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The Study on Prevalence and Importance of Faba Bean Diseases in Sidama and Gedeo Highland Districts, South Eastern Ethiopia

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Abstract
Ethiopia is the largest producer of Faba bean in world next to China. Faba bean is valuable as the cheap source of protein in most Ethiopian diet. However, the productivity remains far below the crops potential. Disease is the major treat to production in Ethiopia. Survey was conducted in Sidama and Gedeo zone highlands of Ethiopia during the 2016 cropping season to determine the prevalence, incidence and severity of faba bean chocolate spot (*Botrytis fabae Sard*.), rust (*Uromyces viciae-fabae*) and ascochyta blight (*Ascochyta fabae*) in major growing districts, and the influence cultural practices on faba bean disease epidemic. A total of 49 faba bean fields were surveyed in four districts. Sample plants were systematically selected in an "X" fashion. In each field, five plants in 1×1 meter quadrant were sampled for disease assessment. During the survey, altitude, cropping system, planting pattern, crop growth stage and weed management practices were recorded. The overall mean prevalence of faba bean chocolate spot, rust, ascochyta blight were 100%, 58.5%, and 33.8%, respectively. Significant differences among districts were showed with respect to chocolate spot, rust and ascochyta blight incidence and severity. The districts varied in incidence and severity of chocolate spot. The mean incidence of chocolate spot varied from 60.0% in Hulla to 100% in Melga, while severity varied from 37.7% in Dara to 50.0% in Bulle district. The mean incidence of the rust varied from 22.0% in Bulle to 58.3% in Melga while severity varied from 16.6% in Bulle to 42.2% in Dara district. The mean incidence of the ascochyta blight varied from 3.3% Melga to 45.8% in Hulla, while severity varied from 14.8% in Melga to 37.7% in Hulla district. The survey was identified cropping system, growth stage, planting pattern and weed management as important variables that influenced faba bean disease epidemic. The result indicated that mixed cropping system resulted in less chocolate spot severity. Fields having good weed management score showed the lowest incidence and severity of rust as compared to their respective other variable classes. Maximum severity of ascochyta blight recorded in where faba bean was at broadcast. The survey revealed high prevalence and distribution of faba bean chocolate spot, rust, ascochyta blight in the study area and the need for effective and feasible management options to be developed.
Keywords: Ascochyta fabae**;** Botrytis fabae Sard; Cropping system, Faba bean; Incidence; Severity, Uromyces viciae-fabae;

1. INTRODUCTION

Faba bean (*Vicia faba* L.) is believed to be originated in the Near East and is one of the earliest domesticated legumes after chickpea and pea. Ethiopia is the 2^{n} largest producer of Faba bean in the world next from to China (Hawitin and Hebblewaite, 1993). It is the first among pulse crops cultivated in Ethiopia and leading protein source for the rural people and used to make various traditional dishes.

In Ethiopia, grain crops are grown annually on approximately 12.5 million hectares of land, of these, 1.5 million hectares is covered by pulses out of which 443,074.68 hectares is dedicated to Faba bean with annual production of about 8,389,438.97 quintals (CSA,2014). Faba bean makes a significant contribution to soil fertility restoration as a suitable rotation crop that fixes atmospheric nitrogen and reduce the dependence on external fertilizer inputs and also an important source of income for farmers and generates foreign currency for the country (Agegnehu and Fessehaie, 2006).

In spite of huge importance, the productivity of Faba bean in Ethiopia remains far below the crop's potential greater than 3 ton/ha. Production of Faba bean has been constrained by several biotic and abiotic factors (Agegnehu G, Fessehaie, 2006). Surveys on diseases of Faba bean in Ethiopia showed that numerous pathogens infect Faba bean in different parts of the country (Gorfu, and Beshir, 1994). Some diseases that are economically most important in the major Faba bean growing regions include chocolate spot (*Botrytis fabae*), faba bean rust (*Uromyces viciae-fabae*), black rot (*Fusarium solani*), Aschochyta blight (*Aschochyta fabae*) and faba bean necrotic yellow virus (FBNYV) (Gorfu, and Beshir, 1994). The diseases were highly expanded and distributed aggressively in the southern part of the country from year to year.

