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PEST MANAGEMENT BEHAVIOUR OF SUGARCANE GROWERS OF KOLHAPUR DISTRICT, MAHARASHTRA: A SOCIO ECONOMIC ANALYSIS

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Abstract: The study was conducted in Bhudargad Taluk of Kolhapur district, Maharashtra having a sample size of 48 sugarcane growers. It was found that majority of the sugarcane growers were young (<35 years). Ninety per cent of growers who adopted sugarcane technologies had education of secondary or graduation level. Around 64.58 per cent of the respondents possessed membership in social organizations and related activities. About 93.74 per cent of the respondents had farming experience of more than 10 years. Nearly all respondent listened or watched agricultural programmes in either television or radio. All the respondents had knowledge on cultural practices *viz*., earthing up at 45 days after planting, summer ploughing, removing water shoots, planting in December-January and trash mulching in the field for reducing the pest incidence. Majority of the respondents (66.7%) knew that intercropping in sugarcane reduces early shoot borer infestation. Knowledge on biological control practices was almost absent. All the farmers had no knowledge on time of chemical intervention (knowledge on Economic Threshold Levels (ETLs) and time of spraying, although 83.33 per cent of them had knowledge on chemicals and dosages to be sprayed. All the respondents adopted the cultural practices. The respondents had knowledge on mechanical practices that reduce the pest load in next generation and majority of them adopted some mechanical practices occasionally if not regularly. Adoption of biological practices was absent. All the respondents used chemical control practices to manage sugarcane pests like early shoot borer, white grubs, termites and sucking pests. High cost of inputs, high cost of labour, non-availability of inputs like pheromone traps, *Trichogramma* egg cards, other bio-control agents and man power for spraying chemicals were the major constraints faced by the respondents. Strategies to be taken for large scale adoption of pest management practices in sugarcane are discussed.

Keywords: Sugarcane growers; Socio-economic profile; Adoption; Constraints; IPM technologies.

Introduction

Though India is the highest producer of sugar in the world at present, the demand for sugar for internal consumption is growing due to increased per capita consumption. The increased requirement of sugar has to be met mostly through enhanced production per unit area/ unit time, since there is no further possibility of increasing the area under sugarcane due to

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competition from other crops. The theoretical maximum yield of cane has been estimated to be 470 t of fresh total biomass/ha/year on the basis of the efficiency (3.6%) of use of total incident solar radiation. A higher yield has been reported to the tune of 340 t/ha in Gujarat. Compared to the above yield potential levels, average productivity of Maharashtra is lower. Thus, there is ample scope for improvement of cane and sugar productivity in this state. Although many reasons are there for low productivity, one of the important factor that affect productivity is damage by pests and diseases and poor pest management in the field. More than 200 species of insects and a few species of non-insect pests have been recorded on sugarcane in the country and a dozen of them, including stem borers, sap feeders and defoliators, and subterranean pests such as root borer, white grubs, termites and rats assume major pest status in a given geographical area (Srikanth *et al*. 2012). Among them white grubs, borer pests, sap feeding pests and rodents cause damage to sugarcane commonly in Maharashtra. So, one of the ways to increase productivity with better returns is to go for integrated pest management. Integrated pest management (IPM) is a systematic approach to crop protection that uses increased information and improved decision-making paradigms to reduce purchased inputs and improve economic, social, and environmental conditions on the farm and in society. Moreover, the concept emphasizes the integration of pest suppression technologies that include biological, chemical, legal, and cultural controls (Allen and Rajotte, 1990). Rajula Shanthy *et al*. (2019) reported that adopting IPM practices facilitated to get more yield and thereby increase in net profit, reduced pesticide cost, reduced pollution, improvement in soil health by reducing the use of chemicals and addition of bio-pesticide, parasites, predators and eco-friendly in sugarcane production. In this regard, the goal of the present investigation is to know the socio economic profile, knowledge and adoption of IPM practices and constraints faced by the sugarcane growers in Kolhapur district, Maharashtra to optimise pest control in terms of overall economic, social and environmental gains.

