustard respectively (Figure 1). Among the three ground storey combinations, Indian aloe gave the highest economic returns of Rs 65802/ha, followed by cluster bean-mustard, Rs 26144/ha and minimum return was obtained from groundnut-wheat combination i.e. Rs 1203/ha.

![Graph](image)

Figure 1: Pod, grain, leaf pad and biomass yield of ground storey crops with ber

2.2 Aonla (Emblica officinalis) multistrata cropping system: The experiment was laid out during the year 2002 with aonla, cultivar NA-7 as an overstorey crop spaced 8m apart with four different cropping models, each on a 40X8m plot. The crops were aonla+ber (Z.mauritiana)+brinjal (Solanum melongena)+moth bean (Phaseolus aconitifolius)+fenugreek (Trigonella foenum graecum) [Model 1], aonla+bael (Aegle marmelos)+karonda (Carissa congesta)+moth bean+gram (Cicer aritinum) [Model 2], aonla+khejri (Prosopis cineraria)+sajī (Suaeda fruticosa)+moth bean+cumin (Cuminum cyminum) [Model 3], aonla+bael+brinjal+moth bean+cumin [Model 4]. The vertical stratification of the species as ground storey crops were (moth bean, brinjal, gram and cumin), I storey crops (karonda and sajī), II storey (ber, bael, khejri) and III storey/over storey crop (aonla)

During the first year of experimentation, brinjal and moth bean were grown as groundstorey crops. Brinjal crop was grown between two aonla plants at a spacing of 60X40 cm leaving 1m away from the main stem thus occupying 75% area. Fruit yield was recorded during different
picking and pooled at the end of experiment. Moth bean (RMO-40) a sixty day crop was sown during the rainy season between the interspaces of aonla.

First year cropping with brinjal crop in models 1 and 4 gave an average yield of 4.10 and 4.25 g/ha respectively as compared to control 3.75 g/ha. Plant biomass production was to the tune of 10.50 and 11.55 g/ha. Yield of moth bean varied from 2.91 g/ha (control) to 4.14 g/ha (model 2), whereas, biomass yield varied from 6.23 g/ha (control) to 11.29 g/ha (model 2). *Suaeda fruviicosa*, a potential industrial crop gave an average biomass yield of 6.30 g/ha (model 3) and 5.80 g/ha in control (Figure 2). The net returns realized from brinjal and moth bean during the establishment of over and understorey crops varied between Rs 800-850 and Rs 2500-3000/ha respectively.

![Graph of Brinjal and Mothbean Yield](image)

*Fig. 2: Fruit/grain and biomass yield of brinjal and moth bean under different cropping models*

### 3. Conclusion:

The study revealed that during the initial stage, when the perennial fruit trees are in their juvenile phase, adoption of ground storey/multistory cropping systems results in staggered generation of returns and employment as compared to mono-cropping without any adverse effect on overstorey components.

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**References**