Previous reports on the occurrence of faba bean diseases in Ethiopia relied mainly on observations of yield and on-farm multi-locational trials. Most of the diseases of faba bean mentioned in these reports were not quantitatively determined to take into account their regional distribution and intensities. Therefore, monitoring and quantifying the status of the diseases is found to be vital to appeal management options. Therefore, this study was conducted with objectives to determine (a) the prevalence, incidence and severity of faba bean

chocolate spot, rust, aschochyta blight in major growing districts of Sidama and Gedeo highlands, and (b) the influence cultural practices on faba bean disease epidemics.

2. MATERIALS AND METHODS

2.1. Survey Area

Disease survey was conducted to assess the prevalence, incidence, and severity of faba bean chocolate spot, rust and Ascochyta Blight in four districts of Sidama and Gedeo highlands during the 2016 main growing season. The altitude of study area was ranged from 2334 to 2794 m.a.s.l. (Table 1). The survey was conducted in Hulla, Dara, Melga, and Bulle districts of sidama and Gedeo highlands. Hulla, Dara, and Melga districts in Sidama zone, while Bulle district in Gedeo Zone of the South Regional State. A total of 49 fields were assessed for disease incidence and severity from October to November, 2016.

Table 1. Characteristic features of surveyed faba bean fields in four districts, Ethiopia

Zone	Districts	Altitude (m.a.s.l)*	No of field assessed
Sidama	Hulla	2612-2794	13
	Dara	2593-2632	11
	Melga	2514-2663	12
	Mean	2514-2794	36
Gedeo	Bulle	2334-2632	13
	Over all Mean	2334-2794	49

*m.a.s.l = meter above sea level

2.2. Sampling

In each surveyed zone, faba bean production fields along the main roads were randomly selected for observation and assessed at about 5-10 km using Vehicle odometer. Five stops were made in each faba bean field by moving in 'X' fashion of the fields using 1×1 meter square quadrants and data were collected from individual quadrants and the five samples per field were used as one site after averaged. All sample fields belonged to small, private farmers. Each field was visited once.

2.3. Disease and Crop Assessment

Prevalence of a disease was calculated using the number of fields affected divided by the total number of field assessed and expressed in percentage. Incidence was calculated by using the number of plants infected and expressed as percentage of the total number of plants assessed. Severity was recorded by examining visually the whole plants using percent leaf area affected in the quadrants. Severity was rated using the 1-9 disease scoring scale (ICARDA, 1986), where 1 indicates no visible symptom and 9 represents disease covering more than 80% of the foliar tissue. Disease severity scores were converted into percentage severity index (PSI) (Wheeler, 1969).

$$Disease\ severity\ index(DSI) = \frac{\sum(score\ x\ number\ of\ plants\ with\ this\ score)}{Total\ number\ of\ plants\ x\ greater\ score}$$

During the survey, altitude (m), type of cropping pattern (row versus broadcast planting), cropping system (sole versus mixed), weed management practices (Good versus intermediate versus poor), and crop growth stage, were recorded for each sampled field. Altitude was recorded using Geographic Positioning System (GPS).

Table 2: Distribution of faba bean diseases in Sidama and Gedeo zone of Ethiopia, in 2016 cropping season

Zone	District	Diseases														
		Chocolate Spot					Rust					Ascochyta Blight				
		Pre	Incidence		PSI		Pre	Incidence		PSI		Pre	Incidence		PSI	
			Range	Mean	Range	Mean		Range	Mean	Range	Mean		Range	Mean	Range	Mean
Sidama	Hulla	100	20-100	60.0	33.3-77.7	40.7	83.3	10-70	23.3	11.1-55.5	31.4	83.3	25-80	45.8	22.2-55.5	37.7
	Dara	100	40-100	88.0	33.3-55.5	37.7	80.0	40-100	54.0	11.1-55.5	42.2	20.0	0-40	8.0	11.1-33.3	15.5
	Melga	100	100	100	33.3-55.5	48.1	100	30-100	58.3	33.3-55.5	37.0	25.0	0-20	3.3	11.1-33.3	14.8
	Mean	100	20-100	82.6	33.3-77.7	42.1	87.7	10-100	45.2	11.1-55.5	34.2	42.7	0-80	19.0	11.1-55.5	22.6
Gedeo	Bulle	100	70-100	87.5	33.3-55.5	50.0	30	5-65	22.0	11.1-33.3	16.6	25.0	0-40	10	11.1-33.3	16.6
Over all Mean		100	20-100	85.0	33.3-77.7	46.05	58.5	5-100	33.6	11.1-55.5	25.4	33.8	0-80	14.5	11.1-55.5	19.6

