Original Research Article

Analysis of productivity and profitability of sweet corn + cowpea intercropping under rainfed condition in NCPZ of Odisha

ABSTRACT

A field experiment on "Planting pattern and nutrient management in rainfed sweet corn + cowpea system" was conducted during the *kharif* 2019-20 and 2020-21 at Regional Research and Technology Transfer Station, Keonjhar, Odisha. The experiment was laid down in Split plot design with three replications. The experiment was conducted to identify the suitable planting pattern and effect of nutrient management practices for enhancing production potentials of Sweet corn+ Cowpea. The treatments taken in this experiment consists of planting pattern with 3 levels i.e P_1 : Sweet corn +Cowpea (1:1) in alternate rows, P_2 : Sweet corn +Cowpea (2:2) in alternate paired rows and P_3 : Sweet corn +Cowpea (1:1) in the same row and nutrient management practices with seven levels i.e. F_1- STBFR to Sweet Corn , F_2- Proportionate of STBFR of (Sweet Corn + Cowpea) based on population, F_3- STBFR to Sweet Corn + Consortia biofertilizer , F_4- 75% STBFR to Sweet Corn + STBFR to Cowpea based on population, F_5- 50% STBFR of Sweet Corn + STBFR to Cowpea based on population, F_6- 75% STBFR of Sweet Corn + STBFR to Cowpea based on population + Consortia biofertilizer, F_7- 50 % STBFR of Sweet Corn + STBFR to Cowpea based on population + Consortia biofertilizer**.** Sweet corn variety 'Sugar 75' and Cowpea variety 'Kashi kanchan' were used as test crops**.** Observations on yield and yield parameters were recorded before and at harvest. The yield and yield parameters measured in the form of cobs per plant, cob length with husk, cob girth with husk , no of seed rows per cob, cob weight, green cob yield, fresh kernel yield, green fodder yield and harvest index in case of sweet corn and pods per plant, pod length, weight of pod, weight of green pod per plant, fresh pod yield, dry pod yield and dry haulm yield in case of cowpea were recorded. Planting of sweet corn + cowpea (2:2) in alternate paired rows(P_2) with application of 75% STBFR of Sweet Corn + STBFR to Cowpea based on population + Consortia bio fertilizer to the maize + cowpea crop (F_6) followed by STBFR of sweet corn and cowpea (F_2) was superior in terms of both yield and yield parameters

Key words**:** sweet corn , cowpea, nutrient management, consortia bio fertilizer, yield, sweet corn equivalent yield

INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crop in the world after wheat and rice. In India also, it stand third position after rice and wheat[1]. . Globally India rank 4th in area and 7th in production, representing around 4% of world maize area and 2% of total production. During 2018-19 in India, the maize area has reached to 9.2 million ha with average productivity 2965 kg/ha [2]. In the USA, Canada and Australia, sweet corn is one of the most popular vegetables. Gradually it is also becoming popular in India and other Asian countries. Sweet corn kernels have a high sugar content in the milk on early dough stage. It is consumed in the immature stage of the crop. Sweet corn is picked when immature (milk stage) and prepared and eaten as a vegetable, rather than a grain. The kernels of sweet corn taste much sweeter than normal corn. The sweet corn industry is expanding because of increasing domestic consumption, export development and import replacement. It is an attractive crop for producers to grow because the plant grows quickly and is considered a valuable rotational crop and farming operation can be mechanized.

In India cowpea is grown over an area of 23,012 ha with production of 1,33,589 tons of green pod and productivity of 5.8 t/ha[3]. Cowpea in Odisha is grown in an area of 0.22 lakh ha with production of 0.15 lakh tonnes and productivity 705 kg/ha[4]. Cowpea (*Vigna unguiculata* (L.) Walp.) have great economical and nutritional importance for the agricultural development. It is a staple food in the diet of the poorest populations, with a nutritional function by the supplying their nutrient needs [5]. This crop can be grown in low fertility soils, adapt to high temperatures and drought conditions, and associate with bacteria of the genus *Bradyrhizobium*, generating biological N fixation by symbiosis[6]. Cowpea can be intercropped with widely grown crops, viz maize, pigeonpea, cotton, sorghum, pearlmillet, sunflower, sugarcane, eggplant, castor etc. in different row ratio [7]. The short space between plants benefits the production, since it increases the soil plant coverage, reduces competition with weeds and soil surface evaporation, allowing the crop to save water and have greater growth and yield [8]. Intercropping cowpea with maize, is characterised by a very low cowpea and cereal yields [9]

