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Assessment and quantification of severity and incidence of major faba bean and field pea diseases in highlands of Guji Zone, Southern Oromia

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ABSTRACT

Aim: The study was aimed to identify the economically important and to indicate the distribution of faba bean and field pea diseases in four selected highland districts namely: Bore, Anna Sorra, Dama and Uraga of Guji zone.
Materials and Methods: The survey was made along the main roads and accessible routes in each surveyed districts at every 5-10 km intervals as per faba bean and field pea fields available. Five samples were taken in each faba bean and field pea fields by moving "W" fashion.
Results: The observed diseases were chocolate spot, ascochyta blight and faba bean rust for faba bean in order of their prevalence. The overall mean incidences of faba bean diseases were 99%, 98% and 21%, respectively. Mean severity scale of chocolate spot and ascochyta blight were 3.3 and 2.7 in their previous order. Those diseases were more sever in Anna Sorra followed by Bore and Dama districts. Based on mean severity faba bean rust was recorded 11.5%. Ascochyta blight and powdery mildew were the two identified diseases of field pea during survey. The mean prevalence and incidence value of ascochyta blight of field pea was 62.4% and 64.6% respectively. The severity of ascochyta blight was low with the mean value of 1.8.The occurrence and distribution of powdery mildew was very low with the mean incidence of 5.8%. Chocolate spot and ascochyta blight were the two most devastating and widely disseminated in the surveyed areas.
Conclusion: It was concluded that diseases are the most devastating agents from an economic standpoint and the most difficult to protection efforts. It is mainly associated with lack of detailed information of economically important faba bean and field pea disease that cause yield loss of the areas.

Keywords: Ascochyta blight; Chocolate spot; Disease severity and Incidence; Epidemic.

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Introduction

Faba bean (*Vicia faba L.*) belongs to family fabaceae and genus Vicia and has many names (Broad bean, Fava bean, Field bean, Bell bean or Tic bean). It is native to North Africa and South West Asia, where it is extensively cultivated. The specie spread from Mediterean to the new world (Street *et al.*, 2008).

In Ethiopia, faba bean is the crop that has the highest absolute production, and the largest area cultivated. Ethiopia is also the second largest producer of faba bean in the world next to China (FAOStat, 2012). It is the major pulse Crops grown in the highlands (1800-3000 masl) of the country, where the need for chilling temperature is satisfied (Gemechu *et al.*, 2003).

According to CSA, 2017 report faba bean ranks first both in terms of area coverage and grain production with 11,263.63ha and 239,161.88 quintals, respectively. Despite its wide cultivation, the average yield of faba bean is quite low in Ethiopia; the low yield per hectare was attributed by many factors including biotic (disease, insects and weed), abiotic (drought, frost etc), poor agronomic practices and lack of improved cultivars and crop protection technologies are the most important constraint of faba bean production in Ethiopia (Negussie, 2006).

Field pea (*Pisum sativum L.*) is widely grown in mid to high altitudes of Ethiopia and ranks fourth in area coverage reaching 2,322.22 ha with an annual production of 35,953.96 quintals (CSA, 2017). It is the major food legumes with a valuable and cheap source of

protein having essential amino acids (23 to 25%) that have high nutritional values for resource poor households (Nawab *et al*., 2008).

The crop has important ecological and economical advantages in the highlands of Ethiopia, as it plays a significant role in soil fertility restoration and also serves as a break crop suitable for rotation to minimize the negative impact of cereal based mono-cropping (Angaw and Asnakew, 1994). It is also used as a source of income for the farmers and foreign currency for the country (Girma, 2003). Having all these multiple benefits in the economic lives of the farming communities, however, the average yield of the crop is only 1.24 t ha^{-1} in Ethiopia (CSA, 2012; FAOSTAT, 2012) which is far below the potential 40 to 50 t ha^{-1} traditionally achieved in Europe and the worldwide average yield of 1.7 t ha^{-1} (Petr *et al*., 2012). Lack of improved high yielder varieties resistance to diseases, insects and abiotic calamities for specific location with appropriate agronomic recommendations can be cited as a major reason for this low productivity (Seboka and Fikresselassie, 2013).

Diseases are one of the major constraints on faba bean and field pea production in worldwide. Several plant diseases are recorded in Ethiopia of which the major field pea and faba bean diseases incur high yield lose and also affect seed quality and marketability (Berhanu *et al*., 2003). According to Abebe *et al*. (2014), seven (Chocolate spot, Fusarium foot rot, Rust, Black root rot, Virus Diseases and Ascochyta blight) economically important faba bean diseases are reported in Ethiopia which devastating unprotected crop. In views of the important disease studies for faba bean and field pea improvement, much work remains to be done to minimize the damage due to disease epidemics in Ethiopia.

