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Perspective, Challenges for Biological and Chemical Management of Important Diseases of Mungbean (*Vigna radiata* L.): A Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Use of biological agents and fungicides like- *T. viride* at 2.5%, *T. harzianum* @ 2.5% and *Pseudomonas fluorescens* @ 2%, neem leaf extract at 10%, garlic extract at 10%, and carbendazim at 0.1% as a fungicide in powdery mildew disease for give the better results compare to control. A germplasms lines of mungbean were tested for resistance to *Macrophomina phaseolina* along with JL-781 as a susceptible check in sick plots these test lines. Among the 2 were moderate resistant, 1 germplasm was moderate susceptible, 1 germplasm was susceptible and JL-781 to highly susceptible. A visual scoring index (VSI) was used to evaluate the signs and symptoms of MYMV infection. Compared to the primed plants, which only had 14% of the same symptoms, more than 70% of the unprimed plants had symptoms that were considered serious or

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deadly. Whitefly control with insecticides has been deemed helpful for managing yellow mosaic virus. The environment and human health were also negatively impacted by the over usage of chemicals. Preventive and therapeutic measures using pesticides effectively is crucial for preventing soil-dwelling and seed-borne infections across all IDM strategies. All of the fungicides outperformed traditional fungicides in terms of performance.

Keywords: Mungbean; powdery mildew; leaf blight and mungbean yellow mosaic virus.

1. INTRODUCTION

Mungbean (*Vigna radiata* L.) is a member of family Leguminaceae also known as green-gram in India. It is much popular pulse crop among the Indian peoples because Indian diet mostly depend on vegetarian protein. Mungbean contains approximately 20-25 % protein instead of protein it contains 3.5-4.5% fibre, 3.5-4.5% ash, 1-3% fat, 50.4% carbohydrate, 132 mg calcium, and 367 mg phosphorus per 100 grammes of seed, separately [1]. After chick pea and pigeon pea, it is the third most important legume crop for the nation's food output. Mungbean cover approx. 16 % area come under the total pulses production of the country [2]. It is originated from India and it grown in many countries of the world such as Southeast Asia, Pakistan, Sri Lanka, Bangladesh, New Guinea, Philippines and Thailand [3,4]. Although mung bean grown in all the states of the country but in view of cultivated area and production Rajasthan is leading in the cultivated land come under the cultivation and total production of the country 32.76% & 30.61%, respectively [5]. Yield potential of mungbean estimated up to 2.5 -3.0 t/ha, however, the mungbean has a relatively poor average production of about 0.5 t/ha. Mungbean productivity is extremely poor, and both living and non-living factors play a role in this. Mungbean productivity is extremely poor, and both living and non-living factors play a role. The major biotic factors include all insects and diseases that affect much quantity of mungbean. Similarly, several living factors affecting mungbean production that is drought, waterlogging condition, salinity of the soil and heat stress. In this article we mainly focused on diseases of mungbean. Powdery mildew, Cercospora leaf spot, dry root rot, and bacterial leaf spot are the main diseases of mungbean [6-10]. In view of its importance necessary action has been taken by several scientists to maintain the stability in quantity and quality of mungbean.

1.1 Powdery Mildew

The efficacy test of bio-agents *viz*., *Trichoderma viride* @ 2.5%, *T. harzianum* @ 2.5% and *Pseudomonas fluorescens* @ 2%, plant extracts *viz*., neem leaf extract at 10%, garlic extract at 10%, and carbendazim at 0.1% as a fungicide were used to combat powdery mildew (*Erysiphe polygoni*) in field condition. Three replications of each treatment and a randomized block design (R.B.D.) were used in the experiment and disease symptoms show Fig. 1. The most effective treatment, *T. viride* at 2.5%, was found to have the lowest disease intensity (15.98%), followed by *Pseudomonas fluorescens* at 2% (18.04%), *T. harzianum* at 2.5% (20.26%), neem leaf extract at 10% (21.55%), garlic clove extract at 10% (22.87%), and carbendazim at 0.1% (14.27%) of the total treatment dose. Used dose of *T. viride* @ 2.5% enhance the growth of plant maximum plant height recorded 42.62 cm and 65.99 cm at 45 and 75 DAS. Similarly, *T. Viride* at 2.5% had the most pods (13.30 and 14.27), followed by *P. fluorescens* (13.00% 14.07%, respectively), and the most pods per plant (8.50 and 9.60) [11]. With the application of Karathane 48 EC (@ 0.1%), a decrease in the severity of powdery mildew was seen, along with an increase in the test weight and seed yield of mungbean over the control. It was most effective, reduced the intensity least mean of powdery mildew (15.14%) and increase the grain yield and test weight was observe (1425 kg/ha) and (58.00 g) respectively. In Contaf @ 0.1% and Calixin @ 0.1%, the fungicides showed the second and third best outcomes. which also lessens the least average amount of powdery mildew, which was equal to each other at 18.43% and 18.99%, respectively.

