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Impact of biotic and abiotic factors on sugarcane production: A case study of Tehsil Khanpur, Punjab, Pakistan

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Abstract

Sugarcane is an important cash crop in Pakistan. It plays an important role for the national economy of pakistan. There are many problems which are encountering in the production of sugarcane. The main reason in the reduction ofsugarcane production are pests. This study is indicating the ways and means of pest identification in a sugarcane crop at Rahim Yar Khan with changing pest dynamics under abiotic and biotic factors and how these factors collectively impact on sugarcane production. Total 120, randomly registered sugarcane growers participated in the study as respondents. Data were collected through interview schedule from participants. The results indicated that abiotic factors are associated with biotic factors and have great impact on sugarcane production.

Keywords: Biotic, Abiotic, Factors, Sugarcane, Production, Farmers

Introduction

Agriculture is regarded as lifeline of national economy of Pakistan. Agriculture accounts about 19% of the national Gross Domestic Product (GDP) and providing an employment opportunities to the 43.5% of the labor force in country (GOP, 2019). Apart from that, agriculture is profound source of foreign exchange earnings. Agriculture is anticipated as one of the profitable ventures and therefore millions of families depend on agriculture for their livelihoods. Agriculture in Pakistan entails numerous major and minor crops such as cotton, Sugarcane, Rice, Maize and Wheat.

Whereas, fruit and vegetables are cultivated on commercial scale to earn capital and meet local diet needs as well. Among major sugarcane value addition accounts for 25.6% in overall agriculture and for GDP 5.3%. This esteemed crop is cultivated for diversified purposes for example the production related to sugar with an effort of board and paper industry. Sugarcane was cultivated on 1313 thousand hectares area in 2017-18 with production of 81.02 million tons. This production was greater than the production obtained in

