Review on Common bean breeding for Angular Leaf Spot resistance

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**Absract**

*Common bean (Phaseolus vulgaris L.) is one of the important grain legumes in food and agricultural systems of Africa and Latin America. It is an important component of subsistence agriculture. Despite the importance of common bean in food security and nutrition, production of the crop is limited due to biotic and abiotic stresses. Among these Angular leaf spot is currently one of the most recurring and devastating diseases of the most important production areas of the world. Breeding for ALS resistance in common bean would be facilitated by determining the inheritance of ALS resistance in the most promising accessions and bred lines, then tagging the genes or identifying molecular markers which are reliable and easy to repeat and screen, provided this is complementary to conventional screening methods is economical and more efficient and time saving.*

**Key words**: Angular leaf spot, breeding, common bean

1. **Introduction**

Common bean (*Phaseolus vulgaris L*.) is one of the important grain legumes in food and agricultural systems of Africa and Latin America. This crop is regarded as “Grain of hope” as it is an important component of subsistence agriculture and feeds about 300 million people in tropics and 100 million people in Africa alone (Broughton et al.,2003; Mudasir *et al*., 2012). It is one of the most important pulse crop in terms of nutrition, food security and economy, is cultivated in different regions of Ethiopia (Lemessa and Tesfaye, 2005).

Common bean grows well at temperatures ranging from 15 to 27°C and will withstand temperatures up to 29.5°C. High temperature (close to or higher than 35°C) and moisture stress during flower and pod setting results in abortion of large numbers of blossoms and developing pods. The ideal growing conditions are rainfall of 350–500 mm rainfall during the growing season combined with low relative humidity to minimize risk of bacterial and fungal disease. It is widely cultivated throughout the tropics for its edible green leaves, green pods, mature or immature seeds for human food and straw as fodder for animal feed (De Luque *et al.,* 2014).

Despite the importance of common bean in food security and nutrition, production of the crop is limited due to biotic and abiotic stresses (Dagnew *et al*., 2014). Among the most cause of poor yield in common bean production was due to fungal, bacterial and viral diseases (Rezene *et al*., 2018). Angular leaf spots (ALS), incited by *P. griseola* is one of the most destructive diseases of common bean in tropical and subtropical regions of the world.

Development of cultivars with improved resistance to biotic and abiotic stresses is a primary goal of bean breeding programs throughout the world. Cultivars with improved stress resistance can reduce reliance on pesticides in high input systems, avert risk of yield loss from pests in low- and high-input systems, and enable more stable bean production across diverse and adverse environments (low precipitation, high humidity) and poor soil conditions (low fertility, hillsides). Therefore, the objective of this paper is to review common bean breeding for Angular Leaf Spot (ALS) resistance.

**2. Literature Review**

**2.1. Effect of Angular Leaf Spot (ALS) in common bean production**

Angular leaf spot is currently one of the most recurring and devastating diseases of dry beans in Latin America and Africa, the most important production areas of the world (Stenglein *et al*., 200; Crous *et al*., 2006). The disease is known to cause a yield loss of 70 to 80% depending on variety susceptibility, environmental conditions and pathogenicity of the isolates or pathotypes (Junior *et al*., 2001; Singh and Schwartz, 2010; Lemessa *et al*., 2011). It causes annual yield losses in Africa up to 384,200 metric tons (Wortmann *et al*., 1998).

**2.2 Angular leaf spot (ALS) Control Mechanisms in common bean**

An integrated control strategy employing use of pathogen free seed, cultural practices, and fungicides is useful, but genetic resistance provides better and more economical control.

Although fungicides are an option for the control of ALS, they are often expensive or not readily available to smallholder farmers (Michelle *et al*., 2019). Infected seeds and plant debris are the main source of infection for ALS, so the use of resistant varieties, use of clean seed, burial of infected debris and rotation can decrease the severity (Degu *et al*., 2020). Cultivars with resis­tance to *P. griseola* offer a cost effective, easy to use, and environmentally friendly management strategy (Pastor-Corrales *et al*., 1998).

**2.3. Breeding Common bean for Angular Leaf Spot (ALS) resistance**

Cultivars with improved stress resistance can reduce reliance on pesticides in high input systems, avert risk of yield loss from diseases and pests in low and high input systems and enable more stable bean production across diverse and adverse environments.

Several sources of ALS resistance have been identified among primary and secondary gene pools of *P. vulgaris* (Mahuku *et al*., 2011). However, development of common bean cultivars with durable ALS resistance is difficult due to extensive virulence diversity of the ALS pathogen suggests that common bean culti­vars with single genes for resistance to ALS will likely attacked to new virulent races of the ALS pathogen in the future (Mahuku *et al.,* 2002, Michelle *et al*., 2019). Thus,a bean variety that is resistant in one year or locationmay be susceptible in another. This situation calls for a breeding strategy based on a broad diversity of quantitative and qualitative resistance, which may confer broad-spectrum and durable resistance (Clair, 2010).

Breeding for ALS resistance in common bean would be facilitated by determining the inheritance of ALS resistance in the most promising accessions and bred lines, then tagging the genes or identifying molecular markers, especially sequence-characterized amplified regions (SCARs) and allele-specific associated primers (ASAPs), which are reliable and easy to repeat and screen, provided this is complementary to conventional screening methods, economical, more efficient, and/or less time consuming (Pastor-Corrales *et al.,* 1998).

**2.3.1 Implication for breeding ALS resistance**

The large variability of the pathogen necessitates the constant identification and characterization of resistance genes, understanding the genetics of the reaction to the pathogen (Borel *et al*., 2011) and subsequent development of resistant cultivars so as to minimize the risk associated with epidemics.

An additional process that is expected to heavily affect plant pathogen dynamics is climate change. The increased warming and occurrence of extreme weather events will have effects on prevalence and plant-pathogen interactions.

**2.****4. Molecular Characterization of common bean for Angular Leaf Spot resistance**

Molecular markers are an important tool to describe and determine genetic diversity among common beans. Some of their advantages are: (1) they can reveal differences between individuals of the same or different species; (2) are used to tag genes of economic importance; (3) are a valuable source of information about the genetic structure; and (4) are used in construction of linkage maps.

**2.4.1 Marker assisted selection for common bean ALS resistance**

Marker-assisted selection (MAS) is a breeding approach, based on the existence of DNA markers in or closely linked to a gene coding for an important phenotypic trait. This procedure can improve breeding effi­ciency by facilitating introgression of resistance loci into elite cultivars, and it allows pyramiding of resistance loci for more durable resistance (Michelle *et al*., 2019).

**3. Conclusion**

Common bean (*Phaseolus vulgaris L*.) is one of the important grain legumes in food and agricultural systems of Africa and Latin America. This crop is regarded as “Grain of hope” as it is an important component of subsistence agriculture.

Despite the importance of common bean in food security and nutrition, production of the crop is limited due to biotic and abiotic stresses. Among the most cause of poor yield in common bean production was due to fungal, bacterial and viral diseases. Among these Angular leaf spot is currently one of the most recurring and devastating diseases of the most important production areas of the world.

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Breeding for ALS resistance in common bean would be facilitated by determining the inheritance of ALS resistance in the most promising accessions and bred lines, then tagging the genes or identifying molecular markers which are reliable and easy to repeat and screen, provided this is complementary to conventional screening methods is economical and more efficient and time saving.

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