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An economic impact of white grub infestation on sugarcane in Northern Karnataka

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Abstract

The present study was undertaken with specific objectives to assess economic loss in sugarcane due to white grub infestation. The study was conducted in 3 districts of northern Karnataka, viz. Belagavi, Bagalkot and Vijayapur Stratified random sampling method was employed for the farmers. The primary data were collected from 120 farmers' field with white grub infested sugarcane crop (FFWWGNISC) and 24 farmers' field with white grub non-infested sugarcane crop (FFWWGNISC). Study revealed that Input used was more in case of FFWWGISC as compared to FFWWGNISC and yield realized by the FFWWGISC (105 t/ha) was lesser when compared to FFWWGNISC (139.58 t/ha). The total variable cost incurred by the FFWWGISC (₹ 1, 14, 988 /ha) was higher as compared to FFWWGNISC (₹93, 215.51/ha). Net return by the FFWWGNISC found to be less (₹ 60, 292. 45/ha) than the FFWWGNISC (₹1, 38, 950.74/ha). Net loss realized was due to the white grub in FFWWGISC (-₹ 48,257/ha) as compared to FFWWGNISC.

Keywords: Economics, sugarcane crop, white grub, infested, Northern Karnataka

1. Introduction

Sugarcane (*Saccharum officinarum* L.) is an important commercial crop in the tropical and subtropical countries of the world. The cane is grown for sugar purpose on a variety of soils. It is a very versatile tropical grass, belongs to family Poaceae and originated in New Guinea [1]. Globally, it is cultivated over an area of 26.11 m ha, with an annual production of 1936.6 million tonnes and a productivity of 68.58 t/ha [2]. India ranks second after Brazil both in area and production of sugarcane in the world. In India, it is grown over an area of 5.01 m ha with an annual of production of 350.02 MT and productivity of 69.83 t/ ha [3]. Sugarcane is an important commercial crop in India, influencing nation's economy in many ways. Besides directly supporting to 5-6 million farmers by being a cash earning crop, sugarcane supports large number of industries like sugar mills (642) producing refined sugars, distilleries (more than 200) producing liquor ethanol, millions of jaggery manufacturing units (mostly handled by farmers themselves), few cooperative bora sugar units (unrefined brown powdered sugar) and millions of family depends on them [4]. Beside these contribution to the economy, sugar industry produces huge quantity of by-products such as molasses (800 million L/annum), which is a source of producing ethanol, which can replace the petrol partially and reduce the dependence on the imports of petroleum products [4].

In Karnataka, sugarcane occupies an area of 4.36 lakh ha with a production of 35.9 MT of cane. The productivity of sugarcane in the state is higher (95.35 t/ha) as compared to the national average (70.93 t/ha) [3]. Karnataka has remarkable possibility for increasing the cane cultivation and achieving higher yields, as the soil and climatic conditions are most favourable for planting the cane in different seasons. [5] for the first time reported the occurrence of white grub in India. [6] reported white grub as a pest of sugarcane in India.

In Karnataka, Belagavi district stands first in area and production (1.6 lakh ha and 138.95 lakh t), followed by Bagalkot (0.91 lakh ha. and 79.8 lakh t) and Vijayapura (0.37 lakh ha and 27.70 lakh t), respectively. The productivity was more in Bagalkot (92 t/ha), followed by Belagavi (87 t/ha) and Vijayapura (78 t/ha) in Northern Karnataka [7].

Some pests of sugarcane like sugarcane borers, sugarcane woolly aphids, sugarcane whitefly, scale insects and white grub are very regular pests throughout the year but among all the pests white grub menace is severe in sugarcane growing belts of northern Karnataka [8]. The white grub in many crops causes losses to the extent of 40-80 per cent [9]. Among the various species of white grubs, *Holotrichia serrata* (Fabricius) has emerged as a key species by causing 30 to

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40 per cent loss in sugarcane alone under irrigated ecosystem of northern Karnataka [4]. Apart from sugarcane, *H. serrata* infestation has spread to both *kharif* and *rabi* crops in these areas and become a devastating pest causing economic concerns for Belagavi and adjoining districts [10]. With this background, the present study was undertaken with the objective to assess the economic loss in sugarcane due to white grub infestation.

