 ISSN: 2581-3749 (online)

Efficient and Economical Agricultural Intercrops Growing under Cashew-based Agroforestry System under Rainfed Condition in Konkan Region of Maharashtra

V. V. Dalvi[1], N.A. Meshram[1]*, A. S. Shigwan[1] and A. D. Rane[2]

[1]AICRP on Agroforestry, DBSKKV, Dapoli, Maharashtra, 415712

[2]College of Forestry, DBSKKV, Dapoli, Maharashtra, 415712

Abstract

An experimental study was conducted during 2010 to 2016 at Research Farm of All India Coordinated Research Project on Agroforestry, DBSKKV, Dapoli on "Efficient and economical agricultural intercrops growing under cashew based agroforestry system under rainfed condition in Konkan region of Maharashtra". Cashew based horti-agricultural agroforestry system consisting of Anacardium occidentale L. as sole tree species planted at 8 x 8 m spacing with four agricultural crops viz. *Eleucine coracana*, *Panicum miliaceum*, *Guizotia abussinica* and *Vigna mugna*. The 6 years data indicated that the maximum yield was achieved by *Anacardium occidentale* with Prosso millet followed by *Mangifera indca* with *Fingermillet*. However in case of economically beneficial with B:C ratio *Anacardium occidentale* with black gram observed highest benefit cost ratio. Black gram performed better during juvenile phase of cashew cultivation and proved its superiority than other intercrops in terms of yield and higher monetary returns with cashew in combination, therefore *Anacardium occidentale* + *Vigna mugna* based horti-agricultural agroforestry system may be preferred as more beneficial and help in generation of additional income during juvenile phase of Cashew under rainfed condition in Konkan region of Maharashtra.

Keywords: Horti-agricultural system, Yield, Economics, Cashew, Black gram.

Introduction

Konkan is a resource-rich region of Maharashtra state. Its five districts stretch 720 km along the Arabian Sea and on its other flank are the hills of the Sahyadri range. This strip of mostly hilly land, which at its broadest point is not more than 100 km wide, receives an average of more than 3500 mm of monsoon rain. Indeed the region gets more than enough rainfall but has no perennial water source. In Konkan region most of the farmers are interested in planting more fruit trees on their farms; cash generation is a major reason for their interest. Cashew is a cash crop in konkan region of Maharashtra and widely farmers are adopting prominent traditional Cashew based agroforestry system. Cashew is generally a spreading type of tree crop and requires lot of space for its canopy spread. When the planting is recommended at a spacing of 8 x 8 m, the plants take minimum 6-7 years to cover the entire allotted space in the initial years such space can be made use of for planting suitable intercrops which would help in generation of additional income, conservation of soil and moisture and utilization of space and other natural resources more effectively and ultimately helps in doubling farmers income in the juvenile stage of orchard life. The prime aim of raising any tree crop under field condition is generally to make profit on capital investment (Rawat 1989). The overall goal of raising tree crops along with agricultural crops in farm lands is to increase production, to generate a sustained agricultural product base, to reduce environmental damage, and to raise the standard of living of the farmer (Betters 1988). Economic analysis helps a farmer to make decisions about allocation of scarce resources in a rational way in order to meet the targeted objectives. Intercropping trees crops during the establishment phase with food crops is an age-long practice in the tropics (Dalvi *et al*. 2019). The benefits of such a practice may include food security for household, income generation to partially offset the cost of establishment, weed control and better use of growth resources (Rodrigo *et al*. 2001; Opoku Ameyaw *et al*. 2003).

Materials and Methods

A field experiment was conducted during 2010 to 2016 at the Research Farm of All India Coordinated Research Project (AICRP) on Agroforestry, Dr. Balasaheb Sawant

***Correspondence**: nandkishor.meshram@rediffmail.com
Received Date: 4.7.2019 ;Accepted Date:3.11.2019.

Konkan Krishi Vidyapeeth, Dapoli, Maharashtra and to study the "Efficient and economical agricultural intercrops growing under cashew based agroforestry system under rainfed condition in Konkan region of Maharashtra" in red lateritic soil. Depending on soil and climatic conditions and local situations agricultural crops like Finger millet (*Eleucine coracana*), Proso millet (*Panicum miliaceum*), Niger (*Guizotia abyssinica*) and Black gram (*Vigna mungo*), may be suitable under rainfed condition in Konkan region were selected for intercropping. The experiment consist of Cashew (*Anacardium occidentale* L.) at spacing of 8 x 8 m and four agricultural crops Finger millet (*Eleucine coracana*), Proso millet (*Panicum miliaceum* L.), Niger (*Guizotia abyssinica*) and Black gram (*Vigna mungo*). Finger millet and proso millet were sown on raise bed in last week of May and transplanted in main orchard in 1st week of July with a spacing of 15 x 20 cm and Niger and Black gram was sown in 2nd week of June with a spacing of 15 x 45 cm. The experiment was laid out in Randomized Block Design (RBD) with four replications and five treatments. Land preparation was started with one summer ploughing in the month of May, followed by two ploughing and laddering. The experimental plot was led out in to small plots of size 21 x 21 m for different treatments. At the time of final land preparation well decomposed Farm Yard Manure (FYM) 10 Mg ha^{-1} and fertilizers doses for particular crops was given as per the university recommendations. The yield of intercrops were recorded and analyzed as per the procedure described for RBD (Panse and Sukhatme, 1985). Standard error of means i.e. SE m (±) and Critical difference (CD) were calculated at 5 % coefficient variance level of significance and compared the treatments means, wherever 'F' test was found significant.

