

Sustainable Productivity and Profitability through Maize-based Cropping System in Hilly Areas of Manipur

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ABSTRACT

The field experiment was conducted for two consecutive years during 2018-19 and 2019-20 at three different locations of the farmers' field in Chandel district of NEH Region, Manipur to compare the different maize-based cropping systems. From the two years data, it was observed that the highest maize yield was recorded from the sole crop 50.65 q/ha and 51.20 q/ha during 2018-19 and 2019-20 respectively, due to its higher plant population. The equivalent yield of maize 52.16 q/ha and 54.90 q/ha was recorded to be higher in maize + groundnut intercropping system during 2018-19 and 2019-20 as compared to maize + rice bean intercropping system. Though, intercropping with other crops reduced the grain yield of maize but intercropping increased the maize equivalent yield than sole maize. The gross return was highest in maize + groundnut intercropping system with Rs. 152510/ha and Rs.160700/ha with the net profit of Rs. 104141/ha and Rs. 110550/ha during 2018-19 and 2019-20 respectively. The benefit cost ratio was also found to be highest in maize + groundnut intercropping system during the years of experimentations. From this result, it can be concluded that maize + groundnut intercropping will be more beneficial and a viable practiced to achieve the goal of higher sustainable productivity and profitability in attaining doubling of farmers' income.

Keywords: *Maize based cropping System, productivity, profitability.*

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INTRODUCTION

Maize is the second cereal crop grown in Manipur next to rice crop. Maize is grown in all the hill and valley districts of Manipur. The area under the crop was higher in hill region than in valley region with total area of 6.20 thousand ha and 19.99 thousand ha in valley and hill region, respectively (GoM, 2016). The farmers grow maize because the choice of alternative open to a farmer is extremely limited not only by his resource base but also is wary of gambling with the weather. The main cropping pattern of Chandel district, Manipur is rice and maize based intercropping systems which proved advantageous because of difference in their crop growth and nutritional requirement. A cropping system refers to the type and sequence of crops grown and practices used for growing them. It encompasses all cropping sequences practiced over space and time based on the available technologies of crop production. Owing to high population pressure and less chance of increase in cultivated land, intercropping seems to be one of the options to increase food grain production and intensify land use as well as to meet the diversified need of farming communities from limited area. Intercropping offers to farmers the opportunity to engage nature's principles of diversity at their farm (Ghosh, 2004). In an intercropping, there is normally one main crop and one or more added crops, with the main crop being of primary importance for economic or food production reasons. This practice is an attractive strategy to small holder farmers for increasing productivity and land labour utilization per unit area of available land through intensification of land use (Seran and Brintha, 2010). Hence, suitable intercrop and

spatial arrangement of main crop and intercrop should be considered when planning legume intercropping. In view of this, the present study was undertaken to find out the most compatible crop for maize intercropping system.

MATERIALS AND METHODS

Over the period of 2018-19 and 2019-20, an experiment of two years duration was carried out at three locations of the farmers' field of Chandel district to study the sustainable productivity and profitability through maize-based cropping system in hilly areas of Chandel district. In general, soils of the area under study were clay loam and medium to low in fertility status. The treatments comprised of three maize based cropping viz. maize (HQPM-5) sole crop, maize (HQPM-5) + groundnut (ICGS-76) and maize (HQPM-5) + ricebean (Local). The crops were sown during *kharif* season i.e. first week of May to first week of June. The main and intercrops were grown with their full agronomic practices. One third of N (40 kg/ha) and full P₂O₅ (60 kg/ha) and K₂O (40 kg/ha) were applied as basal. Remaining N (80 kg/ha) was top dressed in two equal splits, first at knee high and second at tasseling stage with care of urea application in pair rows of maize to avoid N fertilization in legume intercrops. Sources of nitrogen, phosphorus and potassium were urea, SSP and MOP respectively. For comparison between treatments, the yields of the intercrops were converted to maize equivalent yield (MEY) on local price basis. The MEY of the systems were calculated using the following formula:

$$MEY = \sum Y_i \times P_i / P$$

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Table 1: Performance of maize under different cropping system