2. Materials and Methods

The present study conducted during December and January month of the year 2015-16 in three districts out of 13 districts present in Northern Karnataka viz. Belagavi, Bagalkot and Vijayapura were purposively selected based on the highest area and production of sugarcane crop. Multistage stratified random sampling technique was used for selection of the sample farmers. From each district two taluks were purposively selected on the bases of area and white grub infestation. From each taluk two villages were purposively selected on the bases of area under infestation. From each selected village, 10 Farmers Field With White Grub Infested Sugarcane Crop (FFWWGISC) and two Farmers Field With White Grub Non-Infested Sugarcane Crop (FFWWGNISC) were selected purposively, which constituted a total of 144 sample farmers. The present study based on the primary data collected with the aid of well structured, pre-tested and comprehensive schedules exclusively prepared for the study. Collected data were analyzed using Average, percentage and partial budgeting technique in order to compare the costs and returns of FFWWGISC and FFWWGNISC. This will reflect difference in quantitative aspects of FFWWGISC and FFWWGNISC.

3. Results and Discussion

The per hectare input used by the sample farmers for the cultivation of sugarcane is presented in Table 1. On an average Farmers Field With White Grub Infested Sugarcane Crop (FFWWGISC) has used more quantity of human labour (151.10 man days), bullock labour (11.10 pair days), machine labour (7.43 hr), setts (4.49 t), chemical fertilizers (1863.28 kg), FYM (10.19 t) and different quantities of plant protection measures. Whereas, in case of Farmers Field With White Grub Non Infested Sugarcane Crop (FFWWGNISC) used less quantity of human labour (126.90 man days), bullock labour (9.24 pair days), machine labour (6.36 hr), setts (4.01 t), FYM (6.17 t), chemical fertilizers (1479.09 kg), and plant protection chemical (0.23 kg). Sugarcane yield realized by the FFWWGISC (105 t/ha) was lesser when compared to FFWWGNISC (139.58 t/ha). The increase in cane yield may be due to the effective control of the white grub infestation at right time by FFWWGISC. Present findings are in line with the previous findings [11] who studied on variable cost incurred on production and control of western flower thrips in green house.

The quantities of labour utilized (Table 3) was more in case of FFWWGISC on various farm operations like controlling the white grub pest incidence, harrowing, transportation of manure, planting of setts, fertilizer application and inter-cultivation. This was mainly because of use of labour force for controlling the white grub menace and other farm operations. The labour utilization for the production of sugarcane was found maximum in both FFWWGISC and FFWWGNISC for weeding and inter-cultivation operations. In all farm operations, higher quantities of labour utilization were observed in case of FFWWGISC than the FFWWGNISC. Present findings are in accordance with the

previous findings of [11] who studied on different labour utilization for the production and control of western white flower thrips in green house.

A comparison of per hectare cost of cultivation of sugarcane crop between farmer field with white grub infested sugarcane crop (FFWWGISC) and farmer's field with white grub non-infested sugarcane crop (FFWWGNISC) (Table 3). The per hectare total variable cost incurred on sugarcane crop was found more in case of FFWWGISC as compared to FFWWGNISC due to increased use of application of essential inputs in controlling white grub menace. The average cost of human and bullock labours, manure, plant protection chemicals and bio-pesticide usage was found more in case of FFWWGISC than that of FFWWGNISC. The total variable cost incurred by the FFWWGISC (₹. 1, 14, 988 /ha) was found to be higher as compared to FFWWGNISC (₹. 93,215.51/ha) while, fixed cost was worked out and it is found to be highest in case of FFWWGNISC (₹. 24,846.58/ha) as compared to FFWWGISC (₹. 18,794.2/ha). It was mainly due to use of more labour services and undertake plant protection measures to control the white grub incidence. The possible reason for increase in per hectare total cost of cultivation due to use of more quantities of plant protection measures for control of white grub in order to reduce the yield loss. Hence, per hectare total cost of cultivation incurred by the FFWWGISC was more than that of FFWWGNISC.

The average yield realized by the FFWWGISC was comparatively lesser than that of FFWWGNISC (Table 4). There was a 32.93 per cent yield decline in case of FFWWGISC as compared to FFWWGNISC. The per hectare gross returns obtained was less in case of FFWWGISC as compared to FFWWGNISC and there was 39.16 per cent reduction in gross return in FFWWGISC as compared to FFWWGNISC. The cost of cultivation incurred was high in case of FFWWGISC as compared to FFWWGNISC and there was 11.75 per cent increase in cost of cultivation of FFWWGISC as compared to FFWWGNISC. Net return realized from the FFWWGISC and FFWWGNISC were found to be ₹. 60,292.45 and ₹. 1, 38, 950. 74 per hectare respectively and there was 130 per cent reduction in net return. It was mainly due to the cost incurred on controlling the white grub was higher and yield obtained was lesser in case of FFWWGISC due to very high level of infestation of white grub, which reduces the yield level as compared to FFWWGNISC. Presents findings are in line with the previous findings of [10].

