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SUGARCANE PRODUCTION AND PROTECTION CONSTRAINTS FACED BY THE GROWERS OF PUNJAB, PAKISTAN WITH SPECIAL FOCUS ON THE ROLE OF AGRICULTURAL EXTENSION WORKER IN RELATED MITIGATION

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Significance of sugarcane crop is well recognized around the world. Farmers in Pakistan are growing sugarcane for multiple benefits such as sugar, fodder, ethanol production, chipboard, molasses, and bioenergy. Despite its importance, the potential of its production is not being achieved because of various Sugarcane Production and Protection Constraints (SPPCs) as well as the unsatisfactory performance of Agricultural Extension Worker (AEW) to introduce the recommended production technology. District Rahim Yar khan was selected purposively because it is among the largest sugarcane growing area of Punjab. A total of 180 respondents were selected randomly from two tehsils for data collection mainly through quantitative research method followed by two focus group discussions to identify SPPCs. Moreover, the role of AEW was also analyzed in context to mitigate the related constraints. The results indicated that there were various constraints like shortage of irrigation, lack of marketing facility, late payment by the sugar mills, lack of technical knowledge, labor shortage, lack of awareness about integrated pest management and unavailability of resistant varieties. It was also indicated that the role of AEW in alleviating the SPPCs was meager and ineffective. Results indicated that Pearson correlation coefficient had a significant and positive relationship between the role of AEW and SPPCs. Similarly, chi-square value indicated that the AEW had a significant role to mitigate the constraints faced by farmers in SPPCs. However, there was no significant relation between role of AEW and harvesting practices also between role AEW and fertilizer application on sugarcane. So, there is a need for the related capacity building of AEW regarding production and protection methods.
Keywords: Extension worker, production, protection, constraints, sugarcane, Punjab.

INTRODUCTION

Sugarcane is one of the major cash crops of Pakistan. A number of products are obtained from sugarcane such as sugar, molasses, bagasse, ethanol, press mud and jaggery (GOP, 2016). It makes a reasonable contribution to the gross domestic product of the country through its significant annual return (Qureshi *et al.,* 2005). Although the average overall production of sugarcane is satisfactory to some extent, the potential return is still not achieved (Raza *et al*., 2018). In addition, no progress has been made in terms of the potential yield (Mahmood *et al*., 2016) at the same time, the area under sugarcane cultivation is also on decrease each year due to multiple constraints. These constraints include low-quality seed, inadequate harvesting practices, improper production and protection technologies, pest susceptible varieties, lack of budget and lack of access to latest plant protection technologies. So, the sugarcane farmers and economy of the country face a great loss in yield (PSMA, 2018).

Fluctuations in the total production of sugarcane in the country are often observed as shown in the table 1 below;

Table 1. Sugarcane production in Punjab.

Year	Area (thousand hectare)	Production (thousand metric tons)
2015-2016	705.35	41968
2016-2017	777.38	49613
2017-2018	859.13	55667
2018-2019	732.88	46483

(GOP, 2019)

Yield remains low in sugarcane production because sugarcane growers have poor production and protection practices due to lack of access to recommended information sources (Cheema *et al*., 2002). These skills are considered important for sustainable sugarcane yields that are currently at risk. Therefore, the role of AEW is significant to enhance the skills related to SPPCs (Barkat, 2002). In Pakistan, agriculture extension (AE) is a system of introducing modern techniques and ideas to the farmer for incorporation into their farming practices. The AEW not only provides information to farmers for improvement of their status of farming and cropping

patterns but also motivates them to use improved agricultural implements and adopt modern agricultural practices according to their socio-economic status. AEW performs a significant role in the adoption of modern agricultural technologies and has the significant association between research organizations and farmers (Ahmad *et al.*, 2007; Hemandez, 2000; Khan and Khan, 2015). Unfortunately, AEW_S are not working efficiently to disseminate the production technology and they are ineffective as a source of information for the farmers due to various reasons (Baloch and Thapa, 2018 Pervaiz *et al.*, 2013).

The main objective of the research was to investigate the constraints faced by the sugarcane growers and the role of AEW in alleviating SPPCs in District Rahim Yar Khan. This research has tendency to sort out the challenges of sugarcane growers regarding sugarcane production. Moreover, it can also help the government to mitigate the problems of sugarcane growers and formulate the policies to improve the diminishing role of AEW_S.

