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Review Article

Impacts of Diseases and Pests on Forage Crop Production and Management Systems: A Review

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Abstract

A forage crop diseases and pests incidences identification and management system is precondition for the viewpoint of ecological and environmental protection to address the issues of numerous types of forage crop disease and pests-control, and management for easy identification. The incidence of diseases and pests reduces the productivity of forage crops causing significant financial losses, and decrease feed production. This review paper is aimed to illustrate the common diseases and pests in forage crop production and management and indicated the way forward. The application of chemical pesticides used to control the diseases and pests could affect plants, soil, and wildlife as well as human wellbeing. In the next years, there will undoubtedly be a greater need for high-quality feed production as people become more conscious of illnesses and pests. When preparing forage this way, less non-organic items are used. Based on recommendations, chemical pesticides and fertilizers will be essential. In order to minimize the impact of disease and insect infestations on productivity, bio-management of disease and insect pests in fodder crops the following year will surely be crucial. Therefore, several management strategies offer effective and environmentally sound affordable defense. Against foliar diseases, nematode-caused root knot disease, and soil-borne and insect forage crop pests. These disease and pest management systems allowed indispensable contributions in forage genetic resource conservation.

Keywords

Disease, Pest, Management, Conservation, Forage

1. Introduction

Among the several factors reducing the productivity and production of forages disease and pests have consistently been the main hindrances. A few diseases are seriously harming feed crops [1]. Early warnings of the risks of pest and disease outbreaks are becoming more important as the risks to farmers from invasive disease and pests have significantly increased [2].

However, there are mitigations of diseases and pests through the use of chemical controls, but over use of chemical pesticides on forage crops have deleterious effects through accumulations of toxic residue in feed, reducing soil fertility, disturbing natural bio-diversity, and finally resulting in adverse effects on the forage or fodder production including damages on soil, animal and human health. Therefore, alternative bio-management (an eco-friendly, cost effective and easy to handle) of insect pests and diseases evolved and is being used for sustainable agriculture [3].

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Conservations of forage crops and avail fodders are vital for sustainable development of animal production. The uses of agricultural lands to non-agricultural, in natural pasture lands and the cultivations of quality and disease and pest resistance forage crops allowed to improve the quality and sustainable productions. This paper aimed to review and illustrates the impact of common diseases and pests incidences in forage crop production and management and indicates the way forward.

2. Common Disease Incidence in Forage Crops

In 4000 BC, the oldest known period of cultivation, indications of disease were discovered, and farmers chose the healthy cultivars among the seeds for the following crop cycle. Crop diseases were more prevalent in the lowlands, and several diseases damaged various crops [4]. A variety of plant parts, including roots, leaves, stems and seeds, seedlings, and complete plants, are susceptible to the forage and fodder production invasion disease along with the reduction of quality parameters of forages [5].

According to Brian *et al*. [5] reports, long smut and rust are common in Pakistan, West Africa, Iraq, Egypt, and Tamil Nadu. Since long smut and rust disease only affects a few grains in an ear occasionally, they cause minimal harm to forage crops [6]. Different types of diseases for the various forage species presented in Table 1.

Table 1. *Common diseases of forage and fodder crops.*

Disease	Infected plants	References
Anthracnose, Bacterial wilt, stem disease, brown root rot, leaf spot, sprig black stem, Downy mildew	Alfalfa, Sorghum, Oat, Cowpea, Lablab, Lucerne, Soybean, Leucaena, Gliricidia and Calliandra	[5-8]
Phytophthora root rot, Aphanomyces, Pythium, Rhizoctonia, Rhizoctonia, Sclerotinia	Alfalfa	[9-11]
Bacterial canker, seedling blight, tar spot	Sesbania, Maize Sorghum	[5, 6]
Sercospor leaf blight	Cowpea, Lablab, Soybean	[12]
Sooty stripe	Sorghum, Maize	[13]
Stem rust, leaf spot	Ryegrass	[14]
Dwarf virus, crown rust	Oat	[14]

Disease Management

The prerequisite for achieving maximum and sustainable production increases to meet livestock demand is disease management in the forage and fodder industry. The primary limiting factor for the cultivation of fodder and forage has traditionally been diseases, among other restrictions. Fodder crops are suffering significant losses due to a number of infectious diseases. Additionally, these diseases have an impact on the forages' quality (Table 2). In Lucerne and maize diseases can cause losses of productions [15, 16]. In addition to climate change, maize is increasingly challenged by plant pathogens [17].