The FFWWGISC indicated on debit side which includes additional cost incurred due to white grub infestation (₹.11, 529/ha) and reduced return (₹. 62,938.19/ha) (Table 5). On credit side of the partial budgeting revealed that reduced cost was found to be nil due to no infestation of white grub while added returns realized was ₹. 26,208 per hectare. As a result, net loss realized was due to the white grub in FFWWGISC (- ₹. 48,257/ha) as compared to FFWWGNISC. FFWWGISC with controlling the white grub was benefited (₹.14, 679) due to additional returns realized and incremental benefit cost ratio was 2.27. This might be due to the fact that there was high level of white grub infestation on sugarcane and additional cost was also incurred on use of more quantities of human labour as well as on the plant protection components for the control of white grub menace. This result is in line with the previous findings of [12] studied on onion and chilli inter-crops under organic cultivation system using partial budgeting analysis.

Yield obtained from the Farmers Field with White Grub Infested Sugarcane Crops (FFWWGISC) in different varieties of sugarcane under different situations (Table 6) observed that. Majority of the sample farmers realized the highest cane yield (139 t/ha) with a monetary value of ₹. 2,58,585.87 per hectare from Co-92005 sugarcane variety with control of white grub infestation as compared with other sugarcane cultivars CoC-671 and CO-86032. Whereas cane yield (118.83 t/ha) was found less in case of Co-265 variety with a monetary value of ₹. 2, 17, 435. 4 per hectare. The sugarcane farmers had incurred yield loss of 49.71 per cent with monetary value of ₹. 1,13,697.7 due to infestation of white grub without control as compared to other sugarcane cultivars Co-86032 and it was less in Co-92005 sugarcane variety (42.08%) with a monetary value of ₹. 1, 08, 074. 4. This might be due to the fact that very high infestation of white grub on sugarcane crop which reduced the yield. Co-92005 sugarcane variety was found less infested due to the white grub menace as compared to other varieties grown in the study area and farmers can grow more and more of this variety to get more returns without spending on control measures and thereby they can save the cost incurred towards the control of white grub. Findings are in accordance with the [10] who studied on yield level of different varieties of sugarcane in Belagavi district, CoM-265 recorded higher cane yield of 242.50 t/ha. CoSnk-03632 was the next best with cane yield of 184.36 t/ha and [13] reported the yield level of different varieties, the maximum damage was observed in the variety CoS 88230, while the variety CoS 767 was comparatively less damaged in the neighbouring fields, though the soil and other conditions were same.

Per hectare overall average yield loss of all the sugarcane varieties cultivated in the study area is presented in Table 7 that, the FFWWGISC was realised the 130 tonnes per hectare cane yield with a monetary value of ₹.2, 40, 282. 07 from without white grub infestation. The sugarcane farmers were

incurred on an average yield loss of about 19.23 per cent with monetary value of ₹. 46,208.25 due to infestation of white grub with control. On the other hand, the sugarcane farmers were also incurred loss of about 46.15 per cent due to reduction in the yield with monetary value of ₹. 1, 10, 899.8 per hectare. This might be due to infestation of white grub without control. Under white grub controlled situation, the sugarcane yield loss was reduced to the extent of 35 tonnes with an added return of ₹. 64,691.55 per hectare. The reduced yield loss was due to deficit soil moisture coupled with congenial atmosphere which would encourage for high infestation of white grub on different sugarcane varieties grown in the study area. Present findings are similar with the findings of [10], who studied on per cent loss in yield of sugarcane due to white grub in Belagavi district; [8] reported that 30- 40 per cent loss due to white grub infestation in sugarcane.

Additional cost incurred and additional return obtained due to white grub management practices in sugarcane crop was found to be profitable from the biological method (Table 7), which reduced the economic loss to the greater extent than that of chemical method, cultural method and mechanical method. It might be due to the fact that, application of *Metarhizium anisopliae* suppresses the white grub pest drastically in a shorter period of time, its efficacy would be for longer period and multiplication would happen in the soil for a year, which need not require to use frequently in order to keep the pest population under control. While the chemical method for controlling the white grub was efficacy for a shorter for a period of time and it kill the white grub immediately but it need to use frequently. Present findings are complete agreement with the [10] revealed that *M. anisopliae* and *B. bassiana* with FYM was found effective as compared to application of chlorpyrifos 20 EC and [14] studied on management of the tuber damage and yield losses in potato due to white grub.