Growing of sole cereal crops with shallow roots in rainfed areas is very risky, therefore diversification with low water requiring crops with high water use efficiency like maize, cowpea, sesamum, green gram, blackgram etc are option to increase the productivity [10]. Among different maize based cropping system, maize-cowpea is emerging as potential maize based cropping system in India [11]. This cropping system is more popular and is adopted extensively due to its value addition in food and it fits well in the intercropping system compare to green gram [12] it is also tolerant to abiotic and biotic stress. Maize (*Zea mays* L.)+ cowpea(*Vigna unguiculata* L. *Walp.*)intercropping is promising for tribal farmers of Odisha[13]. The soils of Odisha are usually acidic therefore in upland situation there is reduction in yield of maize + cowpea cropping system. Due to this there is deficiency of nutrients in the soil which can be replenished by the application of FYM and bio fertilizers along with the recommended fertilizers [14].

In Kendujhar upland agriculture is predominantly rainfed with low crop yields due to poor soil fertility and productivity, poor soil moisture retention, susceptibility of water erosion. The predominant upland crop in the tribal regions of Kendujhar is maize covering around 27,580 ha area in *kharif* followed by mustard in rabi. The farmers here only add FYM to the soils only once before the land preparation and is incorporated to the soil [15]. Application of FYM alone is not sufficient to meet the crop demands and to replace the nutrients that are lost in the harvested yields [16]. Intercropping of cereal with legume can help maintain and improve soil fertility through the addition of nitrogen by fixation from the component legume [17 & 18] effective usage of sunlight, nutrient and water [19], soil conservation, lodging resistance, yield increment , weed control [20] and mitigation of risk of crop failure [21] over the monocropping . Under these conditions introducing legumes like cowpea with sweet corn is the best option for subsistence food production [22].

Kendujhar district coming under North central plateau zone is mainly a tribal dominated area with low crop yields due to poor soil fertility. The major crop of this area is maize followed by *toria* and since there is no proper systematized research work relating to the planting pattern and nutrient management system has been carried out , the present investigation was ventured to study the planting pattern and nutrient management in rainfed sweet corn + cowpea system .

MATERIAL AND METHOD

A field experiment was conducted at Field Experimental Block, Regional Research and Technology Transfer Station, Keonjhar, Odisha, India during *Kharif -Rabi* season of two consecutive years *i.e.* 2019-20 and 2020-21. The field experiment was laid out in split plot design with three replications and two factors, the first one being the planting pattern (Factor A) and the second one is nutrient management (Factor B). The planting pattern had 3 levels (P_1- Sweet Corn + Cowpea (1:1) in alternate rows , P_2- Sweet Corn + Cowpea (2:2) in alternate paired rows and P_3- Sweet Corn + Cowpea (1:1) within same row) and nutrient management had 7 levels(F_1- STBFR to sweet corn, F_2- Proportionate of STBFR of (sweet corn + cowpea) based on population, F_3- STBFR to sweet corn + Consortia bio fertilizer, F_4- 75% STBFR to sweet Corn + STBFR to cowpea based on population, F_5- 50% STBFR of sweet Corn + STBFR to cowpea based on population , F_6- 75% STBFR of sweet corn + STBFR to cowpea based on population + Consortia bio fertilizer and F_7- 50 % STBFR of sweet corn + STBFR to cowpea based on population + Consortia bio fertilizer). Blanket dose of FYM@ 5 t/ha will be given to all the treatments of sub plot.

