

Intercropping for the Management of Rust and Angular Leaf Spot in Bean

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INTRODUCTION

Rust (*Uromyces appendiculatus*) and Angular Leaf Spot (ALS) (*Isariopsis griseola*) are two of the most destructive foliar diseases of bean (Pamela *et al.*, 2014). ALS reduces the Ribulose 1, 5- biphosphate carboxylase/oxygenase activity whereas rust increases respiration rate, changes in the pattern of translocation of photosynthates and increases in invertase activity (Jesus Junior *et al.*, 2001). Average yield loss of bean due to these diseases was estimated as 23.44% in Bandarawela in *Maha* 2014/15 (Jayasekara *et al.*, 2016). Although resistant varieties are widely used to control these diseases, usage of resistance varieties is limited due to high pathogen variability in the field (Pamela *et al.*, 2014) and in Sri Lanka there are no resistant cultivars to these pathogens.

Intercropping could be a viable option to control these diseases as bean rust is mainly dispersed by wind and ALS is dispersed by wind or rain-splash (Odogwu *et al.*, 2016; Pamela *et al.*, 2014). Fininsa (2008) reported that intercropping bean with maize could reduce rust incidence of bean as compared to sole cropping of bean. This study further revealed that bean-maize mixed cropping was more effective than row intercropping. Intercropping disturbs air movement, traps fungal spores, alters micro climate of environment and reduces the density of host plants (Boudreau and Mundt, 1992). Since no studies have been carried out to investigate the possibility of management of bean rust and ALS through intercropping in Sri Lanka, this study was conducted to identify the potential of using a maize barrier in bean fields to reduce epidemics of rust and ALS in bean.

MATERIALS AND METHODS

Experiments were carried out at Regional Agriculture Research and Development Centre, Bandarawela during *Maha* 2014/15 and *Yala* 2016 seasons. Treatments were, T1 –four bean rows established between two maize hedges; T2 - eight bean rows established between two maize hedges; T3 – maize hedge established

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around the bean cultivation of 100 m² and T4 – sole bean crop. In T4, twelve bean rows were established in the corners of the field to avoid maize hedge effect. Experiments were arranged in randomized complete block design with three replicates. Maize hedges consisted with double maize rows arranged in zig-zag pattern using variety Bhadra in 30 cm X 30 cm spacing. Bean variety Keppetipola nil was planted in 40 cm X 50 cm spacing in 2 m X 3.2 m beds.

Maize seeds were planted 14 days before planting beans. All agronomic practices except fungicide application were practiced according to the Department of Agriculture recommendation. Since the study was planned to explore the effect of intercropping on diseases control, fungicides were not applied. Natural disease occurrence and severity of the disease in each field was recorded in weekly intervals using diagrammatic scales (Godoy *et al.*, 1997) and converted in to values of Area Under Disease Progress Curve (AUDPC) (Jesus Junior *et al.*, 2001). Finally, crop yield of bean was recorded. Since AUDPC values did not follow the normal distribution, nonparametric CATMOD procedure was used in SAS (Anderson-Darling test statistics $p < 0.05$) for data analysis.

RESULTS AND DISCUSSION

As depicted in table 1, AUDPC values of both diseases were significantly low and average yield was high in all intercropping systems as compared to the control (T4). AUDPC values of ALS were lowest in T3, in which maize barrier was established as a cover crop around the bean plots. AUDPC values of rust were lowest in both T2 and T3 in *Maha* 2014/15 and T1 and T3 in *Yala* 2016 (Table 1).

Table 1. AUDPC values for rust and ALS and yield (t/ha) in *Maha* 2014/15 and *Yala* 2016

<i>Treatment</i>	<i>Maha</i> 2014/15			<i>Yala</i> 2016		
	<i>AUD-PC-bean rust</i>	<i>AUDPC - ALS</i>	<i>Yield (t/ha)</i>	<i>AUD-PC-bean rust</i>	<i>AUDPC - ALS</i>	<i>Yield (t/ha)</i>
4 bean rows + 2 maize hedges	41.89 ^a	48.97 ^a	11.03 ^c	8.47 ^c	13.74 ^b	18.19 ^b
8 bean rows + 2 maize hedges	33.91 ^b	48.95 ^a	14.57 ^b	14.95 ^b	16.81 ^a	17.80 ^b
maize hedge around bean cultivation	30.05 ^b	41.21 ^b	16.73 ^a	9.10 ^c	12.23 ^c	22.52 ^a
sole bean crop	41.45 ^a	55.05 ^a	11.73 ^c	22.55 ^a	17.80 ^a	15.74 ^c
CV%	-	-	4.83	-	-	5.23

The study further reveals that the AUDPC values of both diseases were low and yields were higher in *Yala* 2016 than *Maha* 2014/15 (Table 1). Since the temperature prevailed in both seasons was equally favorable for the development of rust and ALS and ALS infection occurs in a wide range of temperature (10-33 °C), this variation could be attributed to the difference in rainfall distribution and relative humidity. High rainfall and humidity in *Maha* season may have favored the development of rust and ALS. Especially, for the development of rust, cool to moderate temperatures with high humidity is favorable (Allorent and Savary, 2005; Hamed *et al.*, 2012). Koech and Whitbread (2006) stated that bean rust reached its peak in damp nights and dry/warm days. Low night and high day temperature combined with wind aggravate the rust as it spreads by windborne inoculums.

CONCLUSION

The prevalence of both diseases were significantly and negatively associated with yield in the two seasons. However, intercropping reduces the incidence of diseases and hence prevents yield reduction. The best intercropping type to suppress bean rust and ALS and for high yield was found to be double row maize hedge established in zig-zag pattern around bean cultivation.

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