



Intercropping in sugarcane a profitable venture among farmers & yield gaps

Kedar Nath Rai, Trilok Nath Rai, Traloki Singh, Anjali Sahu, Sanjeev Kumar Rai
Krishi Vigyan Kendra (ICAR-CSSRI-RRS) Hardoi-II & K.N.I.T, Sultanpur, Uttar Pradesh, India

Abstract

Population density is rising rapidly and supply food to such a growing population is a big challenge for farming community resultantly agriculture people should optimize the use of resource especially soil. Krishi Vigyan Kendra is working for the transfer of technologies like inter cropping for the optimum use of soil and other resources. A survey was conducted with the objective to assess the adoption of intercropping by the farmers. The total 150 Farmers from 5 villages namely Padri piperpati from block Bishunpura, Piperaghat from block Seorahi, Purena Katiya from block Tamkuhi Raj, Premwalia from block Kasia and Manjharua from block Dudahi was interviewed. The result revealed that in one year cropping pattern 37.99% farmers were doing intercropping in main (base) crops of Sugarcane, Banana and Bitter gourd. The oilseed crop toria, pulse crop green gram, vegetable crop cauliflower, coriander and spice crop turmeric were the selected intercrops. It was observed that by adoption of intercropping the yield / ha can be increased from 2.25% to 52.92 % and net return can be increased from 16.67% to 93.59 %. Therefore, it may be concluded that in the one year cropping pattern inclusion of one intercrop can increase the substantial profit of farmer's and availability of food and nutritional security.

Keywords: Cropping pattern, intercropping, soil, sugarcane, banana and bitter gourd

Introduction

Ensuring global food security with changing environment and shrinking natural resource are the major challenges in the present era (Hussain *et al.*, 2015) [4]. Population density has increased over the last few decades, and supply food to such a growing population is a challenge all over the world, and resultantly farming community should optimize the use of resources mainly soil, and the soil management is important for healthy food production (Keesstra *et al.*, 2016a). [5] Efficient use of natural resources in the face of high population density is important and consequently food insecurity is overwhelming for specially developing countries (Araya *et al.*, 2010; Musinguzi *et al.*, 2015; Nyssen *et al.*, 2015; Tsozue *et al.*, 2015). [2, 8, 11] The population pressure on land and water resources has led to the excessive exploitation of natural resources and increased soil losses (Novara *et al.*, 2015; Keesstra *et al.*, 2014). [10, 6] In order to reduce the soil degradation and enhance the ecosystem sustainability, various strategies such as use of cover and buffer strips (Mutch and Martin 1998; Adimasu *et al.*, 2014) [9] and mulching (Cerda *et al.*, 2016; Prosedocimi *et al.*, 2016) are reported elsewhere. Intercropping is one of the most adoptable practice which refers to growing two or more crops simultaneously on the same piece of land with a definite row-planting pattern to obtain higher yield per unit area. Considering the profitability of the intercropping, Krishi Vigyan Kendra planned a survey with the following objectives:

Objective

- to assess the selected base crop grown by respondents in one year cropping pattern

- to assess the selected intercrops and extent of adoption of intercrop
- to assess the impact of intercrop on yield/unit area
- to assess the impact on net return & household income

Methodology

Krishi Vigyan Kendra (ICAR-IIVR), Kushinagar conducted various training programmes, on farm trials, demonstrations and extension activities to aware farming community about inter cropping and after that the farmers of five villages namely Padri piperpati from block Bishunpura, Piperaghat from block Seorahi, Purena Katiya from block Tamkuhi Raj, Premwalia from block Kasia and Manjharua from block Dudahi were interviewed during training programmes and through group discussion and individual contact. From each village thirty farmers were selected for data collection in the year 2017-2018. The data on selected base crops, selected intercrops, yield of intercrop yield of main crop, cost of cultivation and net return were collected and statistically analyzed.

Result & discussion

Crop grown in one year cropping pattern; Data on Distribution of farmers according to crop grown in one year cropping pattern (Table-1) showed that Sugarcane, Banana and Bitter gourd were the selected base crops and Toria, Green gram, Coriander, Cauliflower and Turmeric were the selected inter crops. It is clear that maximum number of farmers i.e. 35.33% grew sugarcane as a sole crop in one year cropping pattern while the minimum number of farmer's i.e. 03.33% were growing the Banana+Coriander in one year cropping pattern. The results are in agreement with the findings given by Sundara (2011). [14]

Table 1: Distribution of farmers according to crop grown in one year cropping pattern

S. No	Crops grown	Frequency	Percentage
1.	Sugarcane as a sole crop	53	35.33
2.	Sugarcane+ Toria	21	14.00
3.	Sugarcane+ Green gram	12	08.00
4.	Banana as a sole crop	19	12.67
5.	Banana+Coriander	05	03.33
6.	Banana+Cauliflower	09	06.00
7.	Bitter gourd-Sponge gourd-Pea	21	14.00
8.	Bitter gourd+ Coriander-Sponge gourd-Pea	06	04.00
9.	Bittergourd+Turmeric-Radish-Spinach	04	02.67
	Total	150	100.00