Results and Discussion

The average life span of cashew was found to be 25 to 30 years. It gives economic returns from the fifth year of planting stabilized at the seventh year and produces economic yield up to the 20th year and then declining the start significantly under the experiment. Therefore the study during juvenile period of cashew plantation was selected.

The six years pooled average yield of 13.98 (q ha^{-1}) was noticed significantly under Cashew + Proso millet followed by yield of Cashew + Finger millet 12.41 (q ha^{-1}) which were found to be at par with each other (Table 1). In regards with yield with crop equivalent ratio, it was found that the Cashew + Black gram management practices showed the highest yields as compare to others crops management practices. Similarly, the yield of different crops under various agroforestry systems has also been reported by Dalvi *et al*. (2019) and also reported in three wheat varieties grown under populous deltoids (Singh *et al.* 1993). Moreover, *Delbergia sissoo* with sesamum and *Casuarina equisetifolia, Eucalyptus* hybrid, *D. sissoo* and *Tectona grandis* with ragi, sesamum, black gram and cowpea were noted significantly under various agroforestry systems (Naugraiya and Singh 2005).

The significantly ($p > 0.05$) recorded the economic evaluation in terms of return from various crop yields over the experiment, net returns and B: C ratio under tree crop combination ranged from Rs. 36792 to 45008 ha^{-1}. Cashew + finger millet combination generated highest gross return as compared to other combination. (Table 2). The net return of the different treatments varied from, Rs. 10050 to (-) 5803 ha^{-1}. Cashew + Black gram combination was proved to the best combination among the other combinations tried from economic return point of view which may be due to low lobour requirement for black gram and niger cultivation as compare to proso millet and finger millet. The B: C Ratio of different tree crop combination varied from 1.30 to 0.88. It was found significantly highest in

Table 1. Year wise grain yield of agricultural crops (q ha^{-1})

Treatment	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Pooled Average	Crop equivalent yield
Only cashew	-	-	-	-	-	-	-	
Finger millet	1158	1175	1107	1281	1339	1385	1241	-
Prosso millet	1909	1225	1150	1330	1389	1383	1398	1165
Niger	472	463	485	513	550	584	511	1135
Black gram	522	437	397	323	358	378	402	1340
SE±	15.8	30.66	22.9	22.9	6.9	5.00	26.78	-
CD at 5%	44.70	NS	69.3	66.4	21.50	14.00	78.00	-

Table 2. The cost and returns from agricultural crop in cashew cultivation.

Name of the crop	Economic returns from crop yield.	Net returns	Cost benefit ratio (B:C ratio)
Only cashew	-	-	-
Finger millet	45,008	(-)4188	1:0.91
Proso millet	43,146	(-)5803	1:0.88
Niger	36,792	6156	1:1.20
Black gram	43,416	10050	1:1.30

Cashew + Black gram combination (1:1.30), followed by Cashew + Niger (1:1.20), whereas lowest were recorded in Cashew + Proso millet combination (1:0.88). This may be attributed to proportionately low labour cost in black gram cultivation in comparison with the other agricultural crops. Overall the economics of black gram as an intercrop in cashew based horti-agricultural agroforestry system was appreciably more beneficial than sole cropping in juvenile phase of plantation. The higher return from agroforestry systems in comparison to sole cropping has been reported in coconut based farming system intercropped with rice, millet grain legumes, oilseed crops, root crops, banana, pineapple and chilies (Das 1991). Sunflower, pigeon pea and pearl millet raised in *Leucaena leucocephala* (Ramshe *et al*. 1994), sorghum, ground nut and grass grown were observed under teak and subabhul based agroforestry systems (Mutanal *et al*. 2006). Moreover, the higher returns of arable crops like, maize, paddy, fodder maize and sunhemp were observed with horticultural crop like sapota and silvicultural agroforestry systems and also observed in *E. terelicrnis*, *Albizia molucana*, *C. equisetifolia, T. grandis* and *D. sissoo* (Patil *et al.* 2010). Coconut and guava based multistoried agroforestry system with medicinal crop like *Aloe indica*, *Asparagus racemosus* and *Kaempferia angustifolia* were noticed maximum return and mores sustainable for long time (Bari and Rahim, 2012).

Conclusion

It can be concluded that the cashew based black gram agroforestry system performed better during juvenile phase of cashew cultivation and its proved superiority over the all other intercrops management practices in terms of yield, higher monetary returns and more economical with cashew in combination, therefore the *Anacardium occidentale* (Cashew) + *Vigna mungo* (balk gram) based horti-agricultural agroforestry system may be suitable and more beneficial for the farmers and also this recommended management practices may be helpful for getting continuous benefit for long time from rainfed condition in Konkan region of Maharashtra.

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