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Sugarcane: Diseases Due to Pests, Pest Management Strategies and Factors Influencing the Production of Sugarcane

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Abstract

Sugarcane (*Saccharum officinarum*, L.) is the second major crop of Pakistan. It is not merely a significant sugar crop but also a resource of inclement notes for different agro-based industries in Pakistan. Sugarcane yields have been rigorously abridged in various parts of Asia as attacked by enormous number of insect pests and diseases. Changes in cropping patterns including the cultivation of high yielding varieties and hybrids have added to the problem in some areas. Plant breeding has been successful to some extent in keeping up with new and evolving diseases and pests. Innovation in agronomic practices, advent of chemicals for control, and more recently genetic engineering tools have been providing new opportunities for reduction of crop losses due to biotic pressures. Insect control is even more important as many viral diseases are transmitted by insects.

Keywords: Sugarcane; insect pests; yield loses; borers; infestation; cane diseases; integrated pest management.

1. Introduction

Sugar is the largely ideal geological sweetener and energy mine worldwide .The healthful reimbursement of sugar is a resource of persistent deliberation in the residential countries [1]. It is a source of occupation to millions of people and is primary to the cost-effective expansion plan of sugar producing countries [2].

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About 80% of the world's sugar is consequent from sugarcane while the enduring 20% is from sugar beet (*Beta vulgaris*: Amaranthaceae) [3]. Sugarcane (*Saccharum officinarum*; Poaceae) is one of the world's largest beneficial crops. Globally 121 countries escalate sugarcane and together with them Pakistan, Australia, Argentina, Bangladesh, Brazil, China, Columbia, Cuba, India, Mexico, Myanmar, Philippines, South Africa, Thailand and USA share 86% of field and 87% of production. In Pakistan, it is the second foremost currency crop after cotton [4], contributing in charge new cultivation and GDP up to 3.4% and 0.7%, correspondingly [5-8]. In supplement to sugar, sugarcane is also used to produce ethanol, bagasse, molasses and lobby mud [9]. Sugarcane provides raw materials as basic resource for industries like paper and chipboard manufacturing. It is furthermore an central basis of earnings and employment for the agricultural society of Pakistan (Food and Agriculture Division, 2009). This is an advantageously significant crop that has a profound economic impact on community and governmental issues in numerous countries around the globe [10]. In 2016, worldwide sugarcane production was estimated 1.89 billion tones [3]. It grows perfectly where there are stretched periods of sunlight (12-14 hrs.), high temperature scope is between 20°C and 35°C and, moisture is high, 80-85% [11]. Sugarcane fertility, which was bare by Soltwedel in Java during the belated 1880s, sharp out a new period in sugarcane culture. Wider clamor spacing of 150 cm is optional for hot region of the country to facilitate mechanical harvesting as well as sustaining top punish yields [12]. The sugarcane flora and fauna (phytobiome) comprises many weeds, arthropods and more than 50 plant pathogens [13-15]. It is sustained duration crop; so a number of biotic and abiotic agents distress its productivity, including insect pests, viruses, bacteria, fungi, nematodes, invertebrates and weeds [16-19]. In general, diseases and insect pests obtain prospective to diminish its creation by 19 and 20%, respectively [20-21]. Sugarcane crop is attacked by huge number of insect pests and diseases [22-23]. Arthropod pests allied with the crop worldwide consist of complexes of branch feeders, sap sucking insects (e.g., aphids, thrips, mealy bugs), root feeders (e.g., white grubs, stem borers), and spider mites [24-31]. Many farmers are in worry about their crops and decreasing production rate. This article offers information on sugarcane production, cultivation, effect of different environmental factors on sugarcane, some of the most important diseases and pests of sugarcane and converse every aspects of pest management strategies.

2. Factors for cultivation of sugarcane

2.1 Suitable Climate

Tropical or sub-tropical climate having about minimum 600 mm rainfall per year is more suitable for sugarcane cultivation. In Pakistan north western zone, central zone and southern zone are more popular for cultivation of sugarcane. Pakistani area of Sindh have hot and semi humid climate, so considered as more suitable and favorable for cane crop. Climate of Pakistan is good for best yield of sugarcane but weather conditions sometimes cause hindrance in growth of sugarcane [32].