Research Methodology

The study was conducted in Bhudargad Taluk of Kolhapur district, Maharashtra with a sample of 48 sugarcane growers. The tool used for the study was a pre-designed and pre-tested interview schedule. The independent variables operationalized in the present investigation comprised age of the respondents as adopted by Kothandapani (1992), educational status, occupational status, farming experience and sugarcane cultivation experience as adopted by Arulraj (1984), operational holding, implements possessed, annual income, mass media participation as adopted by Ahmed (1997), social participation and

sources of information as categorized by Krishnamoorthy (1988). The dependent variables of the study were knowledge and adoption level on recommended pest management practices in sugarcane, and the constraints faced by the growers. To this study, the practices were listed under the headings *viz*., cultural, biological, mechanical and chemical practices. To know the constraints faced by sugarcane growers in pest management, the respondents were given with pre identified constraints under the heads of economical constraints, input availability constraints, technological constraints and situational constraints and requested to categorize them in a three-point continuum *viz.*, most, somewhat and not a constraint. The primary data were analyzed with standard statistical methods like percentage and ranking to draw the results.

Results and Discussion

***Demographic profile of farmers adopting IPM practices*:** The study indicated that about 39.58% of the respondents were young (<35 years old), while 25.0% of them were middle aged (35-50 years). The rest of them were of old age (more than 50 years) and it accounted 35.41%. It is clear that young generation also actively involved in agriculture due to changing attitude towards agriculture. They preferred diversified occupations for getting high income. Majority of growers who adopted sugarcane technologies had education of secondary or graduation level (90.0%). Nearly 6.25% of the respondents were below primary level and they also adopted sugarcane technologies on par with educated ones. Thus it is clear that education level is not a barrier for adopting sugarcane cultivation technologies.

Around 64.58% of the respondents possessed membership at least in one of the social organizations. Membership in more than one organization was 12.5%. This implies that in spite of a hectic schedule in the farm, the respondents could make time to participate in the social organization and related activities. It is found that 87.5% of the respondents were engaged in agriculture and allied farming as main occupation. About 12.5% of respondents were treating agriculture as their secondary occupation and getting major source of income and spending major time in other diversified works. As majority of the respondents were full time engaged in agriculture activities, they had high economic motivation and managed their farm in a better way. They also adopted sugarcane technologies to increase their sugarcane productivity.

About 93.74% of the respondents had farming experience of more than 10 years. Higher farming experience leads to better adoption of technologies such as planting, weeding, fertilizer application and pest management practices. Generally, the level of adoption of

technologies increases with their experience in crop cultivation. It is also a known fact that more the years of experience, their knowledge about sugarcane management was also more. This would help them with easy understanding and quick adoption of latest technologies. In case of operational holding, 72.91% of the respondents had farm size of less than 2.0 hectares while, 27.09% of them had farm size of 2.0-5.0 hectares. Even though farm holdings were small to marginal, the adoption of IPM practices was practiced satisfactorily. Moreover, they were able to get good yield and high net returns in their farms. Basic implements like spade, county plough, cultivator and rotavator were commonly possessed by most of the respondents. They tend to hire tractor and other implements like power tiller, disc plough and mini tractor etc. based on the need. Around 81.25% of the farmers were having annual income of 1 to 2.5 lakhs and 18.75% were having more than 2.5 lakhs. It is understood that diversified agricultural enterprises had boosted the income level of the farmers. Mass media is playing a remarkable role in disseminating information of a new technology to a large number of audiences within a stipulated period. In this study, the impact of three mass media *viz.*, radio, television, newspapers were analysed. It is interesting to note that 100 per cent of the respondents listen to television regularly. This implies a deep penetration of television in rural system as a major entertainment for them. Therefore, any dissemination of agricultural technologies reach more quickly and precisely to the respondents through television. Regarding newspapers, 25% of the respondents were regular reader of newspaper. This was mainly due to the cost involvement. Nearly all respondent listened/ watched agricultural programmes. Roop Kumar *et al*. (2017) reported that most of the farmers were utilizing radio and television as information source to gain knowledge about sugarcane production technologies. Rajula Shanthy *et al*. (2019) also reported that farmers who adopted IPM practices used mass media channels like radio, television and newspaper. They regularly followed them for getting agriculture related information. Hence, it is inferred that radio and television could be effectively utilized for dissemination of integrated pest management.

