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Cost and Income Structure of Sweet Corn (*Zea mays saccharata* Sturt.) Cultivation as Influenced by Different Agronomic Inputs

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ABSTRACT

Globally, maize occupies a prominent place among cereals and ranks first in terms of productivity and third in total area and production after rice and wheat, respectively. But there is hardly any work which has analysed its costs and returns. In order to evaluate the most profitable treatment, economic analysis of treatments was worked out in terms of net returns and benefit cost (B:C) ratio. The cost and analysis structure of production of green cobs and green fodder ha^{-1} on hectare bases worked out for three fertility levels F_1, F_2 and F_3 in combination with three plant population P_1, P_2 and P_3 along with three sulphur levels S_0, S_1 and S_2, the cost incurred on field preparation (₹ 2000), lay-out (₹ 1040), sowing (₹ 1040), irrigation charges (₹ 2032), thinning and earthing up (₹ 832), insecticide application (₹ 568), watching and scaring of birds (₹ 2080), land revenue (₹ 60), weeding (₹ 4680) and harvesting (₹ 2080) was found to be same in all the treatments. The variability in cost of cultivation arised due to different seed rates and application of seconday nutrient i.e. sulphur. It was found that economic returns of the crop are directly related to its yield also, inadequate supply of nutrients and without proper plant geometry, sweet corn plants are undernourished and gives poor yield. Thus, for obtaining higher yield and economically sustained sweet corn should be supplied with sufficient amount of nutrients, while, maintaining proper plant geometry.

Keywords: Cost of cultivation, benefit cost ratio, gross income, fertility levels, plant population, Sulphur, sweet corn

Maize is an important industrial grain and edible crop grown all over the world. It is grown in various agro climatic conditions, ranging from temperate to tropical regions, from sea level to an altitude of 2500 meters. Production of the crop is highly influenced by the inputs, fertilizers, seed, plant population, nutrients etc used and as a result of which the yield is influenced on similar lines. Presently the normally recommended rates of nitrogen, phosphorous and potassium now be felt sub optimal under intensive cropping systems, the situation implies that higher nutrient depletion demands higher rate of nutrient replenishment for the safe guard of nutrient balance in soil, and to overcome the problem graded nutrient application is the only answer. Now days, sulphur application cannot be avoided for balanced fertilization, since, cystine and cistine, which are the building block of proteins. Apart from all the present day agriculture, the agriculture systems require an economically viable, socially acceptable and sustainable approach to improve lively hood of the farming community ensuring food and nutritional security as well as financial power, the sweet corn (*Zea mays saccharata* Strut.) in this context seems vital and alternative crop to meliorate the situation. Majority of work so far reported is sweet corn production from India and abroad is mostly concentrated around nutrient requirement, growth yield etc. Hardly any studies being conducted to analyze its costs and returns. In order to evaluate the most profitable treatment, economic analysis of treatments has to be worked out in terms of net returns and benefit cost (B:C) ratio. Keeping these points in view, the cost and return analysis was done for the sweet corn production being influenced by as influenced by different agronomic inputs.

MATERIALS AND METHODS

The present investigation entitled "Cost and Income Structure of Sweet Corn (*Zea mays saccharata* Sturt.) Cultivation as Influenced by Different Agronomic Inputs" was carried out at Student Instructional Farm, Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University during the consecutive summer seasons from of 2008 to 2010 and experiment was laid out in split plot design with 27 treatment combinations replicated thrice. Main plot treatments were the combination of three fertility levels F_1 (80-17.2-24.9 kg NPK/ha), F_2 (120-25.8-37.4 kg NPK/ha) and F_3 (160-34.4-49.8 kg NPK/ha) and three plant population P_1 (50,000 plants/ha), P_2 (75,000 plants/ha) and P_3 (100,000 plants/ha) and sub plot treatments were three sulphur levels S_0 (0 kg S/ha), S_1 (20 kg S/ha) and S_2 (40 kg S/ha). The economics of various treatments were calculated separately for the years by taking in to account the existing price of inputs and produce. The investment for performing different operations such as ploughing, weeding, irrigation, harvesting and threshing etc. were worked out (ha^{-1}) as per rate prevalent at the Student Instructional Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The cost of cultivation was taken in to account for calculating economics of treatments and expressed as net return hectare^{-1} (₹ ha^{-1}) and net return rupee^{-1} invested. The gross return was taken as the total income received from produce of cobs and fodder of the crop. Corn and fodder cost of crop was based on current market price. Net return and benefit: Cost ratios were calculated with following formulae suggested by Kar *et al.* (2006)