Fig. 1. Symptoms of powdery mildew of mungbean

The disease intensity was botanical NSKE (33.47% and 32.51%, respectively, compared to control. Cost-benefit analysis revealed that all of the therapies were cost-effective. Sulfex, on the other hand, had the lowest cost-to-benefit ratio (1:21.11), followed by the natural NSKE (1:12.76), Contaf (1:7.83), plain water (1:7.61), and Calixin (1:7.28) [12]. The effectiveness of various fungicides against Cercospora leaf spots infection in mungbean and powdery mildew (*Erysiphe polygon)*. On the mungbean variety "K 851," these fungicidal treatments were applied twice, 15 days apart, beginning with the first signs of the illnesses. All of the fungicides outperformed traditional fungicides in terms of performance. Hexaconazole application produced the maximum yield and the least amount of illness, followed by penconazole and tridemorph [13].

1.2 Leaf Blight

Fig. 2. Symptoms of leaf blight of mungbean

The disease symptoms show in Fig. 2 and germplasms lines of mungbean were tested for resistance to *M. phaseolina*, along with JL-781 as a susceptible check in sick plots these test lines. Among the 34 germplasms in plots and 29 were found to be resistant, 2 were moderate resistance, 1 germplasm was moderate susceptibility, 1 germplasm was susceptibility and JL-781 to highly susceptibility [14]. The disease leaf blight has emerged as a significant barrier to the growth of mungbean and effectiveness of several botanicals investigated against the *M. phaseolina* that is the causal organisms of mungbean leaf blight diseases. Five fungicides including-Tricyclazole, Carbendazim, Captan, Benomyl and Mancozeb, were evaluated *in vitro* against *M. phaseolina.* The mycelial growth was fully suppressed by Mancozeb, Benomyl, and Tricyclazole, while in case of Thiram the mycelial growth suppressed significantly (1.8 mm), followed by Carbendazim (61.24 mm), and Captan (72.38 mm) [15]. The test pathogen was successfully defeated by all test fungicides, and they all outperformed the control by a large margin. All of the test fungicides considerably slowed the pathogen's mycelial growth in *In-vitro* experiments; the percentage of inhibition ranged from 71.90 to 94.18%. The town of all test fungicides considerably reduced the severity of the disease. Carbendazim (0.05%), Dhoksal, however, had the fewest cases of sickness (03.46%). In the Aurangabad district, illness incidence was recorded to be 22.24 percent. The percentage ranged from 03.18 to 40.00. The two locations with the highest disease incidence were Pandhari and Bagdi (40.00% each), whereas Jamgaon, a village, had the lowest disease incidence (03.18%). The *Macrophomina* leaf blight of mungbean was most intense in the villages of Bagdi (34.90%), Adgaon (32.20%), and Jamgaon (1.23%), with Bagdi having the least disease [16]. Preventive and therapeutic measures using pesticides effectively is crucial for preventing soil-dwelling and seed-borne infections across all IDM strategies. Additionally, there was insufficient data on the resistance [16].