***Practice wise knowledge level of sugarcane growers on Integrated Pest Management*:** Table 1 indicated that the farmers had adequate knowledge about the cultural practices and mechanical practices. All the respondents had knowledge on cultural practices *viz*., earthing up at 45 days after planting (DAP) which reduces early shoot borer, purpose of summer ploughing in relation to white grub management, removing water shoots at 8^{th} or 9^{th} month, planting in December-January reduces the shoot borer incidence and purpose of trash mulching in the field. However, they did not have knowledge on purpose of detrashing at 5^{th}

and 7th month after planting; and deep ploughing around the field to reduce rat incidence. Majority of the respondents (66.7%) also knew about intercropping in sugarcane reduces early shoot borer infestation. As the cultural practices are easy to practice, almost all the respondents were found to have adequate knowledge about them except few. It was found that the knowledge on biological control practices was almost absent except one respondent (2.08%).

Among the mechanical practices, all the respondents had knowledge on collection and destruction of all insect life stages to reduce the pest load in next generation, purpose of using pheromone traps, knowledge on use of rat traps and shaking trees like neem, *Acacia* trees to dislodge white grub beetles during onset of monsoon (June-July) and destruction mechanically. Though they knew about purpose of using of pheromone traps, but knowledge on number of traps to be used per acre was not clear to majority of them (83.33%).

Among the chemical practices, the respondents had no knowledge on the time of chemical intervention (i.e. knowledge on Economic Threshold Levels (ETLs) and time of spraying, although 83.33 per cent of them had knowledge on chemicals and dosages to be sprayed. Moreover, they had awareness on safe use of pesticides in the field.

Table 1. Practice wise of knowledge of sugarcane growers on IPM (N=48)

S.No.	Items	Yes	%	No	%
I Cultural practices					
1	Earthing up at 45 DAP reduces early shoot borer	48	100	0	0
2	Trash mulching to reduce early shoot borer	48	100	0	0
3	Purpose of summer ploughing in relation to pest management	48	100	0	0
4	Removing water shoots at 8th or 9th month age of sugarcane	48	100	0	0
5	Purpose of detrashing at 5th and 7th month after planting	0	0	48	100
6	Intercropping in sugarcane reduces early shoot borer	32	66.66	16	33.34
7	Planting in December-January reduces early shoot borer incidence	48	100	0	0
8	Purpose of trash mulching in sugarcane	48	100	0	0
9	Purpose of deep ploughing around the field	0	0	48	100
II. Biological practices					
1	Knowledge on usage of *Trichogramma chilonis* for the management of sugarcane	0	0	48	100

	borer pests				
2	Knowledge on place of availability of *Trichogramma chilonis*	0	0	48	100
3	Knowledge on dosage for release of *Trichogramma chilonis*	0	0	48	100
4	Knowledge on usage of *Beauveria brongniarti*, white muscardine fungus for the management of white grubs	0	0	48	100
5	Knowledge on beneficial insects in sugarcane field	1	2.08	47	97.92
III. Mechanical practices					
1	Collection and destruction of all insect life stages to reduce pest load in next generation	48	100	0	0
2	Purpose of using pheromone traps	48	100	0	0
3	Knowledge on number of traps to be used per acre	4	16.67	44	83.33
4	Knowledge on traps to be used to kill rats	48	100	0	0
5	Knowledge on shaking trees like neem, acacia trees to dislodge white grub adult beetles during onset of monsoon (June-July) and destruction mechanically	48	100	0	0
IV. Chemical control practices					
1	When one should go for chemical control (Knowledge on ETLs)	0	0	48	100
2	Knowledge on time of spraying	0	0	48	100
3	Knowledge on what chemicals to be used	40	83.33	8	16.67
4	Dosage of chemicals to be used for spraying	40	83.33	8	16.67
5	Knowledge on safe use of pesticides in the field	48	100	0	0

***Extent of adoption of pest management practices*:** The information in Table 2 indicates that all the respondents adopted the cultural practices like earthing up at 45 DAP, detrashing at 5th or 7th month, cultivating pest and disease resistant varieties, deep summer ploughing, intercropping to reduce early shoot borer incidence and to get additional income, removal of water shoots and wild vegetation or weeds on crop boundaries to reduce rat incidence. Interestingly, all the respondents who practiced detrashing were unknown about the purpose (reduction of incidence of sugarcane internode borer and mealy bugs). All the respondents surveyed in Kolhapur region did not practice early planting to reduce early shoot borer and installation of light traps to reduce the incidence of white grubs.