2.2 Photosynthetic efficiency

Sugarcane has ability to convert the 2 percent of solar energy into biomass and said to be as most effective photo synthesizer. It converts more solar radiations and carbon dioxide into fiber, food and fuel as compared to other crops [33].

2.3 Productivity and utilization

A number of efforts have been done for best production of sugarcane but results are still low as compared other countries which produces sugarcanes. Many factors can be the cause of this like inappropriate methods of growth, infertile land, less production, improper management, poor methods of cultivation etc. while improper irrigation is the main factor of poor yield of sugarcanes [34]. About 73.74% of total yield of sugarcane is utilized by the factories and when the overall production of sugarcane decreases then this percentage decreases to 62-68%. On the other hand Gurr production from the sugarcanes is more profitable even in the low yield years [35].

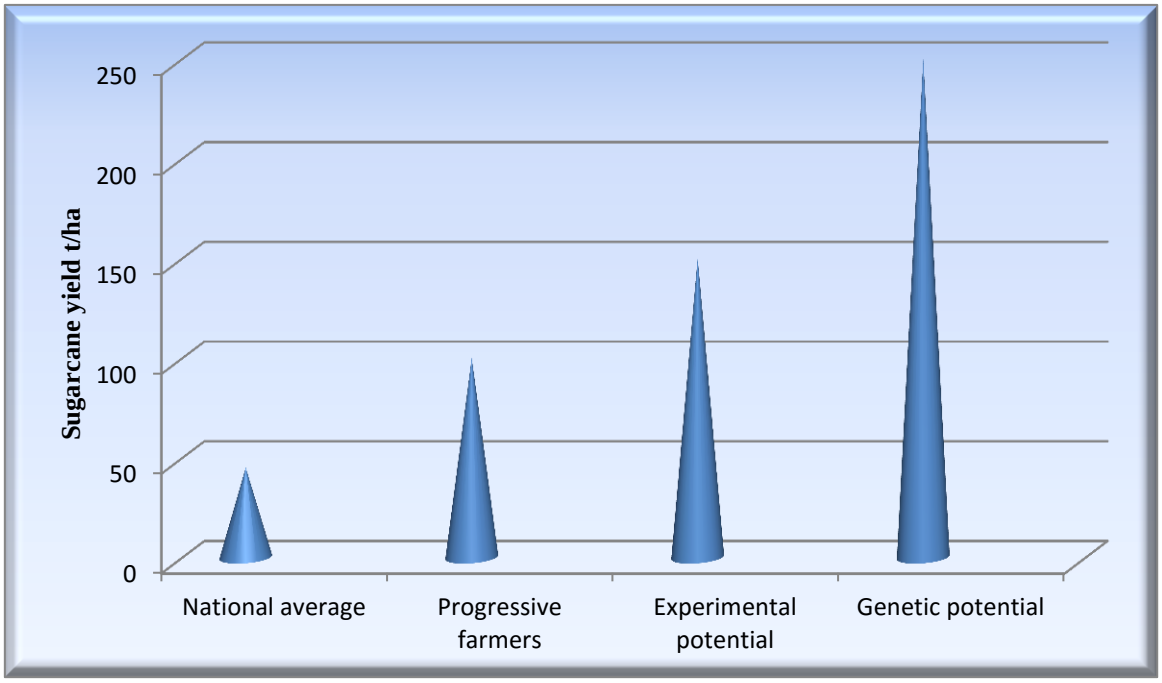

Figure 1: National average and potential sugarcane yields [35]

2.4 Temperature

Temperature has great effect on cane production. High temperature may leads to death of cells while low temperature can cause other damages [36]. High temperature can cause heat stress which can affect the enzymatic activity of sugarcane, germination of seeds, growth of sugarcane as well as yield of sugarcane [37]. Low temperature may reduce the metabolic activities of sugarcane and can cause osmotic stress [38].

3. Factors Affecting Sugarcane Production in Pakistan

3.1 Soil Type

Sugarcane can be grown in all types of soil but for good production loamy clay soil is suggested to be perfect because water intake capacity increases here [39].