Gross return = Monetary value of crop produced

Net return = Gross return – Cost of cultivation

The net returns and B: C ratio was calculated as follows:

$$\text{B:C ratio} = \frac{\text{Net return (₹ ha}^{-1})}{\text{Cost of cultivation (₹ ha}^{-1})} \times 100$$

The experimental results were statistically analysed as per the methods outlined by Panse and Sukhatme (2000) by adopting Fishers analysis of variance techniques.

The cost and analysis structure of production of sweet corn crop on hectare bases worked out for three fertility levels F_1, F_2 and F_3 in combination with three plant population P_1, P_2 and P_3 along with three sulphur levels S_0, S_1 and S_2. The common cost concepts of agricultural economics were used to interpret the results. The actual costs of various inputs used in the production of sweet corn were considered. These costs were worked out for all the treatment combinations separately which includes common cost viz: field preparation, lay-out, sowing, irrigation charges, thinning and earthing up, insecticide application, watching and scaring of birds, land revenue and variable cost (as per treatment) viz: seed cost, fertilizer, weeding, harvesting. Gross returns from sweet corn production in all the treatment combinations were obtained by sale value of green cobs and green fodder.

RESULTS

Cost and return analysis of sweet corn produced in different treatments of fertility levels are presented in table 1, 2 and 3. The table 1 revealed that the cost incurred on field preparation (₹ 2000), lay-out (₹ 1040), sowing (₹ 1040), irrigation charges (₹ 2032), thinning and earthing up (₹ 832), insecticide application (₹ 568), watching and scaring of birds (₹ 2080), land revenue (₹ 60), weeding (₹ 4680) and harvesting (₹ 2080) was found to be same in all the treatments and it was because of the equal area of land utilized for all the treatments.

The cost incurred on the application of different dosages of fertilizers and maintaining different plant populations was found to vary. The table 1 further revealed that the total cost of cultivation in case of sweet corn sown with highest plant population was observed to be highest for treatment combination $F_1P_3S_0$ (₹ 17452) and same for $F_1P_3S_1$ and $F_1P_3S_2$ whereas it was found to be lowest in treatment combination $F_1P_1S_0$ (₹ 16412) and same for $F_1P_1S_1$ and $F_1P_1S_2$.

The table further revealed that net returns were higher (₹ 177200.77) in treatment $F_1P_3S_2$ i.e., sowing of sweet corn crop by maintaining highest plant whereas it was found to be lowest (₹ 81730.29) in ($F_1P_1S_0$) i.e. lowest plant population without sulphar application. It is because of significantly higher yield of sweet corn solely and yield of green fodder in addition obtained at maximum fertility level F_3 and it always determined greater values of these important parameter of economics (cost of cultivation, gross return and net return), while, the same was found minimum the lowest level of fertility F_1. Same behavior of such economic traits was also witnessed from the results obtained in the similar type of investigation by Sahoo and Mahapatra, 2007 and Singh and Choudhary, 2008. The benefit cost ratio ranged from 5.03 $F_1P_1S_0$ in to 8.43 in $F_1P_3S_1$ indicating the superiority of fertilizer and sulphur application.