PSI: Percent Severity index; **Pre**: prevalence

3. RESULT AND DISCUSSIONS

3.1. Status of Chocolate spot and influence of cultural practices

Chocolate spot was prevalent in all the faba bean fields surveyed. Highest prevalence value (100%) was recorded in all districts of surveyed area. The districts varied in incidence and severity of chocolate spot. The overall mean chocolate spot incidence (58.8%) was recorded in the surveyed areas. Among the faba bean fields surveyed in four districts, the least mean incidence (60.0%) was recorded in Hulla district and the least mean disease severity (37.7%) was recorded in Dara district and the highest mean disease incidence (100%) in Melga district and the highest mean severity (50%) was recorded in Bulle districts (Table 2). The recorded mean severity value ranged from 37.7 to 50.0%. Previous study indicated that Chocolate spot is the most important disease of faba bean and

causes a significant yield loss of up to 61% on susceptible cultivars in Ethiopia (Teshome and Tagegn, 2013).

The result of the survey indicated that mixed cropping system resulted in less chocolate spot incidence and severity. The lowest mean severity (40.7%) was noted on faba bean crops mixed (Table 3). Lowest incidence and severity were recorded in fields where faba bean was at flowering stage. Faba bean fields having good weed management score showed the lowest incidence and severity of chocolate spot as compared to their respective other variable classes (Table 3). Sahile *et al*. (2008) reported that high weed density increased chocolate spot disease of faba bean. Faba bean fields cultivated at broadcasting, fields having sole faba bean, and fields having poor weed management score showed the highest incidence and severity of chocolate spot as compared to their respective other variable classes.

3.2. Status of Rust and influence of cultural practices

The overall distribution of Faba bean rust disease in the surveyed area of was with the mean prevalence of 58.5%.The disease prevalence was ranged from 30-100% in which the maximum rust prevalence was recorded in Melga district. Mean rust prevalence of 83.3%, 80.0% and 30.0% was scored in Hulla, Dara and Bulle districts, respectively (Table 2). Faba bean rust mean disease incidence recorded in the range of 22.0 to 58.3 % in all surveyed areas. The maximum incidence 58.3% was recorded in Melga. Mean incidence of 45.2% and 22.0% of the disease was recorded in Sidama and Gedeo zone, respectively. The mean disease severity was also ranges from 16.6 to 42.2%. The maximum mean severity of 42.2% was observed in Dara district followed by Melga with mean severity of 37.0%. The overall mean rust severity of 25.4% was observed in the surveyed areas (Table 2). This is in contrary with previous report that the prevalence of rust was less in the country (Teklay *et al*., 2014).

Table 3: Mean incidence and percent severity index (PSI) of faba bean diseases for different cultural practices in 2016 cropping season in Sidam and Gedeo zone, Ethiopia.

Cultural practices	Class	Percent of field	Diseases											
			Chocolate spot				Rust				Ascochyta Blight			
			Incidence		PSI		Incidence		PSI		Incidence		PSI	
			Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Cropping System	Sole	89.18	80-100	81.0	33.3-61.1	49.5	20-100	46.8	22.2-48.1	36.1	0-80	24.5	22.2-44.4	27.7
	Mixed	10.81	20-100	78.0	29.6-55.5	40.7	0-100	28.6	11.1-33.3	28.7	0-40	9.5	11.1-33.3	18.0
Planting pattern	Row	29.72	20-100	77.2	29.6-48.1	38.8	0-80	29.5	11.1-40.7	29.6	0-60	15.0	11.1-33.3	19.4
	Broadcast	70.27	50-100	85.5	33.3-62.9	50.0	10-100	51.5	22.2-48.1	39.8	0-80	22.7	22.2-33.3	27.7
Growth Stage	Flowering	78.37	20-90	46.1	29.6-40.7	34.2	10-50	25.2	22.2-33.3	25.9	0-80	25.0	11.1-55.5	27.7
	Podding	21.62	40-100	71.8	33.3-55.5	45.3	10-100	37.7	33.3-40.7	35.1	0-80	16.3	11.1-22.2	20.0
Weed Management [a]	Good	35.13	20-85	59.2	25.9-48.1	41.6	10-80	26.7	22.2-40.7	31.4	0-40	5.9	11.1-22.2	14.8
	Intermediate	45.94	40-100	80.0	29.6-55.5	44.4	15-100	39.5	22.2-48.1	36.1	0-70	17.7	11.1-33.3	22.2
	Poor	18.91	80-100	90.0	33.3-62.9	51.8	10-100	52.7	33.3-55.5	46.2	0-40	28.6	22.2-55.5	33.3