previous fiscal year 2016-17 (GOP, 2019) In Pakistan sugarcane is the one main crop. It show an important part in the economics uplifts for the growers and for the manufacturing of sugar and sugar products in the sugar industry provides the raw material. Sugarcane cultivation in Pakistan has increased and are grown on an area of 1,074,700 hectors with respect to the total annual production of 53, 811, 000 tones (Anonymous 2004). Bashir and Saeed in 2000 studied the domestic sugarcane production has increased in the last four decades. The average yield of sugarcane are nationally is 50.07t/ha and average recovery of sugarcane is 9.5 %. (Anonymous, 2004).These are much lower from 256t/ha production of sugarcane which are existing in domestics varieties (Gill, 1995).In Pakistan the low production reason of sugarcane is poor fertility of soil, low seed rate, quality of seed is poor, conventional sowing method and poor agro management. (Ahmed, 1988). Keerio *et al*., (2003) stated sugarcane yielding, low cane inherently and lower provision for evolution, the varieties of improved sugarcane acclimatization are play different role. By adopting better package of technology and high yield different breeding techniques of sugarcane production are improved. (Memon *et al*., 2004). Numerous issues such as environmental impacts, water, air and soil pollutants, fertilizers, chemicals, burning at harvest, soil erosions, compactions, competition with food crops, loss of habitat and impact on biodiversity were perceived responsible for limiting sugarcane production (Bndesand Cgee, 2008). Of the various reasons, attack of insects and pests has significant contribution in limiting sugarcane production. For instance, borers of sugarcane reduced the sugarcane quality, growth and sucrose level and augmented the fiber level (Goebel and way, 2003). Stem bores caused the injury while feeding on internal tissues of sugarcane and reduced the yield of sugarcane (Goebel and way, 2003).In Pakistan a huge loss of sugarcane production pertinent to insects' pests' outbreak has been reported by Islam *et al.* (2016).*Chilo infuscutellus* (Pyralidae: Lepidoptera) an early shoot borer is a wide spread pest in all growing regions of sugarcane of the country. This pest outbreaks the crop at an initial periods of growth with its peak activity during May June in places like Haryana, Punjab and Uttar Pradesh (Butani, 1969). The larva of shoot borer starts damage by boring on the lateral side of the plant to make a way to the base of the stalk through a bored entry hole and inside the plant it bores upwards or downwards killing the growing point. This would sever the central leaf spindle which dries up to form dead heart symptom that can be pulled out effortlessly (Srikanth, 2012).According to the (Nrip and Gaikwad, 2017) sugarcane production India has faced annually loss of about Rs 8.6 million due to the pest insects. The production of the cane was decreased from 5.32 to 44.53T/hac due to the loss of measured yield and loss of sugarcane yield. Sugarcane is also a vital cash crops which are grownup in Pakistan. It is also used as a food for livestock. In 2010 according to FAO an estimated crop sugarcane was cultured in more than 90 countries and zone for this is 23.8 million hectares, with a worldwide crop of 1.69 billion tones. The Brazil is largest producer of sugarcane in the world. Throughout 2010-11, the other sugarcane producers which were leading are India, China, Thailand, Mexico and Pakistan in reducing amounts of production. The greatest significant cause of sugarcane production is the world demand for sugar. Sugarcane contribution in sugar production is 80 percent, while rest is obtained from sugar beet. Sugarcane is naturally present to the environment of South Asia and Southeast Asia (FAO, 2011). Sugarcane is the highest cash crop like rice, wheat and cotton. Its influence is about 0.7 percent in GDP and 3.4 percent of value added in agriculture (GOP, 2014). For 84 sugar mills it affords raw material. Next in textiles the sugar industry is the country's another major agro-industry. According to Ahmad *et al*. (2008) decrease in sugarcane yield was pertinent to inadequate use of resources by the growers. Pertaining to this gap Pakistan is not meeting the household demand of sugar and associated products. To bridge this gap country imports sugar from other countries. James (2004) state that average production of sugarcane around the world is about 170 million tons. Brazil is the foremost producer of sugarcane with production of 33 million tons. Sugarcane is a significant crop that had extensive significance on social and government issues in all over the world. During 2014 sugarcane was cultivated on 27 million hectares area across the world. According to the global ranking in terms of sugarcane production, Brazil stands first with 39% of the total sugarcane production followed by is India with 19% cultivation while Pakistan, China and Thailand each contribute 7% in terms of sugarcane production (FAOSTAT, 2015).The sugarcane is effected by harmful pests. Proper protection of cane from the harmful pests can be minimized by IPM program which are scientifically designed during the year. In IPM program the pesticides are playing an important role. The farmer usually used insecticides for the control of insects. Many factors are responsible for the low sugarcane. But insects are causing the major role in decreasing the yield of the sugarcane. In