1.3 Mosaic Disease

Fig. 3. Symptoms of yellow mosaic virus

Mungbean mosaic virus symptoms show Fig. 3 and most common viral diseases include *Mungbean Yellow Mosaic Virus*, *Leaf Crease*, *Mungbean Leaf Curl Virus*, and *Mosaic Mottle Disease*. The *Mungbean Yellow Mosaic Virus* causes the yellow mosaic illness in mungbeans is dangerous in terms of its rate of spread and yield loss. With a prevalence of 5-28%, the urdbean leaf crinkle virus causes leaf crinkle, which is the second most significant viral disease after MYMV, which has a prevalence of 4-40%. Bright yellow mosaic or golden yellow mosaic symptoms are indicative of MYMV. Mungbean leaf curl virus, which is persistently spread by Thrips (*Frankliniella schultezia*), has the ability to damage plants. Mosaic mottle illness brought on by Bean BCMV, or the Common Mosaic Virus, is spread through sap and seed. When two or more viruses are present and the prevalence of each virus is large. The only realistic method for controlling viral infections is to include viral disease resistance into the current cultivars [17]. The disease has a severe, critical, open spread, and it annually results in significant yield losses. Normative symbols of other resistance (R) genes or R gene homologous sequences were successfully used to generate resistance-linked molecular markers. Illness incidence is non-existent, plant breeders can perform throughout the growth season, repeated genotyping by using linked marker- aided genotyping [18]. A visual scoring index (VSI) was used to evaluate the signs and symptoms of MYMV infection. Compared to the primed plants, which only had 14% of the same symptoms, more than 70% of the unprimed plants had symptoms that were considered serious or deadly. Compared to 32% of primed plants, only 9% of unprimed plants exhibited no symptoms of disease. The components of yield reflected these clear differences in illness incidence and severity amongst priming treatments. According to [19], in primed crops, there was an increase in above-ground biomass of 81% (3.3 compared to 1.9 t ha-1). In all of its growing regions, the whitefly-transmitted Mungbean Yellow Mosaic Disease causes the most damage. The Mungbean Yellow Mosaic Disease severely damages the plants and causes up to 100% yield losses. There are several levels of disease management, including seed treatment, various breeding approaches, and genetic engineering [20].

2. BIOLOGICAL CONTROL

A bacterial disease called "halo blight," which surrounds necrotic lesions with a yellow chlorotic halo, eventually kills plants. This seed-borne infection is caused by *Pseudomonas savastanoi* pv. *phaseolicola*. It is very challenging to treat and significantly reduces yield. The large host range of halo blight, which includes numerous weed and legume species, as well as the existence of numerous epidemiologically significant strains make managing the disease more difficult [21]. More knowledge is available for managing the microorganisms that cause root rot disease in the mungbean. A number of studies has been conducted to manage foliar illnesses like Cercospora leaf spots, powdery mildews, and anthracnose, in mungbean through biological control agent. Only a very small number of experiments were carried out in fields; most investigations were carried out in greenhouses to examine the effects of seed or soil applications as well as foliar application of bio-control agents (such as *Trichoderma* spp., *Pseudomonas*, *Bacillus*, etc.) on the reduction of root rot [22]. If chemical preventatives are not accessible or are not cost-effective, it is recommended that bio-control agents be utilized to effectively reduce soil-borne illnesses. The management of disease incidence and severity, particularly those caused by seed and soil, will then be more advantageous. In fields plagued by root rot, integrated applications of bio-control agents with organic fertilizers were recommended [23-25]. In a greenhouse trial, the root rot disease brought on by *R. solani* was decreased by 75% with the application of *T. viride* @ 8 g/kg in the soil, which also helped to promote plant growth. When *Trichoderma virens* (*Gliocladium virens*) was treated with 10 spores per millilitre per kilograms of seeds as a seed treatment and then *Rhizoctonia* root rot was reported to have decreased by 76% [26].

Bio-products Pusa 5SD (*T. viride*) showed that root rot disease was reduced by 72% and that the yield increased by 978 kg/ha., While Pusa 5SD (*T. harzianum*) showed that there was a 71% drop in illness and 940 kg/ha of yield in fields that were infected [27]. *T. viride* reduced the occurrence of *Rhizoctonia* root rot by 54-73%, just like *T. harzianum*. [28,18] in green house as well as in field experiments. Bacterial strains of *Pseudomonas aeruginosa* and *Bacillus subtilis* in soil drastically fell 39% after being administered as seed dressing [29]. When used with talc-based bacterial strain formulations as a seed treatment and soil application *Burkholderia* spp.'s TNAU-1 decreased the occurrence of root rot by up to three times and stopped *M. phaseolina* mycelial growth in in vitro dual culture [30]. In dual culture, *M. phaseolina* growth was observed to be decreased by *T. viride* and *T. harzianum* (42-33 and 42-25 mm, respectively) [31]. [21] discovered that a combination treatment of vermin-compost (10%), bavistin (0.1%), and *T. harzianum* (4%) completely eliminated Macrophomina root rot. Against *M. phaseolina, Bacillus subtilis* and *T. longibrachyatum* exhibited antagonistic action at 64 and 63%, respectively [32]. In a greenhouse experiment, seed dressing with 4 grams per kilogram of *T. harzianum* and 25 kilograms of phosphate-solubilizing bacteria decreased the incidence of *Macrophomina* root rot by 26% [33].