MATERIALS AND METHODS

Mix method research (quantitative and qualitative) design was used for data collection. Multistage sampling technique was used for selection of the sample. Sampling is a statistically representative portion of individuals in the research population that requires to be sufficient for providing answers to research questions (Majid, 2018). At the first stage, District Rahim Yar khan was selected purposively as this is one of the largest sugarcanes growing districts of Punjab. At the second stage, two tehsils namely Sadiqabad and Khanpur were selected randomly. At the third stage, out of twenty-six and twenty-two Rural Union Councils (RUCs) of the selected tehsils (Khanpur and Sadiqabad) respectively, two RUCs were opted purposively from each selected tehsil due to the high production of sugarcane. From each selected RUC, two villages were selected at random. The list of sugarcane farmers was prepared in the selected villages with the help of key informants of the respective villages (key informants were Numberdar or lambardar and progressive farmers of respective rural areas). Ninety (90) sugarcane farmers were selected from each tehsil through a purposive sampling procedure after making the inventories. The data were collected through semi-structures interview schedule. The reliability of the interview schedule was tested by using Statistical Package for Social Sciences (SPSS). Cronbach Alpha value for questions was between 0.82 to 0.95. Further to check the validity of the data collection tool, it was also presented to the experts of the Institute of Agricultural Extension, Education and Rural Development and later on, necessary amendments were made. The interview schedule was further pre-tested on 20 respondents (that were other than the purposively selected 90 sugarcane farmers). Semi-structured interview schedule was developed for data collection. In quantitative methods, descriptive statistics was applied including frequency and percentages in order to identify the situation of the information sources, related awareness and adoption level of the respondents regarding the sugarcane production and protection practices. Similarly, inferential statistics was applied including Chi-square and Pearson correlation coefficient in order to explore the association between the role of AEW and SPPCs. Statistical Package for Social Sciences (SPSS) was used to analyze the collected data.

Focus Group Discussion (FGD)

Two (02) FGDs were organized for in-depth analysis of the constraints. The first FGD was organized with the sugarcane growers which mainly focused on the SPPCs faced by the growers in the selected area. The second FGD was conducted with the officials of the agriculture department (Extension workers) that identified the role of AEWs to mitigate the SPPCs. In this regard, 14 participants were selected from each group and the discussion point of the participants was penned down in the diary by the researcher. The time period of discussions for each group was between 40-80 minutes. Qualitative data were analyzed through Content Analysis Technique (CAT).

RESULTS AND DISCUSSION

Table 2 represents the association between the role of AEW and Sugarcane Production Practices (SPPs) adopted by sugarcane farmers. It was found that AEW had significant role in residual practices, ($\chi^2 = 6.10$, $p = 0.013$), and Pearson correlation coefficient ($r = 0.184$, $p = 0.013$) confirmed that the relation between the variables was significant and positive. It means, AEW had significant role in providing awareness about post-harvest (residues management) practices to sugarcane farmers. Whereas, the role of AEW was not considered significant in ploughing practices of the growers, ($\chi^2 = 0.663$, $p = 0.415$), and Pearson correlation coefficient ($r = -0.184$, $p = 0.418$) value indicated that the relation between the variables is non-significant and negative. Similarly, non-significant association was found between role of AEW and irrigation practices of the farmers. It was also revealed that the relationship between the variables is non-significant and negative. Other SPPs such as mixed cropping, proper time for planting, application of fertilizer, mixed cropping and harvesting practices showed positive and significant association. It means that AEW played positive and significant role in providing awareness about these practices. The results are in line with the study of Khan *et al.* (2019) who reported that the role of AEW to be important to motivate the sugarcane growers to adopt the latest recommended production technologies to increase their production.

Table 2. Association between production practices of sugarcane and role of extension workers.