Pakistan the insects attack are decreasing the yield of the cane, but it is estimated that Pyrilla, top borers and Gurdpur borer are the main cause of fall in production is 15-20,10-20 and 30-35% individually, which is in a few cases the high from 80-85 percent are decreased in the yield of crop, which is reported due to the attack of insects. (Zubair *et al*., 2006). Pesticides play an important role in IPM program. The pesticides are useful when it is needed. The mixture with culture practice, varieties of resistant as well as conservation of natural enemies are applied. Below the threshold level of IMP are the great desirable approaches which integrate more than one possible measure of control. (Singh *et al.*, 2001; Verma *et al.*, 2002).The production are affected during an impressive period of cane growth due to the early infestation however due the late infestation from September onward in the field of cane the content of sucrose are affected. The harmful effects of the insecticides diverted attention of the scientist. The scientists are trying to control this harmful situation. The suitable technique IPM is adopted for the control of ecosystem disturbance. In IPM techniques the chemical, biological, cultural, mechanical, pheromone sex and light trap practice together are involved. For applying the IPM techniques the field of sugarcane are surveyed. The status of pests and pest's inheritance are studied by identification, monitoring, population dynamics and economic level, with other information. A balance use of fertilizers are helpful to control pests which top borers, shoot borers and black bug etc. Cultural practices such as population sustaining, waste protecting, and avoid crop logging, light entering during May and June are also helpful to control the harmful effect of pests. Sugarcane crop is anticipated as one of the leading crops and considerably significant in strengthening socio-economic position of the growers. The production of sugarcane and yield both have direct and indirect influence on the national economy. To meet dietary needs sugarcane also plays an important role (Hayes and Decker, 1996).In Pakistan, sugarcane cultivation occupied 5% of the total cropped area. During the last few years the average area under cultivation has increased while the average production of sugarcane falls between the ranges of 45-50 tons/hectare. However, the production recorded in Pakistan is lowest among 16 leading sugarcane producing countries. The production of sugarcane was 500-800 mounds/acre as compared the potential yield. The gap between the actual and potential production has been reported very vast by Nazir et al. (2013).In Pakistan, insect and pests had been reported playing a major role in dropping the production of sugarcane. The furthermost serious insect pests limiting sugarcane production are sugarcane borers, stem borers, guard spur borer and Pyrilla. These insects pests potentially reduced in the production of sugarcane from 15-20, 10-20 and 30-35% individually. In few cases the damage perceived was strange as 80-85% fall in crop yield due to the overwhelmed outbreak. Arid sugarcane tops were produced by the attack of Gordaspur borer throughout July to September anddry canes appeared due to its violence (Faqir- Gul *et al*., 2010). Top borer of Sugarcane caused a major yield decline of up to 36.5% (Rahman and Walayati, 2013). The crop Sugarcane is exposed to the violence by a respondents and some species of pest. The mode of damage calculation and found that damage at crop maturity stage (September-November) is high due to the softness in plant (10.40%). Whereas, the least affected variety is Thatta-10 (6.62%). Damage in cane is spread with others physical stress and micro-organisms which declined the sugarcane recovery and its weight as when. The rodents are controlled by formula which is zinc phosphide 2%, bromodiolone 0.005, and brodifacoum 0.005%.These baits decreased the pest population. For good organization of field rodents, IPM in combination of chemical, mechanical and manipulation of habitat are regarded effective in enhancement of the production. (Pervez *et al.*, 2019).According to (Ahmad *et al*., 2008) the increasing termites destruction extendedup to 34.8% in the sugarcane crop. Considering this damage of sugarcane due to pests, this study was planned to measure the effect of different pests in the production of sugarcane crop and the control measures as adopted by farmers to combat the pests of the sugarcane crop.

Methodology

This study was conducted in a randomly selected tehsil Khanpur of district Rahim Yar Khan. Khanpur tehsil is much famous for sugarcane cultivation. The list of sugarcane growers of tehsil khanpur was obtained from the office of deputy director of agriculture (extension), Rahim yar khan. Two villages were selected randomly. 60 register growers from each selected village were randomly selected thus making a total sample size of 120 respondents. Interviews schedule was used as data collection tool. The collected data were analyzed with the help of Statistical Package for Social Sciences.

Results and Discussion

In the month of April the atmospheric relative humidity was 52% and number of pests were 14. This mean that greater the humidity greater of the number of pests observed. In the month of May the atmospheric relative humidity 45% and the number of pests was 18. This mean less than April the relative humidity greater the number of pests. In the month of June the atmospheric relative humidity was 63% and the number of pests was 9. This mean greater the relative humidity lesser the number of pests. In the month of July the atmospheric relative humidity was 70 and the number of pests was 7. This mean greater the relative humidity lesser the number of pests (Figure 1, Table 1).

Table 1: Meteorological data regarding month and with dynamics of pest population.

