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Comparative study for yield and economics of seed spices based cropping system with fruit and vegetable crops

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Abstract

Sustainability and profitability of framing systems particularly of marginal and small holding facing serious challenges due to declining trend of per capita low availability and shrinking size of operational holdings. Natural resources of the country are having more and more pressure due to burgeoning of population which also required more food, folder, fuel, water etc. A study on standardization of sustainable and profitable cropping system with fruit crops was carried out at ICAR-NRC on Seed Spices, Ajmer to increase system productivity and profitability of the farmers. The field experiment was designed with 20 treatments comprised six cropping sequences viz. Nigella-Cowpea, Anise-Cluster Bean, Rai-Black Gram, Ajwain-Tinda, Fenugreek-Okra, Coriander -Green Gram under taken with two types of fruit orchards i.e. ber and aonla compared with sole crop sequence as well as fruit trees. The results revealed that all the cropping sequences intercropped ber with exhibited higher coriander equivalent yield, net returns and BCR over the cropping sequence intercropped with aonla. The cropping sequence Fenugreek- Okra inter cropped with ber exhibited highest coriander equivalent yield (6549 kg ha^{-1}), net return (Rs 809215/- ha^{-1}) and BCR (4.68) followed by intercropping of Ajwain- Tinda cropping sequence with ber which resulted a net return of Rs.722075/- ha^{-1}. Thus, it is inferred that intercropping of fenugreek- okra cropping sequence with ber is recommended for realizing higher system productivity, net returns and BCR.

Key words : Fruit crops, profitability intercropping, seed spices, system productivity

Introduction

Declining trend of per capita land availability with shrinking operational holding size poses a serious challenge to the sustainability and profitability of existing farming system specifically in marginal and small households. Further, population of human being is burgeoning and India being second largest populous country of the world. Demand for food, fodder and fuel is increasing. In order to meet the demand of increasing population, it is necessary to enhance productivity of limited production resources. The only way is to expand agricultural activities in vertical dimension. The expansion of agricultural activities can be done through vertical farming, roof top farming, multistoried farming and intercropping. With an aim to maximize the return from the field and at the same time to minimize the economic losses to the growers, intercropping, in between the tree rows, is better to provide an early cash flow and/or to maximize the land investment. By combining crops on same piece of land that have different growth patterns, (root and shoot), could utilize available water, air, nutrients light etc in a better way. Integration of seasonal crops with fruit trees is a viable approach for enhancing system productivity (Saroj and Krishna, 2017). Intercropping of seed spices with fruit trees is necessary for increasing system productivity and income of farmers (Anwar *et al.*, 2011).Intercropping of seed spices with fruit trees helps in minimizing risk of farmer in event of adverse climatic condition (Vashishtha *et al.*, 2005 and Mehta *et al.*, 2007). Most of the seed spice crops are grown in semi arid region. In seed spice growing regions major fruits are Ber and Aonla therefore; it is the need of the hour to integrate the production of semi arid fruit crops with different cropping sequences so that round the year income could be generated on farmer's field. So the study for enhancing system productivity through intercropping of seed spices with fruit crops was undertaken with view to double the income of seed spice growers.

Materials and methods

The experiment on standardization of sustainable and profitable cropping system with fruit crops was conducted on sandy loam soil of research farm of ICAR-NRCSS,