Production practices	Categories	Role of extension worker		Total	Chi-square value	P-value	Pearson correlation coefficient	P-value
		No	Yes					
Residual	No	69	25	94	6.10	0.013*	0.184	0.013*
		73.4%	26.6%	100.0%				
	Yes	48	38	86				
		55.8%	44.2%	100.0%				
	Total	117	63	180				
		65.0%	35.0%	100.0%				
Ploughing	No	52	32	84	0.663	0.415	-0.061	0.418
		61.9%	38.1%	100.0%				
	Yes	65	31	96				
		67.7%	32.3%	100.0%				
	Total	117	63	180				
		65.0%	35.0%	100.0%				
Mix cropping	No	97	38	135	11.14	0.001**	0.249	0.001**
		71.9%	28.1%	100.0%				
	Yes	20	25	45				
		44.4%	55.6%	100.0%				
	Total	117	63	180				
		65.0%	35.0%	100.0%				
Crop rotation	No	85	52	137	5.11	0.138	0.111	0.139
		62.0%	38.0%	100.0%				
	Yes	32	11	43				
		74.4%	25.6%	100.0%				
	Total	117	63	180				
		65.0%	35.0%	100.0%				
Proper time for planting	No	91	37	128	7.23	0.007**	0.200	0.007**
		71.1%	28.9%	100.0%				
	Yes	26	26	52				
		50.0%	50.0%	100.0%				
	Total	117	63	180				
		65.0%	35.0%	100.0%				
Fertilizers application	No	78	44	122	6.89	0.011	-0.032	0.011
		63.9%	36.1%	100.0%				
	Yes	39	19	58				
		67.2%	32.8%	100.0%				
	Total	117	63	180				
		65.0%	35.0%	100.0%				
Harvesting practices	No	66	11	77	19.69	0.000**	0.331	0.000**
		85.7%	14.3%	100.0%				
	Yes	51	52	103				
		49.5%	50.5%	100.0%				
	Total	117	63	180				
		65.0%	35.0%	100.0%				
Irrigation practices	No	81	43	124	0.018	0.893	0.010	0.893
		65.3%	34.7%	100.0%				
	Yes	36	20	56				
		64.3%	35.7%	100.0%				
	Total	117	63	180				
		65.0%	35.0%	100.0%				

Table 3 indicates different constraints faced by the sugarcane growers. According to the data, the majority of (93%) of the respondents perceived that the marketing problems were the major factor which directly affected sugarcane production. Almost 81% of the sugarcane farmers perceived that the ineffective role of AEW was also the major constrains in reducing the sugarcane yield. About 87% and 77% of the respondents reported that input expenditures and labor cost, respectively influenced the output cost of the growers effectively. Similarly, 79% of the respondents indicated the SPPCs that hampered sugarcane production significantly.

Table 3. List of constraints faced by the sugarcane growers during survey 2019-20.

	Constraints	Responses of the respondents regarding constraints		Explanation of the constraints by the participants during first group discussion (1st group consisted of 14 participants)
		Yes	%	
1	Irrigation related problems	114	63.3	• Shortage of water during sowing and summer • Shortage of ground irrigation
2	Lack of marketing Facility	168	93.3	• Fluctuation support price • Unfair distribution of payment • Late payment • Lack of access to market and storage facility • Dominant role of the middle man • Monopoly from the sugar mills • High transportation charges and worse road condition
3	Ineffective role of extension workers	145	80.6	• Poor response by the department • Favoritism to large farmers • Lack of technical knowledge • Lack of demonstration about new cultivation practices • Lack of information about integrated pest management • Poor trust to extension workers • Lack of information about cultural, physical and biological control • Lack of information about protection measures • Less frequent visit by the extension agent • Lack of training about production and protection measures to the farmers by the extension agent
4	Production and Protection Practices constraints	131	72.8	• Cultivation practices and soil condition • lack of efficient information about resistant varieties, adulteration in pesticides • lack of awareness and of proper cultural practices • Misunderstanding about resistant varieties • Inappropriate use of fertilizer, poor public extension system
5	Input Expenses	157	87.2	• High cost of Fertilizer, pesticides, weedicides and machinery • High cost of fuel
6	Labour Cost	138	76.6	• labor cost is very expensive due to manual planting and harvesting

Different factors were reported to be barriers of production of sugarcane (Pervaiz *et al*., 2013). Among these lack of technical information, poor financial conditions, high prices of inputs like pesticides, resistant varieties, non-recommended doses of fertilizers and poor role of AEWs were the main constraints responsible for low yield. Similarly, Khan *et al*. (2016) reported the key issues of farmers such as shortage of irrigation water, unawareness of latest verities of the crop, land issues, high cost of inputs like weedicides or pesticides and marketing problems. Moreover, role of government in resolving these issues through negotiations was taken as significant by the allocation of water, pesticides, seeds on cheaper rates and ensuring the availability of the latest verities at the time of sugarcane cultivation in markets.