[a] Good weeding, any weed is weeded; intermediate weeding, few weeds are present; poor, no weeding and high weed infestation. PSI: Percent severity index

Faba bean fields were at two different growth stages: 78.37% at flowering, and 21.62% at podding during the survey. Maximum incidence and severity were recorded in fields where faba bean was at late podding stage (Table 3). Faba bean fields having good weed management score showed the lowest incidence and severity of rust as compared to their respective other variable classes (Table 3). Cultivation of faba bean in the presence of high weed populations is known to highly reduce the yield of the crop and favour the development of disease epidemics (Agegnehu and Fessehaie, 2006). Fields cultivated at row, fields having mixed faba bean, and fields having good weed management score showed the lowest severity of rust as compared to their respective other variable classes. Sharaiha *et al*. (1989) also reported reduced (29%) rust incidence in maize-faba bean intercropped plots under the Jordan Valley conditions.

3.3. Status of Ascochyta blight and influence of cultural practices

Ascochyta blight was prevalent in all faba bean growing areas with over all mean prevalence value of 33.8%. The recorded prevalence ranges from 20.0-83.3% in which the maximum score recorded in Hulla district (Table 2). Sidama Zone was highly affected by Ascochyta blight as compared to the Gedeo Zone. The mean severity value of 19.6% was scored in the surveyed areas. The overall mean incidences of 14.5% were scored in the surveyed areas (Table 2). Previous study indicated that Ascohayta blight was categorized as miner diseases (Nigussie *et al*., 2008). Dereje and Tesfaye, (1994) showed as Ascochyta blight will be the potential treat for faba bean Production in Ethiopia. The latest studies showed that the disease became among the major treats of faba bean production in the country (Teklay *et al*, 2014).

Faba bean was planted as sole crop as well as mixed with field pea in survey areas. Out of the total surveyed faba bean fields, 10.81% fields were in mixed cropping with other crops and ascochyta blight was also less as compared with sole faba bean fields. During the survey Faba bean fields were at two different planting patterns: 29.72% at row, 70.27% at broadcast. Maximum incidence (22.7%) and severity (27.7%) of ascochyta blight were recorded in where faba bean was at broadcast (Table 3). Intercropping of broad beans with cereals such as maize or wheat has been suggested as a control measure for the chocolate spot disease caused by Botrytis species (Stoddard *et al*., 2009). The barriers created to aerial spread of Botrytis conidia by the non-host plants

would seem likely to be effective against rain-splash dispersal of Ascochyta conidia as well.

4. CONCLUSION

The purpose of this field survey was to study the status of most important faba bean diseases. As a result, chocolate spot, ascochyta blight and Faba bean rust are the most common diseases of Faba bean in study area of southern region. The mean prevalence of Chocolate spot, rust and Ascochyta blight were 100%, 58.5% and 33.8% respectively. The mean incidence of all earlier diseases was 85.0%, 33.6% and 14.5% in their previous order. This survey information helps to consider the diseases as treat in region and in development of management options. The study also identified cropping system, planting pattern, growth stage, and weed management as important variables that influenced faba bean disease epidemic. The results of this study suggest the importance of research on cultural practices to supplement effective disease management options in the surveyed areas. Furthermore, extensive and consistent survey is suggested to know the intensity of the diseases in similar agro-ecology of the country where the crop is widely grown.

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