The topography of the experimental site was medium high land and the soil was sandy loam with good drainage facility. Composite soil samples were collected from different genetic horizons and various parameters were analyzed in laboratory before the sowing of the crops.

The results reveal that soil has pH (6.5), EC (0.13 dsm-1), OC (0.75%), available nitrogen (288.2 kg ha-1), available phosphorus (18.4 kg ha-1) and available potassium (119.2 kg ha-1). Sweet corn variety 'Sugar 75' and Cowpea variety 'Kashi kanchan' were used as test crops.

Sweet corn and cowpea were sown in the last week of June during both the years of experimentation. For sweet corn the seed rate was 10 kg ha-1 and for cowpea the seed rate was 20 kg ha-1. Line sowing was done by opening shallow furrows of uniform depth of about 3-5 cm . Two seeds were placed per hole. The spacing of the sweet corn and cowpea was taken as per the treatments. To all the plots well decomposed FYM was applied @ 5 t/ha. As per the treatments consortia bio fertilizer was mixed with FYM and applied as basal. Nitrogen was applied in the form of urea, Phosphorus as SSP and potassium in the form of MOP . These fertilizers were applied to the soil on soil test basis as per the treatments. In case of sweet corn, one third dose of N and full dose of P_2O_5 and half dose K_2O were applied as basal, the remaining one third dose of N and half dose of K_2O was applied as top dressing at knee height stage and the rest was applied at silking stage of the sweet corn. In case of cowpea all the fertilizers were applied as basal during the time of sowing as per the treatments in the different subplots. The other intercultural operations such as bund preparation, thinning, weeding and plant protection measures were also carried out as per package and practice.

Observations on yield and yield parameters were recorded before and at harvest . The yield and yield parameters measured in the form of cobs per plant, cob length with husk, cob girth with husk , no of seed rows per cob, cob weight, green cob yield, fresh kernel yield, green fodder yield and harvest index in case of sweet corn and pods per plant, pod length, weight of pod, weight of green pod per plant, fresh pod yield, dry pod yield and dry haulm yield in case of cowpea were recorded. . Economic analysis on the basis of net monetary return was performed to evaluate the cropping sequence system. Sweet corn Equivalent Yield was calculated after[23].

$$\text{Sweet corn Equivalent Yield (REY)} = \frac{\text{Yield of cowpea (Kg ha-1) x Price of cowpea (Rs Kg-1)}}{\text{Price of sweet corn (Rs Kg-1)}}$$

RESULTS AND DISCUSSION

Yield attributes of sweet corn

The measure of yield attribute decided at various crop growth phases and ultimately these contribute to seed yield may be in a direct or indirect manner.

Both the planting pattern and the nutrient management practices did not show any significant difference in the number of cobs per plant and number of seed rows per cob of sweet corn.

Planting pattern influenced the length of the sweet corn cobs, cob girth and cob weight significantly. The longest, thickest and heavier cobs were recorded with sweet corn + cowpea (2:2) planted in alternate paired rows with 21.7cm , 5.2cm and 337.3 g respectively (Table 1), followed by sweet corn + cowpea (1:1) in alternate rows. Sweet corn + cowpea (1:1) in the same rows produced significantly smaller, thinner and lighter cobs than sweet corn + cowpea (2:2) in alternate paired rows.

The nutrient management practices could not significantly influence the cob girth significantly. Maximum cob length of 21.7 cm and weight of the cob (340.8 g) was recorded with the application of 75% STBFR to sweet corn + STBFR of cowpea + consortia bio fertilizer followed by STBFR to sweet corn + cowpea (21.1cm and 317 g respectively). The smallest and lightest cob was recorded with STBFR to sweet corn (19.0cm and 259.5 g respectively) and was statistically inferior to the other treatments.

