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Crop diversification under fruit based cropping system in arid zone of western Rajasthan

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Abstract

The experiment conducted at farmers field in Bikaner district on sandy soil during *Kharif* season of 2003 and 2004 under canal command area for crop diversification in different fruit based cropping systems revealed that the maximum plant height of mothbean and groundnut was recorded under the intercropping with Bael where as clusterbean maximum plant height (49.8 cm) was recorded maxium with Ber. Mothbean intercropping with Bael produced 14.61 and 27.24 per cent higher total dry matter (26.99 q/ha) and grain yield (10.40 q/ha), respectively than its intercropping with Ber (23.77 and 8.98 q/ha). Among the entire intercrop highest mean root dry matter addition (2.49 q/ha) to soil after crop harvest was observed in groundnut intercropping, which was significantly higher over the intercropping of mothbean and clusterbean. However, the mean highest system productivity (8.71 q/ha) was observed under the intercropping of groundnut with the fruit trees which was 15.09 and 9.82 per cent higher over intercropping of mothbean and clusterbean, respectively. Highest total income (Rs. 35,172 /ha), net profit (Rs.30,162/ha) and cost: Benefit ratio (6.02) was observed under the intercropping systems of Bael + mothbean.

Key words: *Fruit trees + crops intercropping, crop diversification, arid zone, cropping system*

Introduction

The Low and erratic rainfall with high variability in its quantity and occurrence, high temperature during summers (as high as 48°c) and low in winters (up to –3 °c). High wind velocity (10-13 km /hr) and high annual evapo-transpiration (1527 mm /year) hinders arable cropping in this region. The introduction of canal in the area, opened new vistas thus allowing the choice for more number of crops which can be included in cropping system. The major canal network in the region is IGNP passing through Ganganagar, Bikaner and Jaisalmer districts in which water availability is @ 5.24 m /ha from 1982-86. The flow values of main canal varies from 1.727 x 10^6 M^3 to 2.961 x 10^6 M^3 in different season (Khan, 1996). However, the untimely and irregular availability of canal water along with reduced quantity again put a question to think for inclusion of low water requiring, perennial crops and fruit trees in the cropping system for its sustainability even under adverse condition. Inter cropping of legumes with Ber produced higher grain yield of intercrops by 5-20 per cent over their sole cropping (Singh et al., 2003). Thus, intercropping of annual crops with the perennial trees provided the extra income to the farmer when fruit trees are in their juvenile phase along with the assured production from the system. Keeping the above points in view an experiment was conducted to find out the productivity of different crops intercropped with different fruit trees under canal-irrigated condition.

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Materials and Methods

The experiment was conducted at farmers field in Pugal tehsil of Bikaner district in sandy soil during Kharif season of 2003 and 2004 under canal command area.

The experimental site is characterized as hyper arid with highest mean monthly temperature of 39.7°c in month of July during 2004 with a minimum of 11.6°c in month of November 2003. The highest wind velocity was 10.06 km/hr in month of July during the crop season, which increased the evaporation of water loss during the study period which had impact on the period for water availability to the plant after the irrigation, which seems to be very less.

The soil situation of the experimental site was loamy sand in texture, calcareous alkaline in reaction with normal EC (0.21dsm^{-1}) low in organic carbon with very low in

nitrogen, phosphorus and good in potassium amounting 43.16.3 and 162.4 kg/ha. respectively.

Three crops viz., Mothbean (*Vigna acontifolia*), clusterbean (*Cyamopsis tetragonoloba*) and groundnut (*Arachis hypogea*) were intercropped in interspace of three year-old Ber (*Zyziphus mauritiana*), Bael (*Aegle marmelos*) and Kinnow (*Citrus spp*) orchards under factorial randomized block design with three replications. The canal water was used for irrigating the plants to all the crops at same time through flood system. All other cultural practices were adopted as recommended for individual crops separately. During the cropping season an amount of 178.6 mm and 91.9 mm rainfall was received during 2003 and 2004 respectively. The system productivity was calculated mathematically by using the following formula.

System productivity (SP)= (Intercrop productivity (q/ha) x Area sown in system per ha (m^2)/ ha (m^2) + Fruit trees yield in terms of crop yield equivalent(q/ha).

Results and discussion

Plant height (cm)

The plant height of different crops was not affected significantly under intercropping with different fruit trees. The highest plant height of mothbean and groundnut was recorded under the intercropping with Bael where as clusterbean gave highest plant height (49.8 cm) in intercropping with Ber. The plants were only 3 years old and have no adverse effect on growth and development of intercrops.

Yield of intercrops

The two year pooled data presented in Table 1 showed that the highest dry matter and Grain yield of all the intercrops were recorded under the intercropping with Bael which was significantly higher in mothbean and clusterbean but was at par in groundnut. The same trend was observed with straw yield also. Mothbean intercropping with Bael produced 14.61 and 27.24 per cent higher total dry matter and grain yield, respectively than it's intercropping with Ber. This was due to the fact that at the initial stage of fruit trees there are no adverse effect on the yield of intercrops. Patil *et al.*, 2005, also reported similar findings where no adverse impact of fruit trees was noticed on intercrops at early stages of tree growth.

