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Production potential and economic feasibility of citronella based intercropping with Kharif maize and Bajra at different doses of fertilizer in central plain Zone of U.P. (India)

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Abstract
It would be justified to accept that inter cropping system will attract increasing attention to overcome ecological constraints. Intercropping is an excellent technique to increase total yield, higher monitory return, greater resource utilization, risk management and to fulfil the diversified need of the farmers. The different farmers thus have more or less land, money and access to information and technologies. In short, it is the money or financial conditions that allow the farmers to take up different farming practices and agricultural technologies. There is a correlation between higher inputs and yield. Thus, the farmer's purchasing capacity for inputs decides cropping system and production practices. Therefore, production practices can be at different levels. The experiment was laid out in randomize block design with 09 treatment of cropping systems with different combination [sole citronella, sole maize, sole bajra, citronella + Maize (100% RDF), citronella + Maize (75% RDF), citronella + Maize (50% RDF), citronella + bajra (100% RDF), citronella + bajra (75% RDF), citronella + bajra (50% RDF)], were replicated four time. Sole treatments with 100%RDF treated as control. Cultivation of citronella sole crop was superior over sole maize and sole bajra cropping system. In intercropping system the highest citronella equivalent oil yield was found in citronella + maize 100% RDF followed by 75% and 50% RDF system, respectively. The highest net return was found in citronella + maize 100% RDF and B:C ratio highest is sole citronella 3.79 followed by C+M with 50% RDF intercrop system with B:C ratio 3.75.

Keywords: production potential, economic feasibility, kharif maize, bajra and fertilizer

Introduction
Indian agriculture has long been described as a "Gamble in the monsoon". Besides the daunting taste of increasing agriculture growth three major issues *i.e.*, (a) Persistence to poverty and nutritional insecurity, (b) Continues pressure and deterioration of natural resources and (c) Globalization and its impact on farm sector, may cell for strength having public-private research consortium development of future global agricultural scenario. In the present situation, to fulfil the increasing demand of agricultural production through extensive agriculture has limited scope due to limited availability of cultivable area. An area of 143 m ha, out of 329 m ha of geographically area is at present under cultivation and further expansion of cultivable area is extremely difficult under these circumstances, to meet the requirements of food, grains for ever increasing population, the only option left is to have vertical to horizontal harvest from the land. Citronella is a perennial grass and is propagated by slips. It grows well under varying soil conditions. Citronella oil is a raw material for production of geraniol, citronellal, Hydroxyl citronella and other similarly high value perfumery bases which are in great demand in India. Citronella essential oil (CEO) has been reported as an excellent mosquito repellent; However, mild irritancy and rapid volatility limit its topical application. It was aimed to develop a non-irritant, stable, and consistent cream of CEO with improved residence time on skin using an industrial approach. Phase inversion temperature technique was employed to prepare the cream. It was optimized and characterized based on sensorial evaluation, emulsification, and consistency in terms of softness, greasiness, stickiness, and pH (Yadav *et al* 2014) [13]. Maize is important crop in the world grown in more than 150 countries

having 600 million ha area with 600 million ton of production. The major maize producing countries are USA, China, Brazil, Mexico, France and India. USA has the largest area and production in the world. Italy having highest productivity in the world 9600 kg ha^{-1} followed by France with 8800 kg ha $^{-1}$. India stand is 5th position after USA China, Brazil and Mexico in area but with regards to production its rank eleventh.

Bajra is commonly known as Pearlmillet in English and Bajra in Hindi. Bajra one of the major coarse grain crop and is considered is to be a poor men's food. Bajra is the most important and probably has the greatest potential of all millets. It is a quick growing rainy season cereal with large stems, leaves and heads. Being tall and vigorous, with exceptional grain fodder yielding potential, Bajra is one of the most important dual-purpose crop. Bajra is grown predominantly in India and Africa. It is generally cultivated in *kharif* as coarse grain crop with rainfall from 150-600mm. It can withstand drought to a great extent, but responds well to good management and higher fertility levels (Nirwal and Upadhyaya, 1979) [8]

Materials and Method

Soil of the experimental field

The university is situated in Indo-Gangetic alluvial tract of Central Plain Zone of U.P. that is come in agro-climatic zone-V. In order to determine the physio-chemical characteristics and fertility status of experimental field, the soil samples were collected randomly from the six places of the field to the depth of 0-15 cm with the help of soil auger prior to fertilizer application. The soil samples of all the places were mixed together to form a composite sample for mechanical and chemical analysis. The soil analysis was done in the agronomy department of this university.