Cost and return analysis of sweet corn produced in medium fertility levels treatments i.e. F_2 is presented in table 2. The table revealed that the cost incurred on field preparation, lay-out, sowing, irrigation, thinning and earthing up, insecticide application, watching and scaring of birds, land revenue, weeding and harvesting was found to be same as incurred under highest fertility levels treatments. The table further explained that the total cost of cultivation in case of sweet corn sown with highest plant population was observed to be highest for treatment combination $F_2P_3S_0$ (₹ 21212) and same for $F_2P_3S_1$ and $F_2P_3S_2$ whereas, it was found to be lowest in treatment combination $F_2P_1S_0$ (₹ 18292) and same for $F_2P_1S_1$and $F_1P_1S_2$. The table further revealed that net returns (₹ 209485.66) were higher when sowing of sweet corn crop by maintaining highest plant population and medium fertility level was done i.e. $F_2P_3S_2$. Whereas, it was found to be lowest (₹ 96074.35) when lowest plant population without sulphar application was done i.e. ($F_2P_1S_0$). The benefit cost ratio ranged from 5.6 in $F_2P_1S_0$ to

Table 1: Cost and return analysis of sweet corn produced under lowest fertility level (F_1). (Mean data of two years)

	Input Structure	$F_1P_1S_0$	$F_1P_1S_1$	$F_1P_1S_2$	$F_1P_2S_0$	$F_1P_2S_1$	$F_1P_2S_2$	$F_1P_3S_0$	$F_1P_3S_1$	$F_1P_3S_2$
A) Common cost (₹)										
1	Field preparation	2000	2000	2000	2000	2000	2000	2000	2000	2000
2	Lay-out	1040	1040	1040	1040	1040	1040	1040	1040	1040
3	sowing	1040	1040	1040	1040	1040	1040	1040	1040	1040
4	Irrigation Charges (four)	2032	2032	2032	2032	2032	2032	2032	2032	2032
5	Thinning and earthing up	832	832	832	832	832	832	832	832	832
6	Insecticide application	568	568	568	568	568	568	568	568	568
7	Watching and scaring of birds	2080	2080	2080	2080	2080	2080	2080	2080	2080
8	Land revenue	60	60	60	60	60	60	60	60	60
9	Weeding	4680	4680	4680	4680	4680	4680	4680	4680	4680
10	Harvesting	2080	2080	2080	2600	2600	2600	3120	3120	3120
	Total	16412	16412	16412	16932	16932	16932	17452	17452	17452
B) Cost Variable (₹)										
1	Fertilizer	1769.86	1943.81	2688.36	1769.86	1943.81	2688.36	1769.86	1943.81	2688.36
2	Seed cost	1880	1880	1880	2800	2800	2800	3760	3760	3760
	Total	3649.86	3823.81	4568.36	4569.86	4743.81	5488.36	5529.86	5703.81	6448.36
Return Structure										
1	Green cob yield	9810.02	10006.09	10177.03	14624.16	14780.72	15017.01	18657.85	18977.17	19380.59
2	Green fodder yield	14767.80	15169.82	15431.47	22670.72	23131.18	23444.88	28187.62	28545.02	29181.05
3	Total value of Cobs (₹)	98100.2	100060.93	101770.33	146241.6	147807.17	150170.1	186578.53	189771.67	193805.87
4	Total value of Fodder (₹)	3691.95	3792.45	3857.87	5667.68	5782.80	5861.22	7046.90	7136.25	7295.26
6	Gross Income (₹)	101792.15	103853.39	105628.2	151909.28	153589.96	156031.32	193625.44	196907.92	201101.13
7	Total cost of cultivation (₹)	20061.86	20235.81	20980.36	21501.86	21675.81	22420.36	22981.86	23155.81	23900.36
8	Net Return (₹)	81730.29	83617.578	84647.84	130407.42	131914.15	133610.96	170643.58	173752.11	177200.77
9	B:C ratio	5.1	5.1	5.0	7.1	7.1	7.0	8.4	8.5	8.4

Table 2: Cost and return analysis of sweet corn produced under medium fertility level (F_2). (Mean data of two years)