Table 1: Partial budgeting analysis to compare the cost and return of FFWWGISC and FFWWGNISC (Per ha)

S.N	Debit (Rs.)	Credit (Rs.)
a.	Added cost due to infestation (₹.11,529)	c. Reduced cost due to infestation Nil
b.	Reduced returns (₹. 62,938.19)	d. Added returns (₹. 26,208)
1.	Total Debit = a + b (₹.74,467.19)	
2.	Total credit = c + d (₹. 26,208)	
3.	Net gain/ loss = 2 - 1 (- ₹. 48,257.19)	
4	Net additional return= d - a (₹. 14,629)	
	IBCR= d/a (2.17)	

Note: FFWWGISC- Farmers Field with White Grub Infested Sugarcane Crop

FFWWGNISC- Farmers Field with White Grub Non Infested Sugarcane Crop

IBCR – Incremental benefit cost ratio

Table 2: Per hectare input used and output realized in sugarcane cultivation.

SN.	Particulars	Units	FFWWGISC (n=120)	FFWWGNIC (n=24)
Input used				
1.	Human labour	Man days	151.10	126.90
a.	Male labour	Man days	77.08	52.54
b.	Female labour	Man days	74.02	74.36
2.	Bullock labour	Pair days	11.10	9.24
3.	Machin labour	Hours	7.43	6.36
4.	Setts	Tonnes	4.49	4.01
5.	Farm yard manure	Tonnes	10.19	6.17
6.	Fertilizers			
	N	Kg	650.22	468.72
	P	Kg	606.202	505.18
	K	Kg	606.86	505.18
	Total	Kg	1863.28	1479.09

7.	Plant protection Components	Weedicide	Kg	0.56	0.23
		Phorate	Kg	7.59	0
		<i>Metarhizium anisopliae</i>	Kg	20.19	0
		Total	Kg	28.02	0.23
		Chlorpyrifos 20EC	Lt	0.51	0
		Chlorpyrifos 50EC	Lt	1.58	0
		Total	Lt	2.09	0
8	Bio fertilizers	No.	0.78	0	
			Kg	0.12	9.90
Output realized					
1.	Main Product (cane)	Tonnes	105		139.58

Note: FFWWGISC- Farmers Field with White Grub Infested Sugarcane Crop

FFWWGNISC- Farmers Field with White Grub Non-Infested Sugarcane Crop

Table 3: Operation-wise labour utilization in sugarcane cultivation (Per hectare)

SN.	Particulars	FFWWGISC (n=120)			FFWWGNISC (n=24)		
		Human Labour (man days)	Bullock Labour (pair days)	Machinery Labour (hr)	Human Labour (man days)	Bullock Labour (pair days)	Machinery Labour (hr)
1	Ploughing	0.42	2.96	1.06	0.02	2.56	3.66
2	Transportation of FYM	5.52	1.10	0.71	6.04	0	0.74
3	Spreading of FYM	9.01	-	-	10.74	-	-
4	Harrowing	0.11	2.92	0.25	0	2.88	1.96
5	Planting	27.88	-	-	24.20	-	-
6	Fertilizer application	31	-	-	22.45	-	-
7	Hand weeding	61.48	-	-	62.55	-	-
8	Inter cultivation	-	4.04	-	-	3.80	-
9	Irrigation	0.64	-	-	0.74	-	-
10	Set treatment	0.05	-	-	0.20	-	-
11	Control the white grub pest by						
A	Cultural method	1.73	0.08	5.41	-	-	-
B	Mechanical method	2.81	-	-	-	-	-
C	Chemical method	7.65	-	-	-	-	-
D	Biological method	2.83	-	-	-	-	-
	Sub total	15.02	0.08	5.41	-	-	-
	Total	151.10	11.10	7.43	126.90	9.24	6.36

Note: FFWWGISC- Farmers field with white grub infested sugarcane crop

FFWWGNISC- Farmers field with white grub non infested sugarcane crop

Table 4: Average return obtained from the cultivation of sugarcane crop (Per hectare)

SN	Particulars	FFWWGISC (n=120)	FFWWGNISC (n=24)	Per cent Change
1	Yield of sugarcane (cane) (Tonnes)	105	139.58	-32.93
2	Procurement price of factory (₹)	1,848.33	1,841.33	0.37
3	Gross returns (₹)	1,94,074.65	2,57,012.84	-39.16
4	Cost of cultivation (₹)	1,33,782.2	1,18,062.09	11.75
5	Net returns (₹)	60,292.45	1,38,950.74	-130
6	B:C Ratio	1.45	2.17	-49