Months	RH%	RH%	Maximum temperature °C	Minimum temperature °C	Total rainfall mm	Wind speed knot	Wind speed knot
April	52	20	40.7	21.8	0.0	2.0	2.6
May	45	19	43.0	25.1	0.00	1.7	2.1
June	63	31	44.2	28.4	6.4	2.5	3.1
July	70	43	41.4	28.4	14.1	1.9	1.8

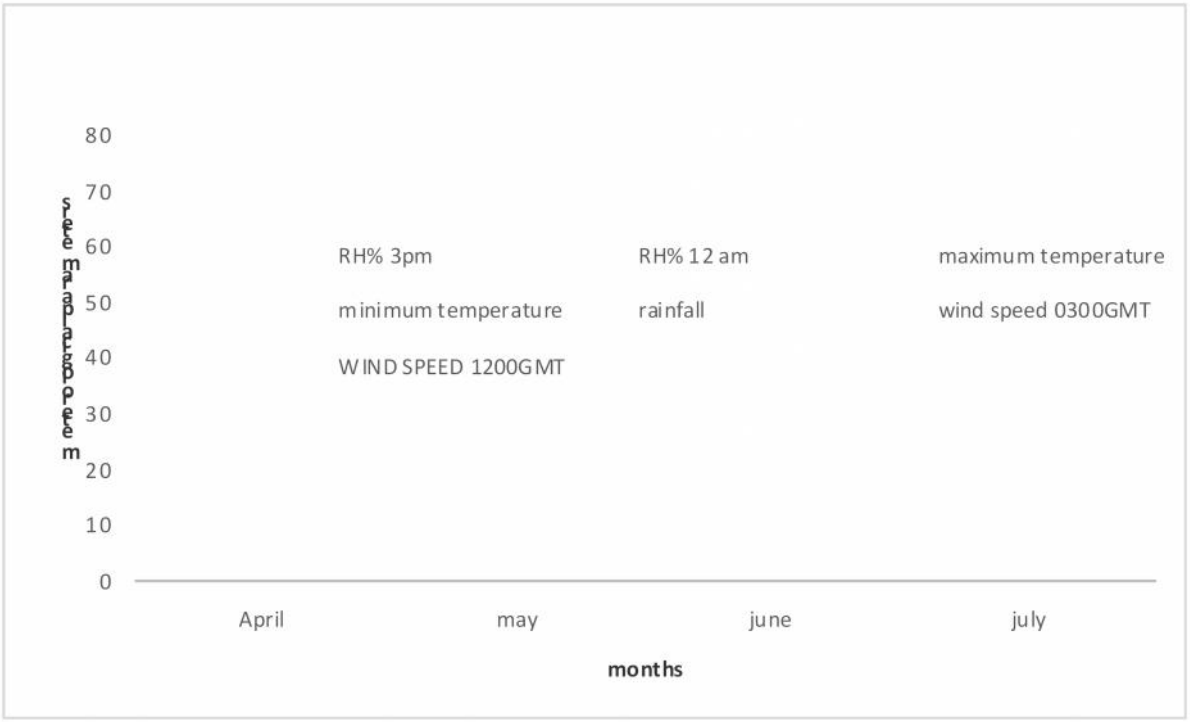

Figure 1: Comparative metrological data regarding months and with dynamics of pest population

In the month of April the maximum temperature was 40.7°C and number of pests were 14. This mean that greater the temperature the observed the number of pests were lesser. During the month of May temperature was 43.0°C and the number of pests were 18. This mean greater the temperature lesser the number of pests. In the month of June the temperature was 44.2°C and the number of pests were 9.This mean greater the temperature greater the number of pests. In the month of July the temperature was 41.1°C and the number of pests were 7.(Figure 1, Table 1).

In the April month the rainfall was 0.0 (mm) and number of pests were 14. This mean that lesser the rainfall greater the number of pests were observed. During May month rainfall was 0.00(mm) and the number of the pests were 18. This mean less the rainfall greater the number of pests. In the month of June the rainfall was 6.4 and the number of pests were 9. This mean greater the rainfall lesser the number of pests. In the month of July the rainfall was 14.1 and the number of pests were 7.This mean greater the rainfall lesser the number of pests (Figure 1, Table 1).

In the month of April the wind speed was 2.6 and number of pests were 14.In the month of May the wind speed was 2.1and the number of pests were 18. This mean less the wind speed and greater the number of pests. In the month of June the wind speed was 3.1 and the number of pests were 9. This mean greater the wind speed lesser the number of pests. In the month of July the wind speed was 1.8 and the number of pests were 7. This mean greater the wind speed lesser the number of pests (Figure 1, Table 1).