Climatic condition

Geographically, Kanpur is situated in subtropical region. It is situated at an elevation of 125.9 meter above mean sea level, 26^{0}20" 35" North latitude and 80^{0}18'35" East longitude. It is situated in the alluvial belt of Indo-Gangetic plain in the Central Part of Uttar Pradesh, which comes into Agro-climatic zone-V. Normally the climate of the area is semiarid with hot dry summer and moderate to severe cold during winter. The average annual rainfall of the area varies from 800 to 900 mm with a mean annual precipitation of about 818 mm, mainly through monsoon rains confined within June to last week of September with occasional frost and shower in winter season from North-East monsoon during December and January.

The weather conditions prevailed during the course of investigation in respect of temperature (Maximum and Minimum), rainfall, wind speed, relative humidity and evaporation rate were recorded average week (meteorological weeks) basis during the course period from the meteorological observatory which is located at Student Instructional Farm (S.I.F.) of C.S. Azad University of Agriculture and Technology, Kanpur (U.P.) India. The trend of the weather condition is summarized in below Table.

It is clear from the table that during the experiment period the maximum and minimum temperature varied from 37 ^{0}C to 33.7 ^{0}C and 24.9 ^{0}C to 17.8 ^{0}C, respectively. Humidity 88 to 50% and total rainfall 13.2 to 00 mm during the crop season.

Studies on weed flora: To study the effect of different treatment on weeds population. The treatment wise weed populations were recorded and compared with the weed population of intercrop treatment.

Harvesting and Distillation of Citronella herbs

The number of harvests, which can be taken during a year, depends upon the growth of the plants. The leaves are ready for harvest about 5- 6 months after planting, and are cut with the help of sickle at 20 cm above the ground level. The second and subsequent harvests can be taken thereafter at 2.5-3.0 months interval during the experiment period one harvesting was done. Distillation was done by the process of steam distillation. The distillation equipment consists of a boiler in which steam is produced, a distillation tub for distilling the grass, a condenser and separators.

Biological yield: The weight of fully dried plants including cobs/panicle weight of each treatment plots were recorded and expressed as biological yield and converted in to quintal per hectare.

Grain yield: After shelling and winnowing, Grain yield of maize and bajra was on net plot basis were recorded and finally, yield was converted in to quintal per hectare.

Harvest index: The recovery of grain in total weight of produce was considered as harvest index which was calculated in percentage and expressed as absolute figures. The harvest index (HI) of Maize and Bajra of each crop/plot was calculated by using the following formula.

$$\text{Harvest index} = \frac{\text{Grain yield (kg/ha)}}{\text{Biological yield (kg/ha)}} \times 100$$

Crop Equivalent yield (CEY): The ratio of inter cop yield (kgha^{-1}) multiply price of inter crop (Rs kg^{-1}) to price of main crop (Rs kg^{-1}). The intercrop yield is converted in to main crop yield with the help of following formula.

$$\text{Crop Equivalent yield (CEY)} = \frac{\text{Intercrop yield (kg /ha) x Price of intercrop (Rs/kg)}}{\text{Price of main crop (Rs/kg)}}$$

Land Equivalent Ratio (LER): Land equivalent ratio is the relative land area under sole crops i.e. required to produce the yield achieved in inter cropping. In the present experiment the LER was estimated by following formula/equations.

$$\text{(i) LER for Maize} = \frac{\text{Yield of citronella in inter cropping}}{\text{Yield of citronella in sole cropping}} + \frac{\text{Yield of maize in inter cropping}}{\text{Yield of maize in sole cropping}}$$

$$\text{(ii) LER for Bajra} = \frac{\text{Yield of citronella in inter cropping}}{\text{Yield of citronella in sole cropping}} + \frac{\text{Yield of bajra in inter cropping}}{\text{Yield of bajra in sole cropping}}$$

Statistical analysis
For determining the significance of difference caused by different treatments data were subject to statistical analysis and significant response of 5% level have been computed whereas necessary critical difference have been worked out for comparison of mean values for various treatments and their effects. Standard error and critical difference values were calculated by the method suggested by Fisher (1937).