Table 1. Effect of planting pattern and nutrient management on Yield attributes of sweet corn (pooled)

Treatments	Cobs plant^{-1}	Cob length (cm) with husk	Cob girth (cm) with husk	No of seed rows per cob	Cob weight (g)
Planting pattern					
M+C(1:1) in alternate rows	1.2	20.4	4.3	14.8	324.6
M+C(2:2) in alternate paired rows	1.3	21.7	5.2	15.2	337.3
M+C(1:1) in the same row	1.0	19.3	3.9	14.3	301.1
S.Em. (±)	0.01	0.5	0.1	0.7	5.32
CD(P=0.05)	NS	1.5	0.3	NS	15.5
Nutrient management					
F1-STBFR(M)	1.0	19.0	3.9	14.4	259.5
F2- STBFR of (M+C)	1.2	21.1	4.9	15.4	317.6
F3- STBFR(M)+C.bf	1.1	20.8	4.5	14.8	296.9
F4-75% STBFR(M)+ STBFR(C)	1.1	20.3	4.4	14.6	286.9
F5-50% STBFR(M)+ STBFR(C)	1.0	19.7	4.1	14.5	279.9
F6-75% STBFR(M)+ STBFR(C) +C.bf	1.3	21.7	5.3	15.7	340.8
F7-50% STBFR(M)+ STBFR(C) +C.bf	1.1	20.7	4.7	15.0	299.5
S.Em. (±)	NS	0.6	0.2	0.4	4.17
CD(P=0.05)	NS	1.8	NS	NS	12.8

NB: M= Sweet corn, C= cowpea, STBFR= soil test based fertilizer recommendation, C.bf= Consortia biofertilizer

Yield and harvest index of sweet corn

Both planting patterns and nutrient management practises influenced the green cob yield, fresh kernel yield and green fodder yield of sweet corn significantly but failed to influence the harvest index significantly (Table 2)

Among the planting patterns, sweet corn + cowpea (2:2) in alternate paired rows gave the maximum green cob yield , fresh kernel yield and green fodder yield of sweet corn (of 18.12, 8.93 and 31.96 t/ha respectively) which was at par with sweet corn + cowpea (1:1) in alternate rows (17.71 , 8.50 and 36.52 t/ha respectively). Minimum yield was recorded with sweet corn + cowpea (1:1) in the same row. The extend of decrease in green cob yield, fresh kernel yield and green fodder yield of sweet corn was by 15.48 % . 16.12% and 10.66% respectively as compared to sweet corn + cowpea (2:2) in alternate paired rows.

Due to the higher yield attributes, the green cob yield and the fodder yield of the sweet corn was better in sweet corn + cowpea (2:2) planting pattern in comparison to the other two. This might possibly be due to higher cell division and more translocation of photosynthates from source to sink. [11] also reported that in maize + cowpea intercropping, the highest number of cob plant-1 were recorded under 2:2 row ratio combination followed by 2:4 row ratio combination. Similarly [24] reported that *p*aired row planted maize + cowpea recorded 18.6 % more yield over 1:1 intercrop maize.

Among nutrient management practices, application of 75% STBFR to sweet corn+ STBFR to cowpea + consortia bio fertilizer produced the maximum green cob yield (18.66 t/ha), fresh kernel yield (9.34 t/ha) and green fodder yield (33.08 t/ha) . Supplementation of biofertilizer increased green cob yield in 75% STBFR to sweet corn + STBFR to cowpea + consortia biofertilizer , 50% STBFR to sweet corn+ STBFR to cowpea + consortia biofertilizer and STBFR to sweet corn + consortia biofertilizer by 3.05 t/ha (19.5 %) , 2.15 t/ha (12.8%), and 1.2 t/ha (7.8%) respectively in comparison to STBFR to sweet corn and the difference were statistically significant. Application of STBFR to sweet corn reported the minimum green cob yield in both the years of experimentation and pooled analysis.