	Input Structure	$F_2P_1S_0$	$F_2P_1S_1$	$F_2P_1S_2$	$F_2P_2S_0$	$F_2P_2S_1$	$F_2P_2S_2$	$F_2P_3S_0$	$F_2P_3S_1$	$F_2P_3S_2$
A) Common cost (₹)										
1	Field preparation	2000	2000	2000	2000	2000	2000	2000	2000	2000
2	Lay-out	1040	1040	1040	1040	1040	1040	1040	1040	1040
3	sowing	1040	1040	1040	1040	1040	1040	1040	1040	1040
4	Irrigation Charges (four)	2032	2032	2032	2032	2032	2032	2032	2032	2032
5	Thinning and earthing up	832	832	832	832	832	832	832	832	832
6	Insecticide application	568	568	568	568	568	568	568	568	568
7	Watching and scaring of birds	2080	2080	2080	2080	2080	2080	2080	2080	2080
8	Land revenue	60	60	60	60	60	60	60	60	60
9	Weeding	4680	4680	4680	4680	4680	4680	4680	4680	4680
10	Harvesting	2080	2080	2080	2600	2600	2600	3120	3120	3120
	Total	16412	16412	16412	16932	16932	16932	17452	17452	17452
B) Cost Variable (₹)										
1	Fertilizer	2655	2828.84	3002.57	2655	2828.84	3002.57	2655	2828.84	3002.57
2	Seed cost	1880	1880	1880	2800	2800	2800	3760	3760	3760
	Total	4535	4708.84	4882.57	5455	5628.84	5802.57	6415	6588.84	6762.57
Return Structure										
1	Green cob yield	11301.82	11446.52	11710.60	16843.50	17088.55	17412.31	22034.29	22357.91	22614.47
2	Green fodder yield	16012.73	16302.35	16455.82	23873.07	24198.35	24468.27	29486.92	29888.37	30221.99
3	Total value of Cobs (₹)	113018.17	114465.17	117106.00	168434.97	170885.50	174123.10	220342.87	223579.13	226144.73
4	Total value of Fodder (₹)	4003.18	4075.59	4113.95	5968.27	6049.59	6117.07	7371.73	7472.09	7555.50
6	Gross Income (₹)	117021.35	118540.75	121219.95	174403.23	176935.09	180240.17	227714.60	231051.23	233700.23
7	Total cost of cultivation (₹)	20947.00	21120.84	21294.57	22387.00	22560.84	22734.57	23867.00	24040.84	24214.57
8	Net Return (₹)	96074.35	97419.91	99925.38	152016.23	154374.25	157505.60	203847.60	207010.39	209485.66
9	B:C ratio	5.6	5.6	5.7	7.8	7.8	7.9	9.5	9.6	9.7

Table 3: Cost and return analysis of sweet corn produced under highest fertility level (F_3). (Mean data of two years)

	Input Structure	$F_3P_1S_0$	$F_3P_1S_1$	$F_3P_1S_2$	$F_3P_2S_0$	$F_3P_2S_1$	$F_3P_2S_2$	$F_3P_3S_0$	$F_3P_3S_1$	$F_3P_3S_2$
A) Common cost (₹)										
1	Field preparation	2000	2000	2000	2000	2000	2000	2000	2000	2000
2	Lay-out	1040	1040	1040	1040	1040	1040	1040	1040	1040
3	sowing	1040	1040	1040	1040	1040	1040	1040	1040	1040
4	Irrigation Charges (four)	2032	2032	2032	2032	2032	2032	2032	2032	2032
5	Thinning and earthing up	832	832	832	832	832	832	832	832	832
6	Insecticide application	568	568	568	568	568	568	568	568	568