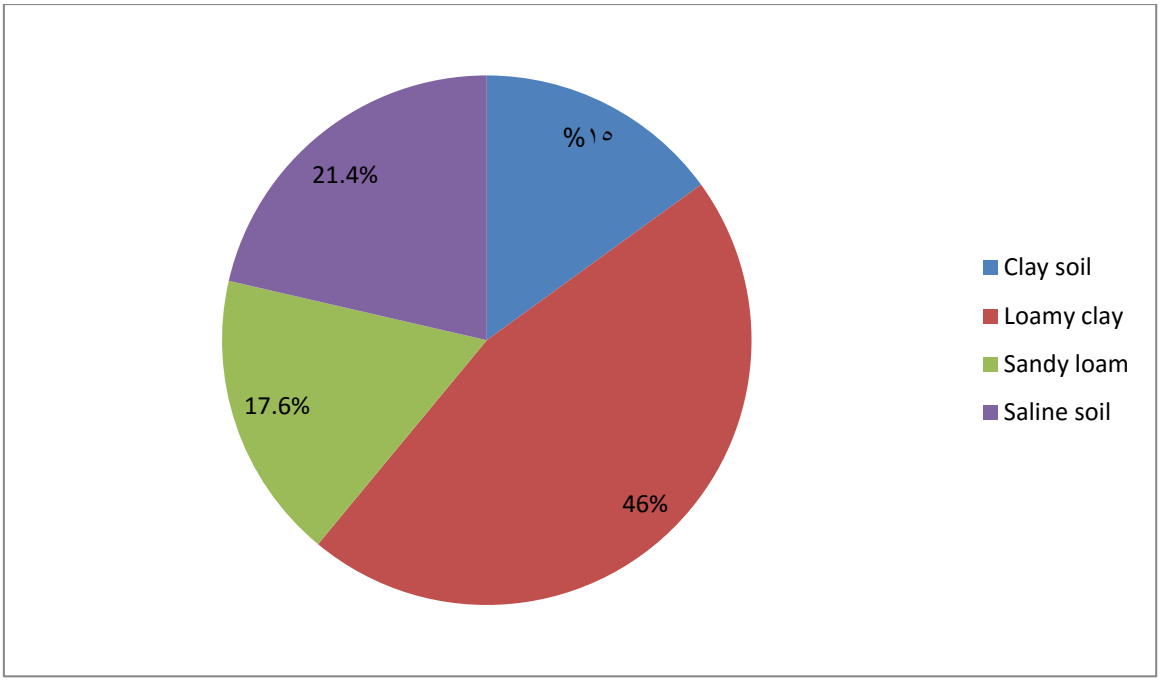

Figure 2: Farmers perception about soil types for the cultivation of sugarcane [39]

3.2 Planting Seasons

Sugarcane planting usually done in two seasons Autumn and Spring but Autumn planting is more suitable because it gives higher yield as compared to spring. According to the months, October planting is more opulent but it have more chances of attack. A study reveals that approximately about 27.4 percent of growers planted sugarcane in February, 20.7 percent in October, 15.8 percent in March and 11.1 percent in September. While 25 per cent of the growers in the study area planted in spring (Feb-March) and in autumn (Sept-Nov) seasons respectively [39].

3.3 Planting Method

The most common method of sugar cane planting is “overlapping”, “end to end” and “double set” methods. The cost for planting was recorded about 872 rupees per acre and investigated that any procedure or seed treatment was not followed before sowing the seeds of sugarcane [39].

4. Sugarcane diseases and their control

4.1 Sugarcane Smut

This disease is mostly caused by the fungus *Ustilago scitaminea* [40]. It can be characterized by normally whip-like surely sorus-bearing structures [41]. Slender stalks, remarkably small narrow leaves and size variation are also its characteristics [42]. After 2-5 months of cultivation, the diseased plant attain smut whip and shoot affects earlier [43]. Globally, the most cane production affected by smut [42]. Sucrose level, yield and juice quality is greatly affected due to sugarcane smut disease [44-45].

Control:

1. Rouging: remove or destroy soil before inserting the whip [46].

2. Plant deadly stems.

3. Hydrothermal treatment for 30 minutes at 52°C before planting [47].

4.2 Red Rot disease

Cane erythema is caused by the fungus Glomerella tucumanensis [42]. Red rot appears on the stem or spots with red spots and white centers and is recognized as a bundle of red blood vessels [42, 48]. Red rot is transmitted mainly from contaminated plant debris in the pores of water and soil. Agricultural and moisturizing agents, which typically infect insects, especially stems and termites, fungi and secondary invaders, accelerate the development of the disease [42, 48-49] red blood cells reduce sucrose in infected plants and increase processing costs due to impurities in the sap, while red artillery significantly reduces the germination rate of infected plants for planting [42].