Economics
Net profit in rupees was worked out on hectare basis. Common cost of cultivation as well as treatment wise cost of cultivation was worked out on the rate prevailed during 2015. The net profit was calculated by subtracting total cost of cultivation from the total returns obtained from grain, straw, and oil yield. Value as grain, straw, and oil yield was calculated on existing price. The treatment wise cost of cultivation was subtracted from the gross income to get net profit (Rs/ha).

B:C ratio: Benefit cost ratio was calculated by the following formula.

$$\text{Benefit- cost ratio} = \frac{\text{Net return}}{\text{Cost of cultivation}}$$

Result and Discussion
Response of treatment combination on soil Health
Data recorded regarding soil health, chemical analysis of soil was done treatment wise presented in below Table. It is clear from the table that soil organic matter and available nitrogen is highest in sole maize and in combination of citronella+Maize intercropping with 100%RDF and 75%RDF fertility level followed by Bajra sole and citronella+bajra intercropping with all their fertility levels i.e. 100%RDF, 75%RDF and 50%RDF, respectively the lowest organic carbon and available nitrogen was found in sole citronella treatment.

Table 1: Effect of treatment combination on soil health

Treatment	O. C. (%)	Available nutrients (kg/ha)			Soil pH	EC (dSm^{-1})
		N	P_2O_5	K_2O		
Citronella Sole	0.42	254	17.50	178	8.08	0.21
Maize Sole	0.48	259	17.75	176.5	8.27	0.21
Bajra Sole	0.46	257	17.75	177.5	8.26	0.21
C+M (100%RDF)	0.48	258.5	18.00	177	8.26	0.22
C+M (75%RDF)	0.48	258.5	18.10	178	8.21	0.21
C+M(50%RDF)	0.46	257	17.50	177.50	8.18	0.20
C+B (100%RD)	0.44	256	17.57	177.10	8.15	0.21
C+B (75%RDF)	0.46	257	17.45	176..75	8.15	0.21
C+B (50%RDF)	0.45	258	17.30	177.20	8.18	0.21

The available phosphorus (P_2O_5) was highest in Citronella: Maize intercropping system with 100% and 75%RDF fertility levels, followed by sole Maize, Bajra and citronella treatment. The lowest availability was found in citronella: Bajra intercropping system with 50%RDF fertility level. The increasing trends of organic carbon, available nitrogen and phosphorus was found in the year in comparison to previous year status.
The availability of nitrogen is depend on the proportion of organic carbon in the sole since the highest available nitrogen was also found in Maize sole treatment in the 2014-15. The available phosphorus and potash was decreased year by year. The highest phosphorus was found in C:M system with 75%RDF (18.10kg ha^{-1}) and 100%RDF (18.00kg ha^{-1}) ratio which 18.25 kg/ha. In table 4.1 the availability of potash was also decreased year by year. The highest available potash (178 kg^{-1}) was found in citronella sole and C:M 75%RDF treatment in the year 2014-15 followed by bajra sole (177.50) and C:M. 50%RDF, (177.20kgha^{-1}) . The data related to pH value, indicated the pH value of the field is lowest in citronella sole, and trends indicated that intercropping with citronella decreased the pH. The trend of E.C. was constant in most of the treatments.

Table 2: Effect of different cropping system on Citronella herb yield and citronella equivalent oil yield (L ha^{-1})

Intercropping system	Citronella herb yield (q ha^{-1})	Equivalent Oil yield (L ha^{-1})
Citronella sole	88.50 (100%)	87.50
C:M (100%RDF)	69.50 (78.53%)	68.25
C:M (75%RDF)	65.50 (74.015)	60.75
C:M (50%RDF)	59.50 (67.23%)	59.75
C:B (100%RDF)	65.75 (74.29%)	65.50
C:B (75%RDF)	61.00 (68.935%)	60.00
C:B (50%RDF)	59.50 (67.23%)	59.25
Sem	1.512	0.612
CD (*P = 0.05*)	4.494	1.819