1st Focus Group Discussion: In Table 3 explanation of the constraints by the participants during first FGD were recorded. The first focus group discussion was conducted with the sugarcane growers in the selected tehsils. During FGD farmers' opinions on SPPCs and the role of the AEW to mitigate these constraints were documented. Responses of the respondents were recorded in the diary during FGD. It was explored by the respondents that there were different

constraints which had impact on sugarcane productivity. Similarly, sugarcane growers were agreed that role AEW had significant association between SPPCs. There were different problems in these areas as lack of irrigation, lack of marketing facility, lack of awareness about production and protection practices, high labor cost and inefficient role of AEWs were major constraints. It was found through FGD that farmers did not have proper information regarding pest attack and their damage on sugarcane crop. During the discussion, one of the farmers annotated the situation regarding awareness about insect pest attack on their crop in these words; *"I have no idea about the proper production and protection measures and I only follow the pesticide agents that visit my farm and sell their products for coping the attack of sugarcane pests. My crop is mainly affected with red rot disease. Lack of awareness about the management of this disease by using resistant seed, improper marketing facilities (Lack of access to market and storage facility) and shortage of irrigation water damaged my sugarcane crop drastically"*.

2nd Focus Group Discussion: The second focus group discussion FGD was held with the officials of the agriculture department (AEWs) in the selected tehsil (Sadiqabad). The officials reported different prevailing methods with the researcher which were used to mitigate the SPPCs faced by the sugarcane growers. It was found that farmers used chemical, agronomic, biological as well as many other practices to mitigate the protection threats to eliminate pest attacks from crops. AEWs informed the researcher that most pathogens survived in soil, season to season or on seed setts, cause destructive damage in the sugarcane crops. Therefore, proper crop rotation for 3-4 years is recommended for a sugarcane farmer. Furthermore, it was revealed that farmers were facing lot of problems regarding pest control/management due to pest attack on crop which leads to low yield of sugarcane. In addition, sugarcane growers were skeptical towards the latest technology and did not adopt the recommended production practices which added to the reasons of low crop production. Extension officials suggested that increasing awareness by training of farmers regarding the production and protection threats can enhance their ability towards high productivity and income. The officials also appreciated intervention of the researcher and considered it important in creating awareness among the farmers regarding recommended practices.

The data regarding role of AEW in providing the information regarding the SPPCs were observed (Table 4). In this case, Chi-square value and Pearson correlation coefficient were used to analyze the association between the role of AEWs and awareness regarding SPPCs. From table 4 indicated that AEW had significant role also in weed control, method, ($\chi^2 = 3.95$, $p = 0.047$). Furthermore, Pearson correlation coefficient was used to determine the relation between the AEW and weed control method, ($r = 0.148$, $p = 0.047$). It means that AEWs

Table 4. Association between protection practices of sugarcane and role of extension workers.

Protection practices	Categories	Role of extension worker		Total	Chi-square value	P-value	Pearson correlation coefficient	P-value
		No	Yes					
Weed control methods	No	84	36	120	3.95	0.047*	0.148	0.047*
		70.0%	30.0%	100.0%				
	Yes	33	27	60				
		55.0%	45.0%	100.0%				
	Total	117	63	180				
		65.0%	35.0%	100.0%				
Pest control methods	No	98	30	128	5.21	0.003**	0.234	0.004**
		76.6%	23.4%	100.0%				
	Yes	19	33	52				
		36.5%	63.5%	100.0%				
	Total	117	63	180				
		65.0%	35.0%	100.0%				
Disease control methods	No	85	13	98	6.68	0.000**	0.397	0.000**
		86.7%	13.3%	100.0%				
	Yes	32	50	82				
		39.0%	31.0%	100.0%				
	Total	117	63	180				
		65.0%	35.0%	100.0%				
IPM awareness	No	83	32	115	7.20	0.000**	0.406	0.000**
		72.2%	27.8%	100.0%				
	Yes	34	31	65				
		52.3%	47.7%	100.0%				
	Total	117	63	180				
		65.0%	35.0%	100.0%				

had positive and significant role in providing awareness about weed control method. It was also observed (Table 4) that AEWs had significant role on pest, diseases control method and integrated pest management, (χ^2 = 5.21, p = 0.003, χ^2 = 6.68, p = 0.000, $\chi 2$ = 7.20, p = 0.000) and Pearson correlation coefficient (r = 0.234, p = 0.004, r = 0.397, p = 0.000, r = 0.406, p = 0.000) confirmed that the relation among the variables was significant and positive. It means that role of the AEW is highly associated with education of the farmers regarding the SPPCs. The results are confirmed by other researchers (Ali *et al*., 2013; Raza *et al*., 2019) who reported that the sugarcane insect pest, weeds and diseases are among important factors which adversely affect production of sugarcane. Therefore, role of AEW was to provide proper information regarding protection measures that were necessary to increase the sugarcane production.