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Ajmer (Rajasthan) India during 2011-12, 2012-13 and 2013-14. The field experiment was consisted of 20 treatments each comprised of six crop sequences viz. Nigella-Cowpea, Anise-Cluster Bean, Rai-Black Gram, Ajwain-Tinda, Fenugreek -Okra, Coriander- Green gram grown with two fruit trees i.e. ber and aonla and were compared with open space and fruit trees as sole. The experiment was laid down statistically in Randomized Block Design. The soil of the experimental site was sandy loam contained low organic matter (0.26%), nitrogen (182.63 kg ha^{-1}), phosphorus (13.0 kg ha^{-1}) and adequate available potassium (175 kg ha^{-1}), slightly alkaline with pH (8.04) and EC (0.076 dS m^{-1}). Ber and aonla orchard used for inter cropping was fully developed. In Rabi season, seed spices were grown and in summer season, vegetables and pulse crops were taken. In Rabi season seed spices were grown on 20 Oct., 23 Oct., 27 Oct in the year 2011-12, 2012-13, 2013-14, respectively and vegetable and pulse crops were grown during summer season on 25th June, 27th and 29th June during year 2011-12, 2012-13 and 2013-14, respectively. Recommended package of practices were followed for of both Rabi and summer season crops. Yield of seed spices, vegetables and pulses was taken from net plots and converted in kg ha^{-1}. After harvesting of fruits complete lopping of ber plants was done to make enable fresh shoot growth on which fruiting would takes place in coming year. Lopping material of ber was used as fodder for animals and hard wood was used as fuel and fencing purpose. There was no need of pruning of aonla. Harvesting of mature and marketable fruits was done and sold them out. Yield of seed spices, vegetables and fruits was converted into coriander equivalent yield based on prices of each seed spices crop, vegetables and fruits. Statistical analysis was done through procedure prescribed by (Panse & Sukhatme 1985).

Results and discussion

Yield of kharif crops

The yield of *kharif* crops was significantly influenced when grown in association with different fruits trees and in open space. All the *kharif* crops resulted the highest grain/ vegetable yield when grown in open space followed by in association with ber and aonla fruit crops. Among the pulses in cropping sequences the highest grain yield was exhibited by cowpea in nigella-cowpea crop sequence with ber, aonla and in open space. The yield of cowpea in nigella-cowpea cropping sequence was 8955 kg ha^{-1}, 8400 kg ha^{-1} and 8200 kg ha^{-1} in open space, with ber and with aonla inter-cropping system, respectively. All the *kharif* crops resulted the lowest grain yield when grown in association with aonla (Table1). The highest yield of *kharif* crops was obtained when grown in open space and it might be due to no competition of other plants except competition within the same species which result in easy availability of solar radiation, air, nutrient and moisture to the crops, which could helped in proper growth and development. Almost similar results were reported by Meena *et al.,* (2014) and Malhotra, *et al.*, (2000).

Yield of Rabi season seed spice crops

Yield of all the seed spices viz. nigella, anise, coriander and fenugreek were highest in open space followed by intercropped with ber and aonla. Among the seed spices, the highest grain yield was produced by fenugreek with ber and aonla while in open space higher seed yield was recorded in rai. The yield of fenugreek in fenugreek-okra

Inter cropping of kharif crops with fruit crops

Fenugreek +Ber

Fenugreek+ Aonla

Table 1. Effect of seed spice based inter cropping with fruit trees on yield of crops and fruits.

Treatments	Fruit yield (kg ha^{-1})	Yield of rabi crops (kg ha^{-1})	Yield of kharif crops (kg ha^{-1})	Coriander equivalent yield (kg ha^{-1})
Ber +Nigella+ Cowpea	25236	499	8400	5825
Ber +Anise+ Cluster bean	25227	523	5220	5319
Ber +Rai+ Black gram	25372	966	525	4831
Ber +Ajwain+ Tinda	24861	559	9500	5969
Ber +Fenugreek+ Okra	26271	1225	12600	6549
Ber + Coriander+ Green gram	25256	528	620	5027
Aonla +Nigella + Cowpea	48473	484	8200	4809
Aonla +Anise + Cluster bean	47246	514	5180	4252
Aonla +Rai + Black gram	46900	967	520	3726
Aonla + Ajwain +Tinda	47478	564	9180	4953
Aonla +Fenugreek+ Okra	48358	1220	12400	5365
Aonla + Coriander + Green gram	47410	512	610	3957
Ber	24580	-	-	4097
Aonla	48425	-	-	3228
Nigella+ Cowpea	-	600	8950	1793
Anise+ Cluster bean	-	831	5460	1393
Rai + Black gram	-	1980	630	996
Ajwain +Tinda	-	800	9700	2093
Fenugreek + Okra	-	1250	11800	2073
Coriander + Green gram	-	832	760	1187
SEm±	1313.72	34.32	307.03	157.75
CD (p=0.05)	3818.94	98.65	882.42	451.63
CV (%)	6.23	7.20	8.68	7.06

Table 2. Effect of seed spice based inter cropping with fruit trees on net return and benefit fruits Cost of cultivation and BCR