Block wise adoption of inter cropping; Data on Distribution of farmer's according to adoption of inter cropping given in table-2 revealed that highest percentage of adoption of intercropping was found among farmer's of village Padripiperpati of block Bishunpura i.e.,63.33 % of respondents were doing intercropping in the main crops of sugarcane and banana and the lowest percentage of adoption of intercropping was found among farmer's of village Manjharhia of block Dudahi i.e.,16.67 % of respondents were

doing intercropping in the main crops of sugarcane, banana and bitter gourd. The average 37.99% adoption of inter cropping was found among all the five selected villages as 57 farmer's out of 150 farmers were doing intercropping of one crop in one year cropping pattern. In the ranking of adoption of intercropping the farmers of block Bishunpura ranked 1st in adoption and the farmers of block Dudahi ranked 5th in adoption of intercropping.

Table 2: Block wise distribution of farmer's according to adoption of inter cropping

S. No.	Name of Block	Name of Village	Frequency of Farmer's doing intercropping	Percentage of Farmer's doing intercropping	Ranking
1.	Bishunpura	Padri Piperpati	19	63.33	I
2.	Kasia	Premwalia	14	30.00	IV
3.	Tamkuhi Raj	Purena Katia	10	33.33	III
4.	Seorahi	Piperaghat	09	46.66	II
5.	Dudahi	Manjharhia	05	16.67	V
		Total	57	37.99	

Impact of intercrop on yield/unit area; Data presented in table-3 revealed that by inclusion of one inter crop in one year cropping pattern increased at least 2.25% yield/unit area and it reached to maximum increase of 52.29 % yield/unit area. On an average 14.04 % increase in yield may be

obtained per hectare. The average yield of sole crop was found 491.67 q/ha whereas by adoption of one inter crop increased the yield/ha from 491.67q/ha to 547.65 q/ha. Similar results were reported by Rasool *et al.*,(2011).

Table 3: Yield per hectare in one cropping pattern and percent increase due to intercropping

S. No	Crops grown	Yield(q/ha)	% increase in yield or yield gap per cent
1.	Sugarcane as a sole crop	695.00	-
2.	Sugarcane+ Toria	710.65	02.25
3.	Sugarcane+ Green gram	747.22	07.51
4.	Banana as a sole crop	438.00	-
5.	Banana+Coriander	457.00	04.34
6.	Banana+Cauliflower (Kharif)	478.00	09.13
7.	Bitter gourd-Sponge gourd-Pea	342.00	-
8.	Bitter gourd+ Coriander-Sponge gourd-Pea	370.00	08.19
9.	Bittergourd+Turmeric-Radish-Spinach	523.00	52.92
10.	Mean yield of Base Crop	491.67	-
11.	Mean yield of Inter crop	547.65	14.04

Impact on net return & household income: Data on economics of Crops grown in one year cropping pattern given in table-4 showed that by cultivation of Banana+Cauliflower (Kharif) the highest increase i.e.,93.59% in household income was obtained whereas by cultivation of Sugarcane+ Toria the lowest increase i.e.,

16.67% in household income was earned. The average increase of 47.55% in household income was observed with intercropping in comparison to sole crops. Although, respondents reported that the net return was much influenced by the market rate and the market demand.

Table 4: Economics of Crops grown in one year cropping pattern

S. No	Crops grown	Gross Cost	Gross Return	Net Return	B:C Ratio	% increase in income or gap analysis
1.	Sugarcane as a sole crop	98300	226119	127540	2.3:1	-
2.	Sugarcane+ Toria	106340	259284	152944	2.43:1	16.67
3.	Sugarcane+ Green gram	108285	274932	166647	2.54:1	23.46
4.	Banana as a sole crop	180500	416100	235600	2.31:1	-
5.	Banana+Coriander	210450	543500	333050	2.58:1	41.36
6.	Banana+Cauliflower (Kharif)	229800	685900	456100	2.98:1	93.59
7.	Bitter gourd-Sponge gourd-Pea	149250	391150	241900	2.62:1	-
8.	Bitter gourd+ Coriander-Sponge gourd-Pea	169300	519300	350000	3.06:1	44.69
9.	Bittergourd+Turmeric-Radish-Spinach	169480	569900	400420	3.36:1	65.53
	Mean of economics of main crop	142683.33	344456.33	201680	2.41:1	-
	Mean of economics of main crop with inter crops	165609.2	475469.3	309860.2	2.83:1	47.55