7	Watching and scaring of birds	2080	2080	2080	2080	2080	2080	2080	2080	2080
8	Land revenue	60	60	60	60	60	60	60	60	60
9	Weeding	4680	4680	4680	4680	4680	4680	4680	4680	4680
10	Harvesting	2080	2080	2080	2600	2600	2600	3120	3120	3120
	Total	16412	16412	16412	16932	16932	16932	17452	17452	17452
B) Cost Variable as per treatment										
1	Fertilizer	3540.08	3713.97	3887.66	3540.08	3713.97	3887.66	3540.08	3713.97	3887.66
2	Seed cost	1880	1880	1880	2800	2800	2800	3760	3760	3760
	Total	5420.08	5593.97	5767.66	6340.08	6513.97	6687.66	7300.08	7473.97	7647.66
Return Structure										
1	Green cob yield	12201.31	12365.89	12551.27	17865.93	18038.17	18352.14	22547.06	22968.66	23307.90
2	Green fodder yield	16433.87	16680.22	16889.55	24557.57	24887.17	25303.28	29786.50	30072.22	30541.18
3	Total value of Cobs (₹)	122013.10	123658.93	125512.73	178659.30	180381.70	183521.43	225470.63	229686.63	233079.03
4	Total value of Fodder (₹)	4108.47	4170.05	4222.39	6139.39	6221.79	6325.82	7446.63	7518.06	7635.30
6	Gross Income (₹)	126121.57	127828.99	129735.12	184798.69	186603.49	189847.25	232917.26	237204.69	240714.33
7	Total cost of cultivation (₹)	21832.08	22005.97	22179.66	23272.08	23445.97	23619.66	24752.08	24925.97	25099.66
8	Net Return (₹)	104289.49	105823.02	107555.46	161526.61	163157.52	166227.59	208165.18	212278.72	215614.67
9	B:C ratio	5.7	5.8	5.9	7.9	8.0	8.0	9.4	9.5	9.6

9.7 in $F_2P_3S_2$. With different plant populations, cob yield and green fodder yield of sweet corn increased with an increase in plant population from P_1 to P_3. This lead to the lowest and highest gross return, net return and benefit: cost ratio with P_1 and P_3 plant population, respectively. Devi *et al.* (2015) also obtained similar results.

It is evident from Table 3 that like the previous, incurred cost remained same on common inputs. Further the highest fertility level F_3 was taken in to consideration for analysis of cost and return of sweet corn production. Treatment combination $F_2P_3S_0$, $F_2P_3S_1$ and $F_2P_3S_2$ were having the same total cost of cultivation (₹ 17452). Whereas, cost of cultivation was found to be lowest in treatment combination $F_2P_1S_0$, $F_2P_1S_1$and $F_1P_1S_2$. The net returns (₹ 215614.67) were found to be highest when sowing of sweet corn crop was done by maintaining highest plant population and fertility level F_3 was done i.e. $F_3P_3S_2$. Whereas, when lowest plant population of crop was maintained without sulphar application, it resulted in lowest (₹ 104289.49) net returns. The benefit cost ratio ranged from 5.7 in $F_3P_1S_0$ to 9.6 in $F_3P_3S_2$. Sulphur application also exerted lucid effect on cost of cultivation, gross return, net return and benefit cost ratio of sweet corn. Cost of cultivation, gross return, net return and benefit: cost ratio increased with increase in level of sulphur. It proved that application of higher sulphur level in crop not only facilitated more cob yield and green fodder yield but also increased cost of cultivation, gross return, net return and benefit cost ratio (Mahajan, 2005).

CONCLUSION

It can be concluded from the results that the maximum gross return and net return were obtained in highest fertility level F_3 (160-80-60 kg N-P_2O_5- K_2O ha^{-1}) along with maximum plant population P_3 (100,000 plants ha^{-1}) and application of 40 kg S ha^{-1} (S_2). While, maximum B:C ratio was obtained in fertility level F_2 (120-60-45 kg N-P_2O_5-K_2O ha^{-1}) along with P_3 (100,000 plants ha^{-1}) plant population and application of 40 kg S ha^{-1} (S_2).

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