Treatments	Cost of cultivation (`)	Gross returns (`)	Net returns (`)	BCR
Ber + Nigella+ Cowpea	168300	873750	705450	4.19
Ber + Anise+ Cluster bean	159432	797835	638403	4.00
Ber + Rai+ Black gram	151800	724600	572800	3.77
Ber +Ajwain+ Tinda	173300	895375	722075	4.17
Ber +Fenugreek+ Okra	173060	982275	809215	4.68
Ber + coriander+ Green gram	156060	754000	597940	3.83
Aonla +Nigella + Cowpea	173000	721330	548330	3.17
Aonla +Anise + Cluster bean	164132	637740	473608	2.89
Aonla +Rai + Black gram	156500	558950	402450	2.57
Aonla + Ajwain +Tinda	178000	742980	564980	3.17
Aonla +Fenugreek + Okra	177760	804780	627020	3.53
Aonla +Coriander + Green gram	160760	593600	432840	2.69
Ber	110300	614500	504200	4.57
Aonla	115000	484250	369250	3.21
Nigella+ Cowpea	58000	269000	211000	3.64
Anise+ Cluster bean	49132	208920	159788	3.25
Rai + Black gram	41500	149400	107900	2.60
Ajwain +Tinda	63000	314000	251000	3.98
Fenugreek + Okra	62760	311000	248240	3.96
Coriander + Green gram	45760	178000	132240	2.89
SEm±	-	23669.00	18729.24	0.06
CD (P=0.05)	-	67762.59	53620.43	0.18
CV (%)	-	7.06	7.15	7.52

cropping sequence was 1225 kg ha^{-1} and 1220 kg ha^{-1} with ber and with aonla intercropping system, respectively. All the seed spices resulted the lowest grain yield when grown in association with aonla. The highest yield of seed spices crops when grown in open space might be due to no competition for reacquired input. Besides, in open space, higher grain yield of anise, fenugreek, coriander and nigella was recorded with ber which might be due to availability of favorable - conditions compared to aonla but higher grain yield of ajwain and rai in association with aonla was recorded owing to less competition of rai and ajwain with aonla. The results are in conformity with the facts and observation reported by Anwer *et al.,* (2011) and Hiwale, *et al.,* (2007).

System productivity

Coriander equivalent yield was significantly influenced with different inter-cropping systems and cropping sequences. All the cropping sequences exhibited higher coriander equivalent yield when grown as an intercrops with ber, followed by with aonla. In open space, coriander equivalent yield of all the cropping sequences was or the least less. The higher coriander equivalent yield with ber and aonla was due to additional yield of fruit trees which fetches good revenue. Further, higher coriander equivalent yield of all the cropping sequence with ber was on account of higher fruit yield and better selling price as compared to aonla. The highest coriander equivalent of 6549 kg ha^{-1} exhibited by fenugreek-okra cropping sequence

intercropped with ber followed by nigella-cowpea cropping sequence (5825 kg ha^{-1}) intercropped with ber. The highest coriander equivalent yield of fenugreek- okra with ber might be due to favourable micro agro-climatic conditions available with ber which resulted higher grain production of fenugreek. Further, fenugreek being leguminous crop helps in enhancement in soil fertility resulting higher production of okra vegetable and ber fruits. The results follow the trends reported by Malézieux, *et al.,* (2009), Singh and Solanki (2015).

Economic analysis of cropping system

The economic analysis of different cropping systems were revealed that, gross return, net return and benefit cost ratio (BCR) were influenced with different cropping system as well as cropping sequences. All the cropping sequences showed higher economic return when intercropped with ber followed by with aonla. (Table 2) Higher return of all cropping sequences with ber is due to heavy ber fruiting and good market prices. In aonla, fruit production was appropriate but prices were comparatively low. Among all the cropping sequences, fenugreek-okra sequence was superior with both ber as well as aonla and highest gross return (982275), net return (809215) and BCR (4.68) were recorded in fenugreek-okra cropping sequence with ber followed by nigella-cowpea cropping sequence with ber were gross return and net return were Rs.873750/ha and Rs 705450/- ha., respectively.

Thus, it can be inferred that intercropping of fenugreek-okra cropping sequence with ber found better for realizing higher system productivity, net return and BCR.

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