Data presented in the figure 1 clearly highlight the perceived sources of the information mainly for the awareness of SPPCs. Only 30% of the respondents reported that they received information from AEWs and 36% respondents had an access towards recommended information through private sectors. While only 34% of the respondents indicated that they were getting information from fellow farmers and mass media.

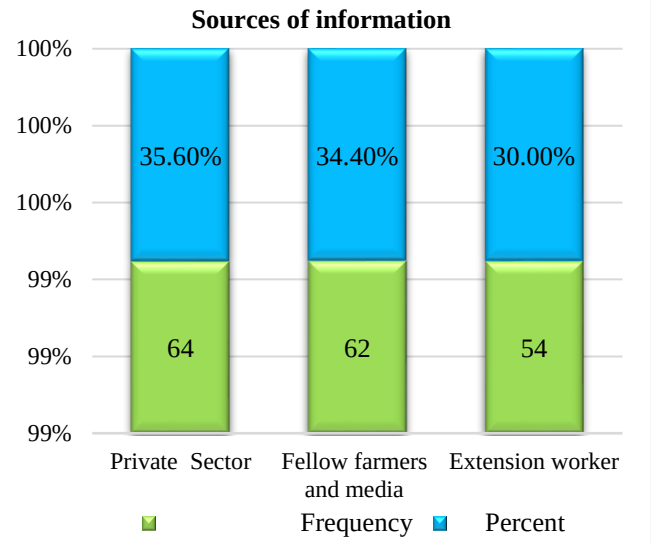

Figure 1. Demographic representation of the respondents regarding the source of information.

The findings of the current study are similar to the findings of Mirani and Memon (2011) who found that majority of sugarcane farmers did not get information related to production and protection practices from AEWs. Likewise, majority of farmers are not capable of the adoption of the latest production technologies due to lack of information sources. Therefore, it is mandatory for AEW to provide the latest agricultural innovations related to sugarcane recommended production technology (Sharma and Singh 2019).

The awareness and adoption rate of proper production and protection practices by the respondents is presented in Figure 2. The respondents' views about the adoption rate for proper ploughing was less than half (47%) and the response of respondents related to proper control of diseases management was 46%. Similarly, respondents reported that the adoption rate for proper harvesting practices, sowing recommended varieties, sowing at the proper time was 43%, 45% and 40%, respectively. Whereas the adoption rate of the respondents related to adoption of other production and protection practices was between 20% to 34%.

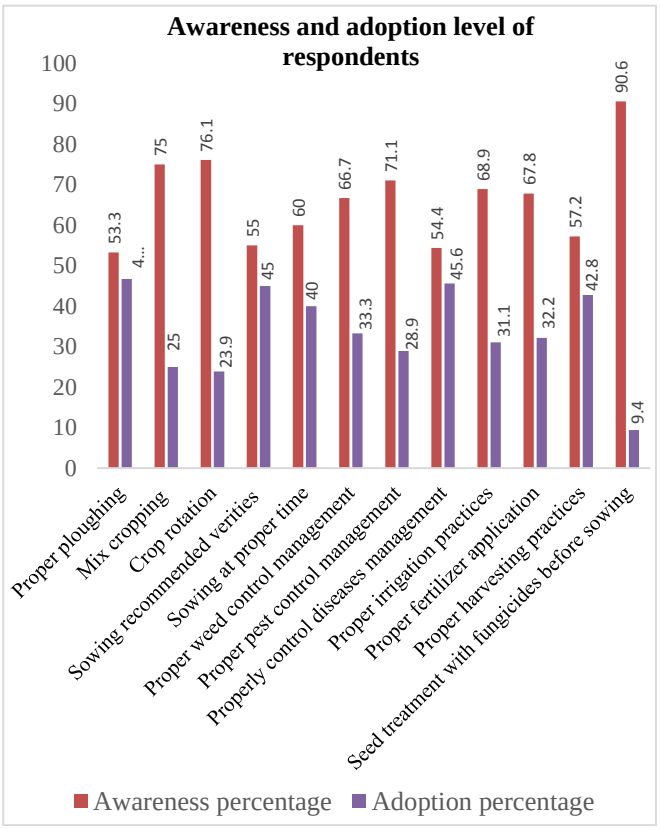

Figure 2. Awareness and Adoption level of the respondents regarding the sugarcane production and protection practices.