The data pertaining to Citronella herb yield and Citronella equivalent oil yield have been given in above Table. Data on Citronella equivalent oil yield (litre ha^{-1}) as influenced by cropping systems have been summarized in above Table. The table indicated that yield reduction of citronella is from 21 to 33% with 50% reduced plan population of citronella.
Results indicate that different cropping systems were found to exhibit significantly variations in Citronella equivalent oil yield. Over all the significantly the highest Citronella equivalent oil yield was found in citronella sole system i.e. 87.50 litre ha^{-1} among the intercropping system significantly highest equivalent oil yield was found in C+M with 100%RDF followed by C+B 100%RDF. After 100%RDF, 75% RDF place second in position in both crop i.e. C+M and C+B respectively. Significantly lowest equivalent oil yield was noted in C+B50% RDF (59.25liter/ha) and

C+M50%RDF (53.75liter/ha). Sole citronella significantly recorded higher values for herbage yields than their intercropping with Maize and Bajra. This may be due to optimum spacing available for the plants. The higher growth performance in sole crop as compared to intercropping system has also been observed by Patra *et al.* (1990) [9] and Ansari *et al*. (2015) [1]. The intercrop was affected due to the presence of inter and intra-specific competition between main crop and the intercrop (Maize and Bajra) for growth resources such as nutrients, moisture and solar radiation due to change in crop geometry as compared to sole crop. The results of the present investigation are in close conformity with the findings of Sher *et al.* (2008) [10].

Table 3: Effect of different treatments of intercropping on biological yield and grain yield of Maize

Treatments	Biological yield (q ha^{-1})	Grain yield (q ha^{-1})
Maize Sole	233.95	44.02
C:M(100%RDF)	124.47	23.85
C:M (75%RDF)	121.02	20.32
C:M (50%RDF)	118.02	17.40
S.E. (m)	14.271	0.530
CD (P = 0.05)	45.656	1.697

Data recorded regarding biological yield and grain yield were recorded analyzed, presented in above table. Data represented in table showed that sole cropping of maize gave significantly highest biological yield (233.95q/ha) and grain yield (44.02q/ha), over all other treatments. Among the intercropping treatment citronella+Maize with 100% RDF gave the highest biological (124.47q/ha) and grain yield (23.85q/ha) is significantly highest intercropping to 75 and 50% RDF. The lowest biological yield (118.02q/ha) and grain yield (17.40q/ha) were recorded in citronella+Maize with 50%RDF treatments. Application of 100%, 75% and 50% RDF produced 54.18, 46.16 and 39.52% grain yield to that sole maize crop respectively, while the plant population of maize of 50% to that of its sole cropping. Sole cropping of maize gave significantly highest biological yield (233.95q/ha) and grain yield (44.02q/ha), over all other treatments. Among the intercropping treatment citronella + Maize with 100% RDF gave the highest biological (124.47q/ha) and grain yield (23.85q/ha) is significantly highest intercropping to C+M 75% and C+M 50% RDF. The lowest biological yield (118.02q/ha) and grain yield (17.40q/ha) were recorded in citronella + Maize with 50% RDF treatments. Similar results also reported by Bhagat (2002) [2], Myaka *et al.* (2006) [7] and Ansari *et al*. (2015) [1].

Table 4: Effect of different treatments on biological yield (q ha^{-1}) and grain yield (q ha^{-1}) of bajra

Treatments	Biological yield (q ha^{-1})	Grain yield (q ha^{-1})
Bajra Sole	170.10	35.50
C:B (100%RDF)	72.70	19.30
C:B (75%RDF)	69.75	17.95
C:B (50%RDF)	68.27	17.50
Sem	0.568	0.264
CD (*P = 0.05*)	1.818	0.846

Data regarding that biological yield (q ha^{-1}) and grain yield (q ha^{-1}) were recorded, analyzed and presented in above Table. The highest biological yield (170.10 q ha^{-1}) and grain yield (35.50 q ha^{-1}) was recorded in Bajra sole treatment which were significantly superior over all treatment Among the intercropping combination significantly of C+B with 100% RDF were superior over 50% RDF. Application of 100, 75 and 50% RDF produced 54.37, 50.56 and 49.30% grain yield of bajra to 100% of sole crop respectively. Difference in yield of base crop and intercrop is due to different fertilizer doses proportions and row ratio. Thus the growth behaviour of the crop performed in a similar way for development activities of plants was reflected in yield attributes and yields of Bajra. Desale, *et al* (2000) [4], Chellamuthu (2000) [3] and Velayudham *et al* (2011) [11].