Control:

1. Planting resistant varieties [50].

2. Loosen the injured mass during the growing season.

3. Protect the weed less field and avoid planting in contaminated fields where plants were previously affected.

4.2-3 years of soybean harvesting practice (without grain).

5. A grid of healthy plants. It is necessary to remove dirt that indicates redness at the edges of the wound or part of a node or hole in the stem.

4.3 Sugarcane mosaic virus disease

Sugarcane mosaic virus disease has been identified as one of the most important and deadliest pipe diseases in the world. SCMV is transmitted by mechanical ways and aphids. Diagnostic symptoms include young leaf spots and bright green or yellow-green leaf spots [42].

Control:

1. Plant-resistant varieties

2. Equalize systematically contaminated stocks by season.

3. Get rid of aphids and alternatives such as ivory, corn and sorghum.

4. Healthy plants should be selected

4.4 Sugarcane leaf blast

Sugarcane leaf eruption caused by the fungus Paraphaeosphaeria michotii. This is a mild disease that survives straw and leaf debris [42]. It attacks both leaves and stems. It affects leaf leaves, initially forming long yellow narrow spots with long axes parallel to the vessels. Spots can merge, and all leaves are red, dry and die from top to bottom [42, 51].

Control:

The best way to control this disease is to use only resistant varieties of a desire plant [50].

4.5 Curvularia leaf spot disease

It is believed that the disease is a leaf region caused by Curvularia lunata [42]. The initial symptom is a slight pale yellow ribbon lesion on the first five leaves. Red changes occur around the lesion, and the affected tissue eventually dies [52].

Control:

To control this disease use resistant varieties only.

5. Pests of sugarcane

5.1 Stem borers

The larvae of several butterfly barrels are among the most important sugarcane pests. The stalk attacks the shoots, which are the parts that grow. They dry up and die, creating a "dead heart." In addition, if young reeds are attacked before the inside is formed, their inventory will decrease, leading to their extinction. When the larvae of the inner stem create an internal tunnel, the weight of the stem decreases, the quality of the juice decreases, the stem breaks and the residence time decreases. If a serious infection occurs, the stem dries or rots, resulting in late processing of unwanted shoots [53]. Sesamia nonagriodes botanephaga, S. calamistis, Eldana saccharina and Chilotrea spp. This is the main stalk of sugarcane [54-56].

5.2 Early shoot borers

Adult moths stain in straw and lay eggs in groups of 10-30 eggs on the surface of the leaves along the edges of the center. Borage infections are serious before the rainy season (April to June). A plant infects plants when lead growth begins before the formation of the inside. Caterpillars penetrate laterally through reeds through one or more holes in the stems (shoots) just above the ground, split up and down, killing growth points and creating

gaps in the field. Caterpillars can destroy three or four buds before germination. The advent of monsoons significantly reduced drilling activity [57-58].

5.3 Internode boresrs

The old butterflies are straw and rather tall. Larvae meet walnut plants three months after sowing (June-December). Immediately after the formation of the node, damage to the plant and its activity continues until harvest. They are inserted into the pipe near the node, the entrance is clogged with dust and spirals. Larvae detect damage in the pipe from one to three segments [59].

5.4 Root Borers

Adult larvae are milky white. They are called root plants, but they do not eat roots, they drill holes in the root surface. Only the underground part of the trunk is attacked by pests. Boring attacks mostly occur on young sugarcane plants, causing total loss of crop and serious damage in the first week of September [60-61].

5.5 Sugarcane leaf hoppers

Raise adults and nymphs by sucking cell juice from the bottom of sugarcane leaves. With the continuous removal of hair in various containers, the upper leaves of the affected stems dry out and the side shoots begin to bloom. The container releases a sticky liquid known as honey dew. Promotes fast and rich growth of the sponge, therefore it is completely covered with fungal leaves. This affects plant photosynthesis and plant growth [59, 62].

5.6 Sugarcane woolly Aphids

Wollblattlaus (SWA), Ceratovacuna lanigera Zehntner (Homoptera: Aphididae) is one of the most important sugarcane pests in Southeast Asia. Severe C. lanigera infection was reprinted to achieve a significant reduction in re-care properties and a 15% reduction in sugar levels [63].