Breeding for resistance against current and potentially emerging plant diseases, which can be increasingly influenced by climatic and atmospheric changes, is one way to manage the growing biotic risks in forage and fodder cultivation [18-20].

Table 2. *Forage and fodder disease symptom and management.*

Forage and fodder	Disease	Symptom	Management
Sorghum	Smuts	Conical at the tip Grain convert to smut sori Dirty grey sac	1. Seed treatment with fungicide 2. Seed immersion in 0.5% formalin for 2hs. & dried quickly 3. Use 0.5-3% copper sulphate solution for 10-15 min then dried and sowing

Forage and fodder	Disease	Symptom	Management
			4. Use fungicide like carboxin (vitavax, Bavistin) [20].
Oat and Sorghum	Loose smut	Affected ear appears like leafy Dark colored spores	1. Seed treatment with formalin, sulpher, copper sulphate, carboxin, Bavistin etc. 2. Crop rotation and field sanitation to destroy spore from soil [7].
Sorghum	Head smut	During ear head or flowering inflorescence is converted to big sorus, thin grayish to white Spores formed at leafs	1. Sanitation, seed treatment and crop rotation 2. Destroy affected plants smutted head in cloth bags and dipping in boiling water to kill the pathogen [21].
	Long smut	Damage grain in an ear Thick whitish to yellow membrane at the ears Green spore balls	1. Difficult to control because it is transmitted by air 2. Controlled by adjusting sowing dates [7, 20].
Oat, Maize, Phalaris Grass, Lucerne and Sorghum	Rust	Yield reduction Occur at 2 months old of plants Appear at lower leaf part Older leaves dry prematurely	1. Removal of other carrier plant because it survive on other hosts 2. Spray Zineb or Mancozeb at 1.25 kg/ha in 15 days interval 3. Use hyper-parasite fungus Trichothecium roseum [13, 22].
Sorghum	Downy Mildew	Whitish color on growing surface of leaves It spread over the leaf blade then, appear yellowish through upper surface	1. It is soil born disease so cultural deep ploughing in (30-35 cm), could control the disease. 2. Use of potassium azide at 25 WP (2g per liter) of water at 10 and 40 or 20 and 50 days after planting [21].
Sorghum	Anthracnose and red rot	It appears as small red, purple or brown spots with whitish or purple center It has 2-4mm long and 1-2 mm broad Discoloration when stem split	Seed treatment with Captan or Thiram at 4g/kg seed and spraying of Mancozeb at 1.25 kg/ha [23].

3. Common Pests Incidence in Forage Crops

Forage and fodder pests can live on any kind of plant. Actually, one of the advantages of plants is that they encourage local insects and pests, which serve as a source of food for pests and other species [24]. Over 97 percent of insects are beneficial to agriculture, while only 3 percent are destructive, reduce productivity and yield [25]. Thus, insects either directly or indirectly uses nearby plants like fodder crops and natural pastures as shelter or a source of food [26, 27]. While forage legumes have relatively few significant persistent insect pests, whereas forage grasses are generally free of pests. This is due to a number of factors, of which the existence of relatively high levels of plant compensatory ability [25, 28].

There are different insect pest in forage and fodder production which limit the gain from product maximizations and expansions. They act on different forage and fodder types regarding the variability of insect pests and act on varied plant parts (root, leaf, stem, flower, seed and/or whole plant parts) and at different stages of growth. The larvae of Japanese beetles are polyphagous that feed on numerous plant species including the plant roots and feed on over 300 species of wild and cultivated plants in around 80 plant families [29].