Under mechanical practices, *viz.*, destruction of termite mounds in the field, clearing crop residues and other debris in the sugarcane field to deprive termite foods and setting up rat traps for managing rat menace were adopted by all the respondents occasionally if not regularly. The respondents were not removing and destroying life stages of the pest and carrying out mechanical collection of white grub beetles emerging out during onset of monsoon, as they felt that these practices were cumbersome. Around 16.7% of the respondents practiced setting up pheromone traps for the management of sugarcane borers.

Regarding biological practices, adoption level was nil, as the knowledge of biological practices was also almost absent among the respondents. Hence, there is scope to create awareness among the sugarcane growers to use these eco friendly practices. Rajula Shanthy *et al*. (2019) also reported that around 65.0% of the respondents were not having much knowledge about bio-control agents and bio-pesticides usage. Though bio-control agents and bio-pesticides are in vogue for quite some time, the adoption of this technology is yet to gain momentum. Farmers have not yet realized the full benefit of this technology.

All the respondents used chemical control practices to manage sugarcane pests like early shoot borer, white grubs, termites and sucking pests. They also had taken some precautions while spraying chemical pesticides like wearing masks (small towel) and wearing over clothes to avoid dermal contact of pesticides. Findings of Rajula Shanthy *et al*. (2019) indicated that due to adoption of IPM practices, the cane yield was increased and thereby net profit was increased. The farmers who used bio-pesticides and bio-control agents had reported that they incurred lesser cost then the chemical pesticides. IPM measures when strictly followed completely avert yield loss due to pest infestation.

Table 2. Extent of adoption of pest management practices (N=48)

S. No.	Items	Yes	%	No	%
I Cultural Practices					
1	Earthing up at 45 DAP	48	100	0	0
2	Trash mulching after planting	10	20.83	38	49.17
3	Detrashing at 5^{th} and 7^{th} month of planting	48	100	0	0
4	Cultivating pest and disease resistant varieties	48	100	0	0
5	Deep summer ploughing during May-June	48	100	0	0
6	Adopting early planting due to regular high incidence of ESB	0	0	48	100
7	Frequent light irrigation to reduce early shoot borer and white grub incidence	0	0	48	100
8	Intercropping with crops like coriander, green gram, garlic, black gram etc. to reduce ESB	48	100	0	0

	Removal of water shoots at 8th or 9th month age of the crop	48	100	0	0
10	Removal of wild vegetation or weeds on crop boundaries to reduce rat incidence	48	100	0	0
II Mechanical Practices					
1	Removal and destruction of all life stages of the pests-eggs, larvae etc	0	0	48	100
2	Destruction of termite colonies/mounds	48	100	0	0
3	Clearing crop residues and other debris in the sugarcane field to deprive termite foods	48	100	0	0
4	Setting up pheromone traps for the management of sugarcane borers	4	16.67	44	83.33
5	Setting up rat traps for the management of rats	48	100	0	0
6	Mechanical collection of white grub beetles emerging out during adult emergence (June-July)	0	0	48	100
III Biological Practices					
1	Release of *Trichogramma chilonis* (Tricho card) for the management of sugarcane borers	0	0	48	100
2	If used, tying of tricho cards under the leaf surface of sugarcane	0	0	48	100
3	Release of Ectoparasitoid, *Epiricania melanoleuca* @ 10,000 cocoons per ha. for the management of Pyrilla in sugarcane.	0	0	48	100
4	Re distribution of woolly aphid predator, *Diphia aphidivora* larvae and cocoons from the established fields to fields without them.	0	0	48	100
5	Use of white muscardine fungus, *Beauveria brongniartii* for the management of white grubs	0	0	48	100
IV Chemical control Practices					
1	Spraying of insecticides chloropyriphos @ 2ml/lit of water when the 15-22% sugarcane plants are infested with early shoot borer	48	100	0	0
2	Drenching the planted setts with Chloropyriphos @ 5 ml/litre or imidacloprid @ 0.5 ml /litre of water for the management of termites	48	100	0	0
3	Application of quinolphos 5 G @ 50kg/ha to manage white grubs in the field	48	100	0	0
4	Avoid spraying during windy days or hours	48	100	0	0
5	Taking precautions during spraying like wearing mask, wearing over coat, etc.	48	100	0	0

Constraints in adopting integrated pest management practices

It is inferred from Table 3 that among the economic constraints, high cost of inputs and high cost of labour were the major constraints (ranked first) as faced by the respondents followed by lack of credit facilities and high rate of interest on credit as somewhat constraints.