Table 2. Effect of planting pattern and nutrient management on yield and harvest index of sweet corn (pooled)

Treatments	**Green cob Yield(t/ha)**	**Fresh kernel yield(t/ha)**	**Green fodder Yield(t/ha)**	**Harvest index(%)**
Planting pattern				
M+C(1:1) in alternate rows	17.71	8.50	30.76	36.52
M+C(2:2) in alternate paired rows	18.12	8.93	31.96	36.19
M+C(1:1) in the same row	15.69	7.69	28.88	35.19
S.Em. (±)	0.43	0.16	0.43	0.331
CD(P=0.05)	0.97	0.49	1.21	NS
Nutrient management				
F1-STBFR(M)	15.61	7.81	29.73	34.44
F2- STBFR of (M+C)	17.79	8.90	32.82	35.14
F3- STBFR(M)+C.bf	16.83	8.45	31.81	34.59
F4-75% STBFR(M)+ STBFR(C)	16.39	8.24	31.09	34.50
F5-50% STBFR(M)+ STBFR(C)	15.90	7.95	30.51	34.26
F6-75% STBFR(M)+ STBFR(C) +C.bf	18.66	9.34	33.08	36.05

F7-50% STBFR(M)+ STBFR(C) +C.bf	17.76	8.82	32.03	35.64
S.Em. (±)	0.44	0.11	0.28	0.26
CD(P=0.05)	1.11	0.33	0.83	NS

NB: M= Sweet corn, C= cowpea, STBFR= soil test based fertilizer recommendation, C.bf= Consortia bio fertilizer

Yield attributes of cowpea

Neither the planting patterns nor nutrient management practices could influence the length of the pods and weight of pods significantly (Table 3).

Among planting patterns, sweet corn + cowpea (2:2) in alternate paired rows recorded the maximum green pods and weight of green pods per plant of 27.9 and 198.2 g per plant during year respectively. This planting pattern was followed by sweet corn + cowpea (1:1) in alternate rows. The minimum number of green pods was observed with the planting pattern sweet corn + cowpea (1:1) in the same row and proved significantly inferior to sweet corn + cowpea (2:2) in alternate paired rows system i.e. 24.1 and 182.8 g per plant respectively. Less number of pods per plant and weight of pods per plant was observed in these planting patterns because of shading of the leaves that were present at the bottom of the plants.

Application of 75% STBFR to sweet corn + STBFR to cowpea + consortia bio fertilizer recorded the maximum pods per plant(30.9 pods /plant) and weight of green pods per plant(204.9 g) . This treatment was at par with STBFR to (sweet corn + cowpea)(29.3 per plant and 193.6 g respectively) . The minimum value of number of green pods was recorded with STBFR to sweet corn(22.8 per plant and 181.0 g respectively). Similar observations were reported by [11] where the yield attributing characters viz. number of rows cob-1, 100 grain weight, number of grains cob^{-1}, length and girth of cob, grain weight cob-1 and number of cob plant^{-1} were recorded highest under treatment receiving 75% RDF in combination with PSB + *Azotobacter* + vermicompost (VC) @ 5.0 t ha-1

Table 3. Effect of planting pattern and nutrient management on yield attributes of cowpea (pooled)

Treatments	Pods plant^{-1}	Pod length (cm)	weight of pod(g)	Weight of green pod plant^{-1} (g)
Planting pattern				
M+C(1:1) in alternate rows	26.0	31.1	6.9	189.2

M+C(2:2) in alternate paired rows	27.9	31.4	7.0	198.2
M+C(1:1) in the same row	24.1	29.8	6.7	182.8
S.Em. (±)	0.95	0.9	0.09	3.8
CD(P=0.05)	2.88	NS	NS	11.3
Nutrient management				
F1-STBFR(M)	22.8	30.2	6.5	181.0
F2- STBFR of (M+C)	29.3	31.2	6.9	193.6
F3- STBFR(M)+C.bf	26.9	30.7	6.7	188.5
F4-75% STBFR(M)+ STBFR(C)	26.1	30.6	6.6	186.1
F5-50% STBFR(M)+ STBFR(C)	25.3	30.5	6.5	183.0
F6-75% STBFR(M)+ STBFR(C) +C.bf	30.9	31.5	7.0	204.9
F7-50% STBFR(M)+ STBFR(C) +C.bf	28.6	30.9	6.9	190.6
S.Em. (±)	1.01	1.1	0.06	3.6
CD(P=0.05)	2.41	NS	NS	12.4

NB: M= Sweet corn, C= cowpea, STBFR= soil test based fertilizer recommendation, C.bf= Consortia biofertilizer

Yield of cowpea

Fresh pod yield, dry pod yield and dry haulm yield per ha of cowpea was significantly influenced by both the planting pattern and the nutrient management practices and followed the similar trend as that of the yield attributes of cowpea (Table 4).