The results are in line with the study of Abbas *et al*. (2003) who concluded that the majority of the farmers had a low adoption rate of recommended production and protection technology. Similarly, Khan *et al*. (2019) indicated that AEW could play an important role to disseminate the information in a proper way and educate the farmers through different techniques and motivate them for the adoption of production and protection practices. Moreover, Qureshi and Afghan (2005) reported that improving sugarcane production through demonstration was one of the highly effective agricultural

extension practices. Figure 3 revealed the responses of the respondents recorded regarding different protection practices.

More than fifty (52%) of the respondents stated that weeds are controlled through mechanical method while only 12.78% of the respondents reported that they used mechanical method against sugarcane pest control. While 23 and 7% of the respondents-controlled weeds through cultural and biological control, respectively. Majorly intensive use of the chemical was used by the respondents in the study area during data collection. The majority of the respondents (89%) also confirmed that they used different chemicals to control sugarcane weeds and pests. Farmers were frequently using toxic chemicals to control insect pest population in the study area. The findings of the current study are similar to the findings of Raza *et al*. (2019) who reported that because of excessive usage of chemicals the insects are becoming tolerant to chemicals. Moreover, Williams *et al.* (2003) also indicated that the use of pesticides and chemicals affected on crops more adversely as compared to other methods.

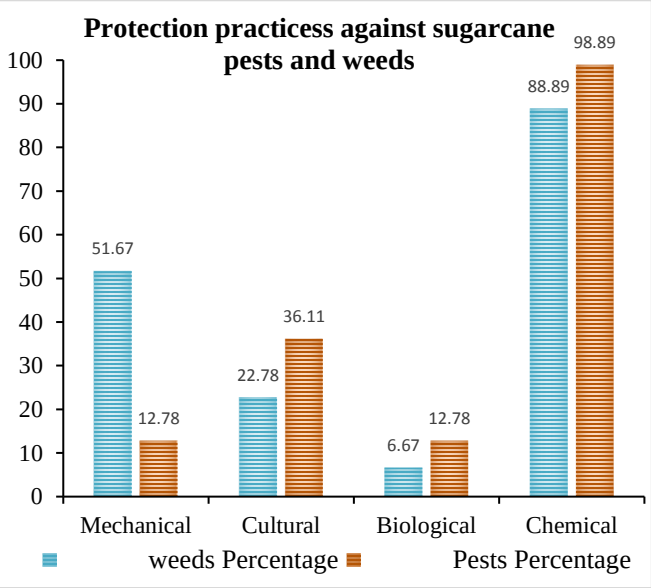

Figure 3. Distribution of the respondents regarding different control methods against sugarcane weeds, pests and disease.

***Conclusions and recommendations*:** The findings indicated that the potential of sugarcane production was not being achieved because of numerous SPPCs. Among these constraints shortage of irrigation, lack of marketing facility, late payment by the sugar mills, lack of technical knowledge, labor shortage, unavailability of resistant varieties, scanty role of AEWs and lack of awareness about IPM were significant. Similarly, there is found low adoption rate among the respondents regarding the sugarcane production and protection practices such as seed treatment with fungicides before sowing, crop rotation, mix cropping and properly control pest management. Furthermore, the role of AEW was unsatisfactory and ineffective in terms of dissemination of information about sugarcane production and protection measures. AEWs were not found to be technically sound enough to mitigate these constraints faced by sugarcane growers. Therefore, development of modern skills and techniques for the extension field staff to improve their competencies and skills regarding production and protection practices is recommended.

REFERENCES

Abbas, M., S. Muhammad, I. Nabi and M. Kashif. 2003. Farmers' information sources, their awareness and adoption of recommended sugarcane production technologies in the central Punjab. Pak. J. Agri. Sci. 40:202-206.