Under input availability constraints, all reported that non-availability of pheromone traps, non-availability of *Trichogramma* egg cards in time and non-availability of labours for spraying chemicals as the most important constraints that affected pest management practices. Similarly, the findings of Ahmed *et al*. (2016) revealed that non-availability of labourers during peak period ranked as prime constraint in Assam. Availability of plant protection chemicals in the market is not at all a constraint to the respondents.

In the study area, although farmers were interested to use bio control agents, the major constraint under technological domain was the non-availability of bio-control agents. This is because, production and storage of bio-control agents need sophisticated lab facilities and special skill to produce them, they are not commercially available to the farmers. These findings are in agreement with Rajula Shanthy *et al* (2019) who reported that though biological method is a promising technology, there are not many firms producing bio-control agents. Hence 87.5% of respondents felt that enough quantity was not available in time.

Further, all the respondents reported that they were lacking on adequate knowledge on ETLs of different pests in order to use the plant protection chemicals judiciously and timely. Moreover, they were not able to differentiate between beneficial and harmful insects. Other technological constraints were inability to contact extension agencies at times of emergency or in need. Under somewhat important constraint category are lack of adequate knowledge on pests and their symptoms of damage and lack of knowledge about correct management measures.

Under situational constraints, labour scarcity and lack of co-operation among the farmers for large scale pest management programme especially in the case of rat and white grub management were reported as the major constraints by all the respondents. IPM would be more effective when it is practiced in large scale. Fragmentation of land holdings and staggered plant protection operations in a region affect the effectiveness of IPM in sugarcane. Most of the agricultural labourers preferred to go to non-agricultural related professions which fetched good salary, rather than doing hard field operations. This caused labour scarcity in the study area. Apart from the above, as the rainfall is erratic due to climate

change issues, which leads to an unfavourable climatic conditions for the crop and leads to lack of assured water which posed some constraints in pest management.

More or less similar constraints were faced by sugarcane growers from Maharashtra as reported by Lahoti *et al*. (2018) from Punjab by Devi and Chahal (2013), from Assam by Ahmed *et al*. (2016) and from Tamil Nadu by Rajula Shanthy *et al*. (2019). However, the order of ranking of constraints differ from place to place due to socio economic status of the growers, biotic and abiotic factors prevalent in a region, institutional support, infra structure availability etc.

Table 3. Constraints in adopting integrated pest management practices (N=48)

S.No.	Particulars	Most	%	Somewhat	%	Not at all	%	Rank
A. Economical constraints								
1	High cost of inputs	48	100	0	0	0	0	I
2	High cost of labour	48	100	0	0	0	0	I
3	Lack of credit facilities	0	0	48	100	0	0	II
4	High rate of interest on credits	0	0	48	100	0	0	II
B. Input availability constraints								
1	Non-availability of pheromone traps	48	100	0	0	0	0	I
2	Non-availability of *T. chilonis* egg parasite cards in time	48	100	0	0	0	0	I
3	Non-availability of plant protection chemicals in time	0	0	0	0	48	100	II
4	Non-availability of labour for spraying	48	100	0	0	0	0	I
C. Technological constraints								
1	Lack of adequate knowledge on pests, symptoms of damage and damage	0	0	48	100	0	0	II
2	Lack of adequate knowledge on ETL of different pests	48	100	0	0	0	0	I
3	Lack of knowledge on *Trichogramma chilonis*	48	100	0	0	0	0	I
4	Lack of adequate knowledge about pheromone traps	30	62.5	18	37.5	0	0	III
5	Lack of knowledge about correct	0	0	48	100	0	0	II

	management measures							
6	Inability to contact the extension agencies at the time of emergency	48	100	0	0	0	0	I
D. Situational constraints								
1	Unfavourable climatic conditions	0	0	48	100	0	0	II
2	Lack of assured irrigation	0	0	48	100	0	0	II
3	Labour scarcity	48	100	0	0	0	0	I
4	Lack of transport facility	0	0	48	100	0	0	II
5	Lack of co-operation among farmers for large scale pest management programme	48	100	0	0	0	0	I