Root dry matter addition to soil

Significant differences have been observed in root dry matter addition by different intercrops. Highest root dry matter (2.76 q/ha) was added in the treatment when groundnut was intercropped with kinnow plantations followed by Bael. Mothbean root dry matter addition was lower under intercropping with all the trees, which was due to the harvesting system of mothbean in which the plants are normally uprooted at the time of harvesting along with

Table 1. Yield of intercrops grown with different trees under intercropping system (Pool of two years).

Fruit Trees	Yield of intercrops			
	Mothbean	Clusterbean	Groundnut	Mean
		Total dry matter yield (q/ha)		
Ber	16.90	27.24	27.17	23.77
Bael	19.37	32.63	28.97	26.99
Kinnow	18.10	26.97	27.69	24.25
Mean	18.12	28.94	27.94	
C.D. at5%	Crops=1.20	Trees=5.36	Crop x trees=NS	
		Grain yield (q/ha)		
Ber	6.13	9.36	11.47	8.98
Bael	7.80	10.97	12.43	10.40
Kinnow	6.16	8.37	11.12	8.55
Mean	6.70	9.57	11.67	
C.D. at5%	Crops= 1.13	Trees= NS	Crop x tree=NS	
		Straw yield (q/ha)		
Ber	10.78	17.40	15.75	14.64
Bael	11.57	22.18	16.49	16.75
Kinnow	11.95	19.07	16.32	15.78
Mean	11.43	19.55	16.18	
C.D. at5%	Crop=0.15	Tree= NS	Crop x tree=0.18	

thin roots as compared to the clusterbean and groundnut. The highest root dry matter addition of 1.95 q/ha was recorded under Ber + mothbean intercropping followed by Kinnow+mothbean intercropping (Table2). Among the entire intercrop highest mean root dry matter addition (2.49 q/ha) was observed in groundnut intercropping, which was significantly higher over the intercropping of mothbean and clusterbean. The intercropping of groundnut with Bael produced highest root dry matter addition (2.76 q/ha). This was due to the better growth and development of groundnut plants as well as more root dry matter yields per plant in comparison to other crops in the system.

System productivity (SP)

The different crops under intercropping with the fruit trees significantly affected the system productivity, which was lower over the intercrop productivity because the fruit trees were not in bearing. However, the highest system productivity was 8.71 q/ha under the intercropping of groundnut with the fruit trees which was 15.09 and 9.82 per cent higher over mothbean and clusterbean intercropping (Table 3). Over all mean of the crops indicated that intercropping of crops with the Bael produced highest mean system productivity (9.63 q/ha), which was significantly higher over intercropping with Ber and Kinnow.

Table 2. Root dry matter addition in different intercropping systems (Pool of two years).

Fruit Trees (3 years old)	Intercrops			Mean
	Mothbean	Clusterbean	Groundnut	
Ber	1.95	2.07	1.97	2.00
Bael	1.7	2.35	2.73	2.26
Kinnow	1.9	2.03	2.76	2.23
Mean	1.85	2.15	2.49	
C.D. at 5%	Crops=0.47	Trees=0.47	Crop x tree= 0.82	

Table 3. System productivity (q/ha) with the intercropping of crops with trees (Pool of two years).

Fruit Trees*	Intercrops			Mean
	Mothbean	Clusterbean	Groundnut	
Ber	5.40	8.29	8.32	7.34
Bael	9.43	9.62	9.84	9.63
Kinnow	7.88	5.97	7.97	7.27
Mean	7.57	7.96	8.71	
CD at 5%	Crops=1.07	Trees=1.06	Crop x tree= 1.84	

* Fruit tree were not in production.

Economics

Highest total income (Rs. 29,729 /ha) and net profit (Rs.21,799/ha) was observed under the Bael + groundnut intercropping followed by Ber +Groundnut and kinnow +groundnut (Table4). This was due higher yield of groundnut with reasonable market price. The highest cost: Benefit ratio (3.02) was recorded with Bael + clusterbean intercropping followed by Bael+ Mothbean (2.86). The lowest was with Ber+ mothbean (2.06). The results confirms the findings of Patil *et al.* (2005) in which the highest net profit was recorded with the Sapota+ Groundnut intercropping.

Table 4. Economics of different treatments under intercropping system (Pool of two years).

Treatments	Economic (Rs /ha)			
	Total Income	Cost of cultivation	Net profit	Cost : Benefit ratio
Ber + Mothbean	16124	5270	10854	2.06
Ber+ Clusterbean	18540	5570	12970	2.33
Ber + Groundnut	28709	8330	20379	2.45
Bael + Mothbean	19320	5010	14310	2.86
Bael+ Clusterbean	21364	5310	16054	3.02
Bael + Groundnut	29729	7930	21799	2.75
Kinnow + Mothbean	16025	5010	11015	2.20
Kinnow+ Clusterbean	16432	5310	11122	2.10
Kinnow+ Groundnut	27760	7930	19830	2.50

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