Ali, S., M. Ahmad, T. Ali, B. Shahbaz, G.A. Khan, M. Iftikhar and F. Nosheen. 2013. Role of private sector in promoting IPM practices among farming community in Punjab, Pakistan. J. Anim. Plant Sci. 23:1473-1476.

Baloch, M.A. and G.B. Thapa. 2018. The effect of agricultural extension services: Date farmers' case in Baluchistan, Pakistan. J. Saudi Soc. Agric.17:282-289.

Barkat, A. 2002. An investigation into the performance of Crescent Sugar Mills extension personnel in district Faisalabad. M.Sc. (Hons.) Thesis, Agricultural Extension. Univ. Agri., Faisalabad, Pakistan.

Cheema, I.A., M. Ayub and A. Jabbar. 2002. Morphological response of spring planted sugarcane to spaced arrangement and nutrient management. Pak. Sug. J. 17:62-68.

Govt. of Punjab. 2019. Sugarcane production plan. Available online at http://dai.agripunjab.gov.pk/system/files /SAUGARCANE%20PLAN%202019-20.pdf Accessed online on: 18-12-2019.

Govt. of Pakistan. 2016. Budget speech 2014-15.www.finance.gov. pak. Accessed on: June 3, 2016.

Hemandez, B. 2000. A method for assessing the economic desirability of leaving sugarcane plants standing. World Agric. Econ. Rural Social. 3:395-402.

Khan, A.Q., M. Idrees, and F. Aldosari.2016. An assessment of main problems faced by farming community in sugarcane production of district Peshawar. Int. J. Agric. Ext. Rural Dev. 3:149-155.

Khan, F. and Z.M. Khan. 2015. Role of education in enhancing sugarcane yield in Mardan and Charsadda districts of Khyber Pakhtunkhwa, Pakistan. Sar. J. Agi. 31:123-130.

Khan, F., M. Wegener and M.Z. Khan. 2019. Engagement with extension services by small-acreage sugarcane farmers in selected districts of Pakistan. Rur. Ext. Inno. Syst. J. 14:34-42.

Mahmood, I., S. Hassan, M.R. Yasin, A. Bashir and M. Abbas. 2016. Determinants of sugarcane yield differentials across selected districts of central Punjab: an empirical investigation. J Agric. Res. 54:331-341.

Majid, U. 2018. Research fundamentals: Study design, population, and sample size. Und. Res. Nat. Clinic. Sci.Tec. J. 2:1-7.

Mirani, Z. and A. Memon. 2011. Farmers' assessment of the farm advisory services of public and private agricultural extension in Hyderabad district, Sindh. Pakistan J. Agric. Res. 24:56-64.

Pervaiz, U., F. Khan, D. Jan and M. Zafarullah. 2013. An Analysis of sugarcane production with reference to extension services in union council Malakandher-Peshawar. Sar. J. Agi.29:37-42.

PSMA. Annual report, 2018. Available online at https://fp.brecorder.com/2018/ 11/ 20181129427148/.

Qureshi, M.A. and S. Afghan .2005. Sugarcane cultivation in Pakistan. In: Naqvi, H.A. (Ed). Pakistan Sugar Book. Mandi Baha-ud-Din: Pakistan, Pakistan Society of Sugar Technologists, Karachi, Pakistan. Pp.1-11.

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Qureshi, M.A. and S. Afghan. 2005. Sugarcane cultivation in Pakistan. Pakistan Sugar Book. Pakistan Society of Sugar Technologists, Karachi, Pakistan.

Raza, H.A., R.M. Amir, A.H. Wudil, S. Usman, M. Shoaib, R. Ejaz and H.A. Khan. 2018. Economic analysis of Jaggery (Gur) production in Tehsil Shakargar. J. Glob. Innov. Agric. Soc. Sci. 6:69-73.

Raza, H.A., R.M. Amir, M.K. Ullah, A. Ali, M. Saeed, S. Usman, M. Shoaib. 2019. Coping strategies adopted by the sugarcane farmers in Punjab; An integrated pest management approach. J. Glob. Innov. Agric. Soc. Sci. 7:33-37.

Sharma, S. and M. Singh. 2019. Information sources and channels mostly preferred by sugarcane growers. Prog. Agri.19:85-87.

Williams, T., J. Valle and E. Vinueal. 2003. Is the naturally derived insecticide Spinosad (R) compatible with insect natural enemies? Carfax Publishing, Hants, England 13:459-475.