***Strategies to be taken for large scale adoption of pest management practices*:** Due to the advancement in scientific approach towards agriculture, many new technologies are available for adoption. It is not the dearth of technology that haunts Indian agriculture today, but the non-availability of adequate knowledge about the technologies to the indented clients. Adequate technical support is needed to increase the rate of adoption. Hence, the following strategies are to be taken for large scale adoption of pest management practices and other sugarcane technologies like, farmers participation in meetings, seminars, related to pest management practices, frequent contact with extension personnel of ATMA and Agricultural Department; provision of machinery, pesticides and bio-control agents, establishment of bio-control laboratories, providing spraying equipment in subsidized cost to the farmers at Government level; popularizing the pest management technologies through mass media like newspapers, television, radio etc. and conducting trials and demonstrations at farmer's field level related to new technologies in the field of IPM for quick and easy adoption by researchers.

Conclusion: This paper attempted to know the socio economic status of cane growers; the knowledge and adoption levels of IPM technologies and to identify the constraints faced by the farmers in Kolhapur district, Maharashtra. IPM for sugarcane cultivation is an important viable technology and also an essential foundation for the development of sustainable sugarcane cultivation. Hence, it is necessary to utilize it, along with other technologies like

integrated nutrient management, integrated disease management, agronomic and water management practices to maximize the productivity in Maharashtra State.

References

[1] Ahmed G.M. (1997) Study on the perception of cane growers and non-growers towards cane development programme in sugar factories unpub. *M.Sc* (*Ag*) *Thesis*, TNAU, Coimbatore.

[2] Ahmed, P., Nath, R.K. and Sarmah, A.C. (2016) Production constraints of sugarcane cultivation in Tinsukia district of Assam. *International Journal of Agriculture Sciences*, **8**(62): 3540-3541.

[3] Allen, W.A. and Rajotte, E. G. (1990) The changing role of Extension Entomology in the IPM era. *Annual Review of Entomology* **35**: 379-97.

[4] Arulraj. S. (1984) Threshold in innovation decision on sugarcane variety unpub: *Ph.D. Thesis*, TNAU, Coimbatore.

[5] Devi, A.A. and Chahal, S.S. (2013) Socio-economic constraints perceived by cane growers in sugarcane production in Punjab. *Indian Journal of Economics and Development*. **9**(2): 93-113.

[6] Kothandapani, K.R. (1992) A study on the yield gap and constraints analysis in sugarcane with special reference to Ambur co-operative sugar mills Ltd. *M.Sc (Ag) Thesis*, Tamil Nadu Agricultural University, Coimbatore.

[7] Krishnamoorthy, N. (1988) Farm analysis on information management and adoption of technological units of low cost seed treatment practices by small and marginal farmers. unpub: *M.Sc (Ag) Thesis*, Tamil Nadu Agricultural University, Coimbatore.

[8] Lahoti S.R., Chole, R.R. and Rathi, N.R. (2010) Constraints in adoption of sugarcane production technology. *Agricultural Science Digest*. **30**(4): 270-272.

[9] Rajula Shanthy, T., Chinnapillai, M. and Saravanan, L. (2019) Pest management in sugarcane- A socio economic analysis. *International Journal of Science, Environment and Technology*, **8**(4):834-839.

[10] Roop Kumar., Yadav, R.N., Mishra, A.K., Akshay Kumar and Sunil Kumar (2017). Study on socio-psychological, socio-economical profile and constraints faced by the sugarcane growers in Meerut District of western Uttar Pradesh. *Progressive Agriculture* **17**(1):168-171.

[11] Srikanth J., Salin K.P. and Jayanthi, R (2012) Sugarcane pests and their management. Published by ICAR-Sugarcane Breeding Institute Coimbatore. *pp*.1-88.