Conclusion

The study was conducted from the month of April to July in the crop of sugarcane. During the survey different pest are collected. Some of them are dominant pests in the sugarcane crop which are *Bissetia steniellus,Emmalocera depressella, Pyrilla perpusilla, Chilo infuscatellus, termite* and *Scripophaga*. The weather role toward the fluctuation population of the pests was find out by processing yearly data of study, using comparison paired t-test. The mean of Temperature, humidity, wind speed and Rh is determined by applying SPSS software. Degree of freedom and many control methods, like chemical (Carbofuran), cultural and biological applied, separately, and their possible groupings, to a specific resistant sugarcane genotype.

Gordaspur borer *Bissetia steniellus (Hampson*) was noted first in Khyber Paktunkhwa province in 1980's. It is a harmful pests in sugarcane. During the period of July it infect the sugarcane crop. *According to the*Faqir Gul *et al*. (2010), the larvae in young condition enter in the upper part of sugarcane through a hole which is present overhead the node. Afterward a week or ten days the pest attack the cane. The larval condition of duration is 21-27 days. The whole life cycle of *Bissetia steniellus* is 35-40 days. The sugarcane top dry are produce due to the violence of Gordaspur borer during theJuly to September months. Due to these borers attack large patches are appear in the dried cane.

Scripophaga is a sugarcane top borer. It belong from a family pyralidae and order is lipidoptera. It is the most harmful pests which is found in China, Pakistan and India. The active season of this pest is March to November. Later hatching the larvae in young condition cane bores concluded the midrib into the leaf, stalk and main shoot. In the form larva it hibernates. It occur when it attained the full growth. The maximum damage is noted from the month of April to July. The top part of sugarcane plant is infest by top borers. The generation number in a year is 4-5 and completely damaged the crop. The first two generation the sugarcane plants in young condition had reddish streaks in a plant due to its attacks. In the later stages of sugarcane plants growth is caused a symptoms which called “bunchy top” which deteriorates the quality and quantity of juice.

Chilo infuscatellus is a sugarcane stem borer which belong from the family of crambidae and order Lepidoptera. It is a harmful pests for the sugarcane crop. Its causes the loss of crop 36.5%. There damaged is 30-70% in a year. The larvae outbreak the plants base and start nourishing on them. The leaves are cut down by the caterpillar which in result causes the drying. The Central dead shoot is called as well the “dead heart”. When the development of cane are completed the violence of stem borers does not develop dead heart and only in few internodes is restricted destruction. It causes the major decline in yield. (Rahman and Walayati, 2013).

The *Pyrilla perpusilla* sugarcane leaf hopper belong from family liphopidae and order homoptera. It is also called (Walker). In sugarcane it is the greatest hazardous sap-sucking pest. It is also found in wheat, millet and Maize crops. It cause fungal diseases when it suck phloem sap from the leaves and excretes the

honey dew into the foliage. It harms the production of sugarcane directly and indirectly and its quality. Its nymphs are migrated to the other crops when sugarcane is harvested. Particularly in the morning, evening and night they are inactive. They become very active during the time of 10-3 pm and can be found on the both side of the leaves. Among the plants they jump easily. From the leaves the nymphs and adult sap suck and it decrease up to 50% sucrose level. Current study indicating the ways and means of pest identification in a sugarcane crop at Rahim Yar Khan with changing pest dynamics under abiotic and biotic factors and how these factors collectively contributing the success or failure of pest spectrum in a sugarcane crop. So this study is of great significance and applied contributing applied information useful for studies aiming to achieve the management of an introduced pests in Pakistan. Future course of action on these pests will serve as a reference in exclusive control and surveillance on abiotic and biotic parameters for effective control strategy. The results obtained in this study demonstrated the possibility of exact identification in systematic for effective control measures.

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