3. BIOLOGICAL STIMULANTS AND BOTANICAL FUNGICIDES

The plant parts and crucial oils, appear important toxicity to various genera of pathogenic decay, bacteria, virus, insect and pinworm [34]. Spraying neem extract (1:4 W/V) boosted mungbean crop output by 25% and reduced Cercospora leaf spot infestation by 65%. [35]. Powdery mildew conidial germination was reduced by 60-66% when behada leaf (*Terminali belerica*) extract, tapioca (*Manihot utilissimum*), and sadafuli (*Vinca rosea*) were combined (*E. Polygoni)* [36]. In greenhouse experiment trials, the use of leaf extract under in vitro conditions reduces the incidence of Macrophomina blight and *Adenocalymma alliaceum* by about 75-77% [37], [38]. In studies conducted in greenhouses, treatments combining 10% garlic extract, mancozeb (0.2%), and 10% garlic extract with zinc sulphate (0.5%) decreased the occurrence of Macrophomina root rot by 88–94% [12]. When Datura dry leaf manure (1.5% w/w) was utilized, *M. phaseolina*-related plant mortality was reduced by 80% [39]. In mungbean Palmarosa (*Cymbopogon martinii*) oil @ 2 per cent concentration was used for seed dressing applications to check the effect on *M. phaseolina.* The result show that 100 per cent mycelial growth of *M. phaseolina* checked in poison food testing and 72.33 per cent decreased in dry root rot in green house experiment trials [21].

Few bacterial diseases associated with mungbean that includes bacterial wilt, bacterial blight, leaf spot, and halo blight. Some natural soil amendments and botanical foliar spray (Gulmohar, neem, chicken droppings, hardwood ash, and kitchen ash, neem seed, ginger stem, and bitter kola seed) were used as a control measure of above mentioned minor bacterial diseases of mungbean. Streptomycin sulphate was employed as a benchmark test while water served as the control. The leaves of neem and Gulmohar were used as organic amendments after being given time to degrade. The organic fertilizers from kitchen waste increased mungbean growth, maintained total pod production, and reduced the severity and frequency of hidden diseases. The results of a foliar spray revealed that *A. indica* was superior to other plant extracts in terms of promoting growth, yield and reducing disease occurrence and infection severity [40].

4. SOME CHALLENGES FOR THE DISEASES MANAGEMENT

Variability in plant pathogen populations exist amongst various natural features; There should be several different locations and years for screening trials. Due to increased pathogenic unpredictability [41]. Despite the fact that the majority of fungicides are preventive, which need treatment before pathogen infection or before the first symptoms occur, some growers fail to apply fungicides in the proper quantities and timing. Additionally, inadequate IPM knowledge and extension, farmers do not regularly rotate fungicides with varied modes of action. Since the global market for legumes is greatly concerned about fungicide resistance [42-44]. Commercial mungbean use of biopesticides faces difficulties as well. Growers suspiciously utilize to the bio-pesticides items because majority they are less effective as compare to chemical fungicides in the control of diseases [45], [46]. Similarly, growers often choose bio-pesticides as a part of integrated approach because of inadequate awareness about it. When combined with other bio-control agents, the application of one is successful; however, other researchers noted that certain combinations might not always be beneficial due to antagonistic behavior among bio-control organisms [47]. Moreover, numbers of biotic and abiotic variables reduce the field effectiveness of bio-pesticides [37], [48]. Because of the potential for bio-control agents to become crop pests, great consideration must be given to their development and evaluation [29]. The environment and human health were also negatively impacted by the over usage of chemicals [49-53].

5. CONCLUSION

Few bacterial diseases associated with mungbean that includes bacterial wilt, bacterial blight, leaf spot, and halo blight. Some natural soil amendments and botanical foliar spray. The use of neem oil, NSKE, chicken droppings, hardwood ash, kitchen ash, ginger stem, and bitter kola seed) were used as a control measure of above mentioned minor bacterial diseases of mungbean. The mungbean plant disease control measures are used properly natural resources. These are the people who use most of the fungicides and insecticides in India. But now in India and across the world bioagents should not be used to cause environmental pollution. Use as many bio-agents as possible in crops, otherwise one day all the beneficial microorganisms will disappear. Save the soil and environment and human health.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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