5.7 Nematodes

Nematodes (blackheads) are filiform animals that are invisible to the naked eye, attack sugarcane, cause discoloration of the roots, cause infectious diseases, infect viruses, grow, produce giant cells and reduce the amount of nutrients. , In severe cases, nematodes cause growth disorders, yellowing and subsequent death of infected plants [64, 65].

5.8 Scale Insects

High temperature and high humidity contribute to the accumulation of Scale insects. Seeds are the way of spreading them into new areas. Scales are usually attached to an internal assembly covered by a leaf cover. The trees of diseased canes give you an idea about secret code of tip drying and unhealthy pale fresh color and with never-ending plague junction yellow. De-sapping leads to non-opening of plants jaunt blonde and ultimately emotionless up. Nodal area is extra infected than intermodal region. Contaminated crop enlargement is small

and the intermodal measurement lengthwise is cheap drastically [59, 66].

5.9 Termites

The termites incident setts, shoots, canes and stubbles. The termites collect submission through the graze split ends or through buds of the setts and give to eat on the silky tissue. The tunnel excavated is packed with the soil. This affects germination and like so the first crop plunk and finally the staff yield. The germination collapse can be up to 60% [67-68].

5.10 Whitefly

Waterlogging and nitrogen malnourishment source plain eruption of whiteflies. Varieties with broad and lengthy foliage are new susceptible to this pest. The nymphs of pallid flies (white flies)suck the sap away from the under rise of foliage which results in color changes like yellow and pinkish and in serious case it results in drying of the leaves. Arduous infected trees are roofed by the dirty mould caused by the fungus, which adversely affects photosynthesis. The whitefly plague retards hit intensification and reduces honey please [59].

6. Pest Management Methods or Practices in Sugarcane [69]

With respect to sugarcane cane Crop production following are the Pest manage-ment Methods which can be adopted.

6.1 Cultural Method

The practices like manipulation of date of planting, Trash mulching, Detrashing, Earthing-up etc are cultural method of pest management in sugarcane crop.

6.2 Physical or Mechanical Method

Collection and destruction of adult beetles at the time of emergence, egg masses of top borer, cane harboring for Gurdaspur borer etc. would reduce the pest population in short term and long term. Although the mechanical practices are constraints by non-availability of human resource and operational economic.

6.3 Varietal Management Method

Some Pest resistant varieties are available; the proper verity of the crop should be planned for cultivation.

6.4 Biological Method

The biological methods include the principles like develop the native natural enemies of targeted pest or colonizing pests in the invaded areas. This method is mostly recommended by entomologist now a day.

6.5 Chemical Method

Chemical practices are largely used by the farmers to control Pests. Insecticides or pesticides prevent the rapid buildup of pest population to economic injury levels. Despite the minimal usage there is a need to select appropriate insecticide and formulation and adopt proper method and time of application for different seasons and situations. It is not compulsory for the keep in check of bit people that integrated mosquito management tradition must be followed from the sowing time up to harvesting. Awareness is supposed to be shaped amongst the growers all the same augmentation people and schooling workshops about other sugarcane borers, their excitement cycle, time of hurt and habit of management practices. Resistant varieties must be adult to underestimate monetary losses [68]. Sugarcane mice are able to be prohibited by the next events [53]:

1. Planting sugarcane as remote left as on the cards from maize, millet and sorghum and eliminating elephant meadow from the vicinity of the walking stick farm.

2. Planting of good and vacuum setts should be done which are free from bit plague (no bored holes).

3. Handpicking and larvae Killing and adults and burning the diseased parts of the plant.

4. Planting should be in October or at the newest November to avert borer.

5. Practicing 2-3 day rotation with leguminous crops.

6. Avoiding planting in fields beforehand cropped to sugarcane, which will dole out as a lake for the borers.

7. Conclusion

With increasing availability of information and understanding on how plant pathogens and pest cause damages to sugarcane, new strategies are being devised to enhance protection that is possible. Plant breeding and biotechnology tools in combination are already providing new materials for better plant management. The pest management tools that have been deployed have had a positive impact on the environment by reducing the amount of chemical pesticides that are applied to these crops.

8. Recommendations

In future, such steps should be taken by the government/non-government organizations to aware people about diseases of sugarcane due to pests and how they can be avoided from this problem. Researchers should find out more reliable methods to control these pests biologically to save the crops.

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