It was found that among the planting pattern sweet corn + cowpea (2:2) in alternate paired row produced the maximum fresh pod yield, dry pod yield and dry haulm yield of 1.92 t/ha , 0.63 t/ha and 1.10 t/ha respectively . There was a decline sweet corn + cowpea (2:2) in alternate paired row in the cowpea fresh pod yield by 0.09 t (4.7 %), dry pod yield by 0.05t (7.9%) and dry haulm yield by 0.10 t (9.1%) when compared with the planting pattern where sweet corn + cowpea (1:1) was planted in alternate rows however the variation was not statistically significant. Sweet corn + cowpea (1:1) planted in the same row gave 0.40 t/ha (52.1 %) less fresh pod yield, 0.24t/ha(39%) less dry pod yield and 0.33 t/ha (30%) than sweet corn + cowpea (2:2) planted in alternate paired row and proved significantly inferior to it.

Among the nutrient management practices application of 75% STBFR to sweet corn + STBFR to cowpea + consortia bio fertilizer recorded the maximum fresh pod yield, dry pod yield and dry haulm yield of 1.95 t/ha, 0.71 t/ha and 1.06 t/ha respectively. There was an enhancement of yield by 0.41 t/ha (21%), 0.40 t/ha (56.3 %) and 0.22 t/ha (20.7%) when compared to the treatment where STBFR to only sweet corn was applied and the difference was statistically significant. This showed that there is harmony between the nitrogen availability at its critical stages along with other advantages acquired from bio fertilizer. Further the bio fertilizers convert insoluble forms of soil phosphorus into soluble forms. As a result, phosphorus will be available for plants. They are also known as nitrogen fixers or phosphate solubilizers. They help in the multiplication and survival of beneficial microorganisms in the root region. Better synthesis and availability of hormones, vitamins, auxins and other growth-promoting substances improves plant growth. provide atmospheric nitrogen directly to plants and thereby enhance soil texture by increasing amount of humus and maintain soil fertility [25] .

Table 4. Effect of planting pattern and nutrient management on yield (t/ha)of cowpea (pooled)

Treatments	Fresh pod Yield(t/ha)	Dry pod yield(t/ha)	Dry haulm yield(t/ha)
Planting pattern			
M+C(1:1) in alternate rows	1.83	0.58	1.00
M+C(2:2) in alternate paired rows	1.92	0.63	1.10
M+C(1:1) in the same row	1.52	0.39	0.77
S.Em. (±)	0.09	0.02	0.13
CD(P=0.05)	0.28	0.07	0.87
Nutrient management			
F1-STBFR(M)	1.54	0.31	0.84
F2- STBFR of (M+C)	1.86	0.59	1.01
F3- STBFR(M)+C.bf	1.77	0.51	0.95
F4-75% STBFR(M)+ STBFR(C)	1.71	0.46	0.95
F5-50% STBFR(M)+ STBFR(C)	1.65	0.39	0.91
F6-75% STBFR(M)+ STBFR(C) +C.bf	1.95	0.71	1.06
F7-50% STBFR(M)+ STBFR(C) +C.bf	1.82	0.57	0.99
S.Em. (±)	0.10	0.02	0.11
CD(P=0.05)	0.30	0.06	0.33

NB: M= Sweet corn, C= cowpea, STBFR= soil test based fertilizer recommendation, C.bf= Consortia biofertilizer