Weed flora

During the course of study, the weeds found in the experimental field are listed in Table. In all, there were mostly annual weed species infesting the crop during the course of study. Out of which *Cynodon dactylon* of sedges group, *Convolvulus arvensis* of broad leaf group and *Sorghum helepnse*of grassy group, etc.

Common weeds of Citronella intercropping with Maize, and Bajra crop observed during study period

Sr. No.	Local name	Common name	Botanical name	Family	Habit
1.	Barru grass	Johnson grass	*S. helepence*	Poaceae	P
2.	Parthenium	Gajar grass	*P. hyesterophorus*	Compositae	A
3.	Motha	Purple nut sedge	*C. rotundus*	Cyperaceae	P
4.	Dudhi	Spurge garden	*E. thymifolia*	Euphorbiaceae	A
5.	Hiranhkuri	Morning glory	*C. arvensis*	Convolvulaceae	P
6.	Makoi	Blacknight shade	*S. nigrum*	Solanaceae	A

Table 5: Effect of different treatments of intercropping on weed population/m^2, fresh weight and dry weight of weeds/m^2 (g) at 30 DAS stage

Treatments	Population	Fresh weight (g/m^2)	Dry weight (g/m^2)
Citronella sole	6.0	6.75	3.50
Maize sole	10.0	10.75	5.50
Bajra sole	9.5	10.50	5.50
C:M (2:2) 100%RDF)	9.3	10.00	4.75
C:M (2:2) 75%RDF)	8.5	9.75	4.25
C:M (2:2) 50%RDF)	6.5	7.25	3.75
C:B (2:3) 100%RDF)	9.0	10.00	4.50
C:B (2:3) 75%RDF)	7.5	8.75	3.50
C:B (2:3) 50%RDF)	6.0	7.50	3.00
Sem	0.5	0.58	0.48
CD (P=0.05)	1.6	1.69	1.41

It is obvious from the results that the significantly highest weed population ,fresh weight and dry weight was found in *kharif* Maize sole and Bajra sole treatment which was at par with C+B 100% RDF followed by C+M 75%RDF. The lowest weed population was found in Citronella sole during experiments periods. Among the Intercropping treatments significantly lowest weed population was found in 2:3 row ratio treatments of citronella + Bajra followed by 2:2 row ratio of Citronella + maize. The maximum weed density was recorded in *Kharif* season at early stage (30 DAS). Due to that spacious Maize sole stand allowed to growing more weeds than other intercropping systems. These findings are also in line with Singh and Singh (1993) *Cyperus rotundus* was the dominating weed flora followed by *Anagallis arvensis*.

Economic analysis

The economics of different treatments as sole crop and intercropping was worked out in the form of cost of cultivation, gross return, net profit and benefit cost ratio and LER and summarized in Table.

Cost of cultivation

The treatment wise is calculated as per market rate. The highest cost of cultivation was found in sole maize and lowest cost in sole citronella because citronella crops already planted in previous year. In C+M intercropping system highest cost of cultivation was found in100%RDF (Rs25100) and Lowest in 50%RDF (Rs21800) and C+B intercropping system highest cost of cultivation 100%RDF (Rs.22000) and lowest in 50%RDF (Rs.18693.34).

Gross income

The data computed regarding gross income showed that in. Intercropping system the highest gross income was found in Citronella:Maize 100%RDF(Rs.107969.7) followed by 50%RDF and 75%RDF. In Citronella+Bajra intercropping system the high gross income was found in 100%RDF(Rs.93594.00) followed by 75%RDF. The lowest gross income was found in Bajra sole (Rs.68147.00) followed by C:B 50%RDF. The sole citronella, gave the gross income Rs. 80750.00

Net income

The data pertaining to net income rupees per hectare received under different treatments were summarized in table. It is clear from table that the highest net income was obtain in intercropping system of both C:M and C:B at all levels of fertility in comparison to sole treatments. The C:M intercropping system with 100%RDF gave highest net income Rs.82869.7 followed by citronella: maize 50%RDF and 75%RDF. In citronella: bajra intercropping system net return was found in100%RDF which was at par with 75%RDF.The lowest income was found in Bajra sole system (Rs.49147.00)