Treatments	Plant height (cm)		No. of cobs/plant		Cob length (cm)		Grain weight/cobs (g)		Maize grain yield (q/ha)	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Maize (sole)	146.50	147.40	2	2	16.10	16.45	130	131.30	50.65	51.20
Maize + groundnut	145.20	146.75	2	2	15.12	17.25	127.40	133.10	24.10	25.45
Maize + Rice bean	145.40	147.20	2	2	15.50	18.10	128.50	134.55	24.85	26.60

Table 2: Performance of groundnut and rice bean under different cropping system

Treatments	Plant height (cm)		No. of pods/plant		No. of seeds/pod		Pod length (cm)	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Maize (sole)	-	-	-	-	-	-	-	-
Maize + groundnut	45	45.50	50	51.00	3	4	3.5	3.80
Maize + Ricebean	51.20	50	42	40	6	6	13	12.5

Where, Y

- i = yield of different crops;
- Pi = price of respective crops and P
- (p) = price of maize.

RESULTS AND DISCUSSION

Yield and yield attributes

The yield attributes (Table 1 and Table 2) like number of cobs, cob length and grain weight of maize differed owing to different intercrop combinations. The performance of sole maize was higher during the first year (2018-2019), but during the consecutive year of the field trial, it was observed that maize under intercrops performs better on all the tested yield attributes, It might be due to legume interaction with maize crop. Differences in yield of maize crop (Table 3) between sole crop and intercrop were mainly due to higher plant

population of maize. Intercrops influenced maize grain yield differently. Maximum grain yield of maize was recorded in maize + ricebean intercrop with 24.85 q/ha and 26.60 q/ha during 2018-19 and 2019-20 respectively which was higher than maize + groundnut intercrop in both the years of experimentations. All the intercropping combinations have lower grain yield than sole cropping. Similar results were also reported by [Bhatnagar et al. \(2012\)](#).

Maize equivalent yield and economics

The maximum maize equivalent yield (Table 3) of 52.16 q/ha and 54.90 q/ha was recorded in maize + groundnut intercrop during 2018-19 and 2019-20 respectively than other cropping systems which might be due to higher symbiotic effect of groundnut on maize.

Table 4 indicated that different maize intercropping systems influenced the economics of the systems. Among the

Table 3: Performance of groundnut and rice bean under different cropping system

Treatments	Grain yield (q/ha)				Equivalent yield of maize (q/ha)	
	Maize		Intercrop		Maize	Intercrop
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Maize (sole)	50.65	51.80	-	-	50.65	51.80
Maize + groundnut	24.10	25.45	11.59	12.20	52.16	54.90
Maize + Ricebean	24.85	26.60	6.50	7.45	29.25	33.53

Table 4: Economics of maize based intercropping systems

Treatments	Cost of cultivation (Rs/ha)		Gross return (Rs./ha)		Net return (Rs./ha)		B:C ratio	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Maize (sole)	37500	38150	101300	103600	63800	65450	2.70	2.72
Maize + groundnut	48369	50150	152510	160700	104141	110550	3.15	3.20
Maize + Ricebean	43270	44750	108200	120250	64930	75500	2.50	2.69

intercropping system maize + groundnut intercrop has the highest gross income. The net income of maize + groundnut intercrop was Rs.104141 and Rs.110550 during 2018-19 and 2019-20 respectively. The highest benefit: cost ratio of 3.15 and 3.20 was also recorded in maize + groundnut intercrop was Rs.104141 and Rs.110550 during 2018-19 and 2019-20 respectively which might be due to higher production and comparatively lesser production cost. Similar results were also reported by Sun *et al.* (2021) and Uddin *et al.* (2003).

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CONCLUSION

From the two years study, it can be realized that the sole maize cropping system can be improved by intercropping with legumes. It has the advantages of both soil fertility and crop yields also diversification of the existing cropping system will enhance the productivity and economic point of view. Therefore, it can be concluded that maize + groundnut intercropping may be a viable and remunerative intercrop in maize based intercropping systems in hilly regions of Chandel district of NEH Region, Manipur.

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