In the cause of legume species, over ten insect species limit the production; the most important ones are in the order *Coleoptera*, *Hemiptera* and *Thysanoptera*. *Hypera postica*, species of *Sitona virtuoso*, *Apion seniculus*, and *Otiorrhynchus ligustici* L., all of which belong to the family *Curculionidae* are *Coleoptera* within the subsequent stages of the development of horse feed [30-33] mentions 86 different species of insects and mites, 3 bacterial, 24 fungui, 3 viral, and 3 mycoplasmic diseases, as well as 9 nematodes that attack alfalfa and other forage species like *tree lucerne*, lupines, cowpea (*Vigna anguiculata*), lablab (*Lablab purpureus*), pigeon pea (*Cajanus cajan*) and sesbania (*Sesbania sesban*) (Table 3). The most common pest species in cowpea are *Lepidopterous*, *Coleoptera*, *Homoptera*, *Thysanoptera*, *Diptera* and *Hemiptera* that cause yield loses up to 85% and more in African and Asian countries [34, 35, 9].

Table 3. *Common insect species affecting forage species.*

Insect species	Host plants	References
Odontotermes (like termites), white grubs, Chrysolagria, Alcidodes erythropterus, Acanthoscelides obtectus and Agonoscelis pubescens Thunb	*Sesbania sesban*, Tree lucerne, *Cajanus cajan and lupine*	[33, 29, 10]
Aphi fabae	*Cajanus cajan, Gliricidia sepium*	[31]
Aphis craccivora	Cowpea, alfalfa	[29, 7]
Lepidopterous, Coleoptera, Homoptera, Thysanoptera, Diptera and *Hemiptera*	Cowpea, alfalfa, lablab	[34, 10, 36]
Brachycaudus helychrisi, acrosiphum euphorbiae, Aphis craccivora, Acyrthosiphon kondoi, Myzus persicae	Lupine, Cowpea, alfalfa, lablab, tree lucerne, faba beans	[35, 9]
Sitona hispidulus, Sitona aliceae, Sitona lineellus	Tree Lucerne, cowpea, alfalfa,	[37, 11]
Spodoptera frugiperda, Chilo partellus	Napier grass, maize, (Pennisetum purpureum), sorghum (Vulgare sudanense)	[12, 2]

Pest Management

Long-lasting pest management should have no negative effects on the environment. Chemical, cultural, biological, mechanical, and physical control applications predominated (Table 4). The control of fungi such as Trichoderma viride, Trichoderma virens, Trichoderma harzianum, Aspergillus niger, Aspergillus terreus, Cladosporium oxysporum, Paecilomyces lilacinus, Beauveria bassiana, and Anisopliae metarhizium, etc (known for their fungicidal, insecticidal, nematicidal activities) the most crucial bio-management is the mass manufacture of biocontrol agents. Biocontrol agents mentioned above can be separated from the locality or purchase from government agencies [38].

Table 4. *Pest control methods and applications.*

Control methods	Application
Cultural	1. Use treated, improved and resistance seed 2. Timely planting or sowing 3. Burning of old crops debris 4. Removal of weeds
Physical and mechanical	1. Manual control by destroying (egg, larvae, pupa and adult etc.) 2. Pheromone trap (sex pheromone and aggregating pheromone) 3. Insect light trap
Biological	1. Uses of bio agent like *Trichogramma* species, lady bird, beetle 2. Chrysopa the installation of bird perches at 15 birds per hectare
Organic insecticide	1. Use of neem seed kernel extract 2. Spray of nuclear polyhedrosis virus (NPV) at 2.5 ml/10 liter water 3. Soil treatment at 1.25 kg/ha or seed treatment with 5g/kg of seed by bio fungicide like Trichoderma virile
Chemical control	Uses of chemicals based on proper stage of application
Sterile insect	Mass rearing of pest species on artificial diet by exposing to the radiation to cause chromosome damage, damaged; chromosome not fertile for mating.

Source: [39, 14]

4. Genetic Resource Conservation

Genetic decay is caused by both biotic and abiotic processes. Additionally, the past has paid relatively little attention to the resource's collection, conservation, characterization, evaluation, and sustainable usage. In contrast to trim germplasm, which is found as landraces in farmers' areas, wild forage and fodder are found in meadows and forest areas that characterize pastures, either with tiny numbers of plants distributed throughout a vast zone or as massive regions of one species in open grasslands and forests [40]. While scavenge landraces tend to have less seed breaking and more uniform growth, some scavenge grasses exhibit seed shattering that occurs as the seed ages or as the seed unit dehisces in some scavenge vegetables [41]. This comes about in a few seeds being collected while they are youthful and unable to survive the drying and capacity handle, coming about in destitute quality or little numbers of seeds being stored [42].