Table 6: Cost of cultivation, Gross returns, Net returns, B: C ratio and LER

Treatments	Cost of cultivation (Rs ha^{-1})	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio	LER
Sole Citronella	16840	80750	63910	3.79	1.00
Sole Maize	21500	91840	70340	3.27	1.00
Sole Bajra	19000	68147	49147	2.58	1.00
C:M (100%RDF)	25100	107970	82870	3.30	1.27
C:M (75%RDF)	22600	103006	80406	3.55	1.20
C:M (50%RDF)	21800	103560	81760	3.75	1.20
C:B (100%RDF)	22000	93595	71595	3.25	1.25
C:B (75%RDF)	21000	92365	71365	3.39	1.23
C:B (50%RDF)	19300	80223	60923	3.16	1.22

Benefit: Cost ratio (B:C ratio)

The data pertaining to benefit: cost ratio of different treatments was summarized in table. The highest B:C ratio was found in Citronella sole followed by citronella + maize 50%RDF and 75%RDF treatment, respectively and lowest B: C ratio observed in Bajra sole treatment (2.58).

Land Equivalent Ratio (LER)

Land equivalent ratio is the relative land area under sole crops i.e. required to produce the yield achieved in inter cropping. Table the highest LER found in Citronella + Maize 100% RDF (1.27) followed by C+B 100% RDF and C:B 75% RDF and lowest LER found in sole Crops (1.00). Intercropping systems showed improvement in citronella equivalent oil yield (CEOY), net returns and B: C ratio. The result indicates that different cropping system was found to exhibit significantly variations for Citronella equivalent oil yield, economics and increasing in soil organic matter and increase in nitrogen level in combination of citronella + Maize intercropping system. The Citronella sole cropping system gave significantly the highest Citronella equivalent oil yield, net returns and B: C ratio followed by Citronella + Maize (100% RDF), Citronella + Maize (75% RDF) and Citronella + Maize (50% RDF) intercropping system than other cropping systems. While, Citronella + Bajra (75% RDF) intercropping system was being statistically with Citronella + Bajra (50%RDF). It might be due to less effect of competition in citronella sole stand, which reduces inter-specific competition than intercrops. The maximum among intercropping system citronella + Maize (2:2) 100% RDF recorded significantly higher citronella equivalent oil yield as compared to other of the intercropping system. It was due to similar citronella oil yield under intercropping system as that of its sole stand, and additional yield of Bajra as a bonus in intercropping system. The results are in accordance with the findings of Maheshwari *et al.* (1996).

Conclusion

Organic matter and available nitrogen were highest in sole maize and in combination of intercropping citronella+maize with 100% RDF and 75% RDF followed by Bajra sole and citronella+bajra intercropping with all three fertilizer doses i.e. 100%, 75% and 50%RDF, respectively. The available phosphorus (P_2O_5) was highest in citronella + maize intercropping system with 100% and 75% RDF fertility level, respectively. The available of potash was decreased year by year but the highest potash was found in citronella sole followed by C+M 75% RDF in the year 2014-15 followed by bajra sole (177.50 kg/ha) and C+M 50% RDF. The lowest weed population was found in Citronella sole stand. The

maximum weed density was recorded at early stage (30 DAS) as compared to later stages. Significantly highest weed population of different weed flora were found in maize sole (*Kharif*) and Bajra sole stand followed by C+M. Among the all other intercropping system significantly lowest weed population was found in C+B (2:3) 50 % in *kharif* season. Citronella oil equivalent yield (COEY) was significantly higher in sole stand of citronella over sole stand of maize, and bajra as well as their intercropping system with citronella. Citronella sole cropping resulted in higher B: C ratio and net returns over sole Maize and Bajra as well as their intercropping system in various fertilizer doses combination and fertilizer doses. The highest cost of cultivation was found in C+ M 100% RDF, followed by C+ M 75% RDF in *Kharif*. The highest gross return and net return C+M 100% RDF followed by C+M 50% RDF. The B: C ratio was found in C + M 100% RDF citronella sole system followed by C + M 50% RDF. The highest LER C+M 100% RDF followed by C+B 100% RDF. From economic point of view the highest net return was found in sole Maize system. But among the intercropping system, intercropping of C+M with 100% RDF is the next highest (LER) treatment followed by C+B with 100% RDF and C+B 75% RDF, respectively.

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