Note: FFWWGISC- Farmers Field with White Grub Infested Sugarcane Crop

FFWWGNISC- Farmers Field with White Grub Non Infested Sugarcane Crop

Table 5: Per hectare average economic loss in different varieties cultivated by the FFWWGISC in study area (n=120)

Variety	Yield obtained (tonnes)			Yield loss due to infestation (tonnes)		Price (₹)	Monetary value of yield without infestation (₹)	Monetary value of yield (₹)		Monetary Loss due to infestation (₹)		Reduced yield loss (tonnes)	Added Return (₹)
	Without infestation	Infestation with control	Infestation without control	with control	without control			Infestation with control	Infestation without control	with control	without control		
Co-265	118.30	92.30	59.50	26.00 (21.47)	58.8 (49.71)	1838.00	2,17,435.4	1,69,647.4	1,09,361	47,788	1,08,074.4	32.80	60,286.4
CoC-671	132.40	102.30	70.10	30.10 (22.73)	62.30 (47.05)	1825.00	2,41,630	1,86,697.5	1,27,932.5	54,932.5	1,13,697.5	32.20	58,765
Co-86032	130.30	106.40	69.90	23.90 (18.34)	60.40 (46.35)	1870.00	2,43,661	1,98,968	1,30,713	44,693	1,12,948	36.50	68,255
Co-92005	139.00	119.00	80.50	20.00 (14.38)	58.50 (42.08)	1860.33	2,58,585.87	2,21,379.27	1,49,756.5	37,206.6	1,08,829.30	38.50	71,622.70
Overall	130	105	70	60 (46.15)	25 (19.23)	1848.33	240282.07	1,94,074.65	1,29,383.73	46,208.25	1,10,899.8	35	64,691.55

Note: (i) FFWWGISC- Farmers Field with White Grub Infested Sugarcane Crop
(ii) Figures in parentheses indicate the percentages to respective varieties yield of without infestation.

Table 6: Per hectare overall average yield loss of all the sugarcane varieties cultivated by the FFWWGICSC in the study area (n=120).

Particulars	Infestation without control	Infestation with control	Without infestation
Yield (tonnes)	70	105	130
Yield value (₹)	1,29,383.77	1,94,074.65	2,40,282.07
Yield loss (tonnes)	60 (46.15)	25 (19.23)	-
Yield loss value (₹)	1,10,899.8	46,208.25	-
Reduced yield loss (tonnes)	35		-
Reduced yield loss value (₹)	64,691.55		-

Note: (i) FFWWGICSC- Farmers field with white grub infested sugarcane crop
(ii) Figure in the parentheses indicates the percentages to respective sugarcane yield of white grub without infestation

Table 7: Per hectare average additional cost and additional return obtained from the different management practices by the FFWWGISC (n=120).

S. No	Particulars	Added cost (₹)	Added return (₹)
A. Cultural method			
a	Crop rotation	10,000.00	25,000.00
b	Deep summer ploughing	12,000.00	21,000.00
c	Flooding	6,007.74	15,480.71
	Sub average (a+b+c)	9336.00	20,494.00
B. Mechanical method			
a	Light trap	8,867.73	16,100.00
b	Collection of grub	8,152.73	17,277.35
c	Collection of adult	9,114.55	15,109.83
	Sub average (a+b+c)	8,711.70	16,162.40
C. Chemical method			
a	Phorate 10G	13,000.00	30,476.00
b	Clorpyrifos 20EC	14,200.00	38,000.00
c	Clorpyrifos 50EC	14,700.00	32,085.00
	Sub average (a+b+c)	13,967.00	33,520.00
D. Biological method			
a	<i>Metarhizium anisopliae</i> Dust	14,100.00	34,655.00
		14,100	34,655
	Overall average (A+B+C+D)	11,529	26,208

Note: FFWWGISC- Farmers Field with White Grub Infested Sugarcane Crop

4. Conclusion

Sugarcane is an important commercial crop in India. Inputs (labour and PPC) used by the FFWWGISC was more for the controlling white grub in order to reduce the economic loss. Popular sugarcane varieties like CoC-671, Co-265, Co-86032 and Co-92005 cultivated by the FFWWGISC in the study area were infested at a greater extent, replacement of susceptible sugarcane variety to white grub and breeding by the researcher to develop tolerant sugarcane variety in order to control the white grub menace effectively to reduce the economic loss. Individual method of controlling the white grub in sugarcane yields lesser return and management practices existing earlier were found less effective. Hence, the integrated pest management practices like best combination of cultural, mechanical, chemical and biological methods may be designed to control the white grub infestation successfully to reduce the economic loss on community approach base.

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