Both cultivated and wild species have been taken into consideration while designing seed gene bank protocols, however most gene banks place a strong emphasis on the preservation of edited hereditary assets despite the necessity of include edited wild relatives in their collections. Although the main paradigm and information base focused on the preservation of edited plants, the same criteria have been successfully applied to the ex situ preservation of wild plants. The challenge with establishing standard norms is that seeds from forages, wild relatives, and wild populations generally do not have the tall intra-seed component consistency of edited seeds [43].

Scavenge species' seeds exhibit significant inconsistency inside and between seed packages as well as within and between increases of a species, which makes it challenging to develop thorough protocols. For scavenging species, information is available on seed maintenance from seed collection through storage to germination and multiplication [41].

The multilateral system of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) serves as the legal foundation for crop and forage crop collections [44]. This pertains to the main crops where countries are mostly dependent on one another's genetic resources for food security, allowing them to interact without restriction. Utilized for feed and agriculture and traded under a standard material transfer agreement (SMTA) includes options for benefit-sharing based on their commercial use [45, 46].

The expenses of administration and conservation in gene banks reflect the organic differences between edit species on the one hand and scavenge and wild species on the other. Other than from the gene banks of the consultative centers, there is no information available on the actual costs of preservation [47, 48].

Using this data as an example, it can be seen that in CIAT in 2000, the amount of preservation and administration per test was more than twice as high for scrounges as it was for beans [47]. Costs for the preservation of the same species vary considerably between locations. The expenses of acquisition, characterization, safety duplication, medium and long-term capacity, germination and seed wellness monitoring, regeneration, seed handling, data administration, dispersion and common considerations were calculated in 2006 and 2009 [47].

One illustration is the relative expense and risk of gathering forages, preserving them ex situ in seed or field gene banks, or sustaining them in situ in conservation zones among the vast grasslands where they originated and continue to adapt and evolve. If there is no indication of a current threat to these forage genotypes or of historical genetic erosion, in situ conservation is a good solution for forage species that are well protected in the wild [49].

One of the methods used in the initiative to conserve plant genetic diversity is the field gene bank. It is an ex situ technique in which samples of a species, subspecies, or variety are moved and preserved as living collections while genetic variation is preserved away from its original location. The most popular technique for conserving genetic resources of species with resistant seeds and vegetative propagated plants is the field gene bank. Even though the economic cost-benefit analysis of conserving large ex situ collections of forages combined with the option to conserve forages in secure conservation areas in national parks indicates that there are other more cost-effective options for the conservation of forage diversity in many cases, the forage germplasm currently held in ex situ collections may well be the more accessible source for research and forage development because it eliminates the need to collect [47, 48, 50].

5. Conclusion and Recommendations

Because grass species have a high rate of compensatory development, grass species are more likely to exhibit pest and disease resistant feed than species of legume fodder. The majority of insects are polyphagous, feeding on many plant species. Early agricultural cultivation and disease discovery occur close to one another. In the lowland, diseases that affect the cultivation of forage crops are more frequent. Environmental harm caused by other chemical pesticides is avoided while using biological, physical, mechanical, and cultural treatments are appreciated in diseases and pests control. To meet cattle demand, disease management in the forage and fodder industry has increased. Disease is the main factor that restricts the production of forage and fodder. In general the establishment may be significantly impacted by pests and pathogens, the lifespan and yield of grass and pasture crops.

People are becoming an increase aware of diseases and pests in future need for quality feed production without a doubt years. Forage prepared in this approach uses less inorganic ingredients. Chemical insecticides and fertilizers will be crucial based on recommendations. The following year's disease and insect pest bio-management in forage crops will undoubtedly be important in reducing the losses of illness and insect infestations affect yield.

Abbreviations

CIAT	International Center for Agricultural Technology
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
NPV	Nuclear Polyhedrosis Virus
SMTA	Standard Material Transfer Agreement International Center for Agriculture

Conflicts of Interest

The authors declare no conflicts of interest.

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