Economics

Among the different planting patterns, sweet corn + cowpea (2:2) in alternate paired rows recorded the highest SEY of 1.06 t/ha which was at par with sweet corn + cowpea(1:1) in alternate rows and sweet corn + cowpea (1:1) within the same row. These two planting patterns were statistically superior to sweet corn + cowpea (1:1)) in the same row which recorded the minimum system yield (0.84 t/ha). Maximum gross return , net return and B:C ratio of the system were also recorded with sweet corn + cowpea (2:2) in alternate paired rows (Rs 21200/ha, Rs 13090 /ha and 1.61 respectively) and the minimum values of the same were recorded with sweet corn + cowpea (1:1)) in the same row (Rs 16800 /ha, Rs 8690 /ha and 1.07 respectively). According to [26] the highest total productivity in terms of maize equivalent yield (MEY) was recorded with 2:2 row ratio of maize + black cowpea intercropping pattern. Similarly highest maize equivalent yield (9668 kg ha-1) was obtained in maize + vegetable cowpea (2:2) in paired rows [27 & 28].

Among the various nutrient management practices, application of 75% STBFR to sweet corn + STBFR to cowpea + consortia bio fertilizer recorded the maximum SY of 1.07 t/ha, gross return of Rs 21400/ ha, net return of Rs 13110/ ha and B:C ratio of 1.58 which was at par with STBFR to (sweet corn + cowpea) and recorded SY of 1.03t/ha gross return of Rs 20600/ ha, net return of Rs 12270/ ha and B:C ratio of 1.47 and 50 % STBFR to sweet corn + STBFR to cowpea + consortia bio fertilizer with SY of 1.00 t/ha, gross return of Rs 20000 / ha, net return of Rs 11930 / ha and B:C ratio of 1.48. The other four nutrient management practices remained significantly inferior to these treatments. STBFR to sweet corn recorded the minimum SY of 0.85 t/ha, gross return of Rs 17000/ ha, net return of Rs 9010 / ha and B:C ratio of 1.13. These findings were in close agreement with the results of [29 & 30].

Table 5. Effect of planting pattern and nutrient management on economics of sweet corn +cowpea intercropping (pooled)

Treatments	Sweet corn Equivalent Yield of cowpea (t/ha)	Total cost of cultivation(Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	Benefit - cost ratio
Planting pattern					
M+C(1:1) in alternate rows	1.01	8100	20200	12100	1.49
M+C(2:2) in alternate paired rows	1.06	8110	21200	13090	1.61
M+C(1:1) in the same row	0.84	8110	16800	8690	1.07
S.Em. (±)	0.1		8.4	5.1	0.01
CD(P=0.05)	0.4		25.6	15.3	0.02
Nutrient management					
F1-STBFR(M)	0.85	7990	17000	9010	1.13
F2- STBFR of (M+C)	1.03	8330	20600	12270	1.47
F3- STBFR(M)+C.bf	0.97	8170	19400	11230	1.37
F4-75% STBFR(M)+ STBFR(C)	0.95	8050	19000	10950	1.36
F5-50% STBFR(M)+ STBFR(C)	0.91	7890	18200	10310	1.31
F6-75% STBFR(M)+ STBFR(C) +C.bf	1.07	8290	21400	13110	1.58

F7-50% STBFR(M)+ STBFR(C) +C.bf	1.00	8070	20000	11930	1.48
S.Em. (±)	0.2		9.3	5.6	0.03
CD(P=0.05)	0.6		28.1	16.9	0.08

NB: M= Sweet corn, C= cowpea, STBFR= soil test based fertilizer recommendation, C.bf= Consortia biofertilizer

CONCLUSION

Based on results of this study, it is seen that in Keonjhar region, sweet corn + cowpea planted in alternate paired rows gave higher yield, net returns and B:C ratio. Similarly among the nutrient management practices 75% STBFR to sweet corn + STBFR to cowpea + consortia bio fertilizer recorded recorded higher cob and pod yield, net returns and benefit: cost ratio. Thus, it can be concluded that, planting sweet corn + cowpea in alternate paired rows with application of 75% STBFR to sweet corn + STBFR to cowpea + consortia bio fertilizer resulted higher yield.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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