Photograph of Intercropping in Sugarcane





Conclusion

Inter cropping is a complex suite of new resource-efficient technologies, which possess the capability to improve soil, air, and water quality; increase net return and land equivalent ratio; and control weeds and pest infestation. Inter cropping compensates the yield loss of main crops by providing additional income from inter crops. Furthermore, inter cropping maintains a natural ecosystem via crop diversification. There is also evidence for higher crop yields with inter cropping by the inclusion of legumes. However, more research is inevitable to further improve its adoption especially regarding the interaction of its key components with local soil and climate conditions. On farm-research level, development and demonstration of the production potential of this system is required, including economic analysis and farm budgeting at regional and global levels. For an inter crop combination to be biologically advantageous, agro techniques such as fertilizer application, seed rate of intercrop and base crop, and selection of suitable genotypes must be taken care of to reduce the depressing effect of inter crops on sugarcane and to increase the productivity and profitability of the inter cropping system.

References

1. Adimassu Z, Mekonnen K, Yirga C, Kessler A. Effect of soil bundson runoff, soil and nutrient losses, and crop yield in the central highlands of Ethiopia. *Land Degrad Dev*,2014;25:554-564. doi:10.1002 /ldr.2182
2. Araya A, Keesstra SD, Stroosnijder L. Simulating yield responseto water of Teff (Eragrostis tef) with FAO's AquaCrop model. *FieldCrop Res*,2010;116(1-2):196-204. doi:10.1016/j.fcr.2009.12.010
3. Cerdà A, González-Pelayo O, Giménez-Morera A, Jordán A, Pereira P, Novara A, *et al*. The use of barley straw residues to avoid high erosion and runoff rates on persimmon plantations in eastern Spain under low frequency–high magnitude simulated rainfall events. *Soil Res*,2016;54(2):154-165. doi:10.1071/SR15092
4. Hussain S, Peng S, Fahad S, Khaliq A, Huang J, Cui K, *et al*. Ricemanagement interventions to mitigate greenhouse gas emissions: areview. *Environ Sci Pollut Res*,2015;22:3342-3360.
5. Keesstra S, Pereira P, Novara A, Brevik EC, Azorin-Molina C, Parras-Alcántara L, *et al*. Effects of soil managementtechniques on soil erosion in apricot orchards. *Sci Total Environ*,2016a;551-552:357-366. doi:10.16/j.scitotenv.2016.01.182
6. Keesstra SD, Maroulis J, Argaman E, Voogt A, Wittenberg L. Effects of controlled fire on hydrology and erosion under simulatedrainfall. *Cuadernos de Investigación Geográfica*,2014;40:269-293. doi:10.18172/cig.2532
7. Keesstra SD, Bouma J, Wallinga J, Tiftonell P, Smith P, Cerdà A, *et al*. The significance of soils and soil science towards realization of theUnited Nations sustainable development goals. *Soil*,2015;2:111-128. doi:10.5194/soil-2-111-2016
8. Musinguzi P, Ebanyat P, Tenywa JS, Basamba TA, TenywaMM, Mubiru D. Precision of farmer-based fertility ratings and soil organic carbon for crop production on a Ferralsol. *Solid Earth*,2015a;6:1063-1073. doi:10.5194/se-6-1063-2015
9. Mutch DR, Martin TE. Covercrops. In: Cavigelli MA *et al* (eds) *Michigan field crop ecology: managing biological processes for productivity and environmental quality*. Bull, E-2646 Michigan State Univ, Ext., East Lansing, MI, 1998.
10. Novara A, Rühl J, La Mantia T, Gristina L, La Bella S, Tuttolomondo T. Litter contribution to soil organic carbon in the processes of agriculture abandon. *Solid Earth*,2015;6(2):425.
11. Nyssen J, Frankl A, Zenebe A, Poesen J, Deckers J. Environmental conservation for food production and sustainable livelihood in tropical Africa. *Land Degrad Dev*,2015;26(7):629-631. doi:10.1002/ldr. 2379
12. Prosdocimi M, Jordán A, Tarolli P, Keesstra S, Novara A, Cerdà A. The immediate effectiveness of barley straw mulch in reducing soil erodibility and surface runoff generation in Mediterranean vineyards (2016). *Sci Total Environ*,2016;547:323-330. doi:10.1016/j.scitotenv.2015.12.076
13. Rasool AM, Farooq A, Zubair M, Jamil M, ahmad S, Afghan S. Prospects of intercropping rabi crops in autumn planted sugarcane. *Pakistan Sug J*,2011;26(2):2-5.
14. Sundara B. Agrotechnologies to enhance sugarcane productivity in India.*Sugar Tech*,2011;13(4):281-298.
15. Tsozué D, Nghonda JP, Mekem DL. Impact of land management system on crop yields and soil fertility in Cameroon. *Solid Earth*,2015;6(3):1087-1101. doi:10.5194/se-6-1087-2015