Disease survey is the basic to all effective control and research program (Stubbs *et al*., 1986). However, the highland of Guji zone is one of the area where the crops are dominantly grown for different purposes even if there is no detailed information of economically important faba bean and field pea disease that cause yield loss. For instance, the production of faba bean and field pea in the area was highly affected by the biotic factors. Therefore, assessing the distribution and monitoring of the status of the disease is found to be crucial to draw management options. Hence, current study was conducted with the following objectives: to identify economically important Faba bean and Field pea diseases in the study area; to determine distribution and damage caused by important Faba bean and Field pea diseases.

Materials and Methods

Description of the Survey Area

The Survey was conducted at highlands of Guji zone, Southern Oromia covered with four major Faba bean and Field pea producing districts in two consecutive years of 2014 and 2015 main cropping season. The surveyed districts were namely; Bore, Anna Sorra, Dama and Uraga with the distribution of those crops in the potential areas of the kebele s'. The former four districts are the major faba bean and field pea growing areas of the zone. A total of 84 and 45 fields of faba bean and field pea respectively were assessed in 2014 and 2015 from four districts. The altitude of the study area was ranged from 2103 to 2902 m.a.s.l.

Survey Methodology

The survey trips was made following the main roads and accessible routes in each survey districts, and stops were made randomly at every 5-10 km intervals based on vehicles odometers as per faba bean and field pea fields available. Five stops were made in each faba bean and field pea fields by moving in "W" fashion of the fields using 1meter square quadrants and data were collected from individual quadrants and the five samples per field were used as one site after averaged. Common faba bean and field pea diseases in the surveyed areas were assessed and data on diseases prevalence, incidence and severity were recorded and evaluated.

The 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 for rust but for chocolate spot, aschochyta blight and powdery mildew 1-9 scale were used.

The data of the survey were summarized by districts. The geographic coordinates (latitude

and longitude) and altitude were recorded using Geographic Positioning System (GPS (ddd.WGS-84)) unit.

Results and Discussion

Status of Faba Bean Diseases

Chocolate spot (Botrytis fabae): Chocolate spot was among the widely distributed and prevalent in all faba bean fields of the districts. The highest prevalence value of 100% was recorded in Bore and Dama woreda's while the minimum prevalence of (91.7%) was recorded in Uraga. The mean chocolate spot prevalence in all surveyed areas was 97% (Table 1).

The maximum incidence (100%) disease of chocolate spot was recorded in Bore, Dama and Uraga districts. Among the four surveyed districts, the minimum incidence (95.8%) was recorded in Anna Sorra woreda. The mean incidence (99%) of chocolate spot was recorded in four surveyed districts of the zone.

The mean of chocolate spot severity scale ranged from 2.7 to 4 in which the maximum severity (4) was recorded in Anna Sorra woreda's and the minimum was recorded in Uraga (Fig. 1). Past study showed that Chocolate spot is the most important disease of faba bean and causes a significant yield loss up to 61% on susceptible cultivars in Ethiopia (Hailu, 2014). It also indicated that the disease was the most important and widely prevalent in the surveyed faba bean growing districts of Guji highlands.

Ascochyta blight

The disease was distributed in all faba bean growing districts of the areas similar to Chocolate spot. The mean prevalence value of 96.5% whereas the maximum and minimum average prevalence (100% and 91.7%) was recorded in (Bore and Dama) and Anna Sorra, respectively.

The mean incidence (100%) of Ascochyta blight in the surveyed districts of Bore,Dama and Uraga was the maximum while in Anna Sorra the minimum incidence value (91.7%) was recorded. Anna Sorra was less affected by Ascochyta blight as compared to the three districts.

The mean severity value of 2.7 was scored in the surveyed areas. Severity of 2.5, 2.6, 2.7 and 2.8 was recorded in Uraga, Bore, Dama and A/sorra districts respectively. Previous study indicated that Ascochyta blight was categorized as miner diseases (Nigussie *et al.,* 2008). Dereje and Tesfaye, 1994) indicated as Viruses and Ascochyta blight will be the potential treat for faba bean production in Ethiopia. The recent study indicated that the disease became among the major treats of faba bean production in the country. Hence, in Guji zone the disease was observed as one of the decreasing the yield of faba bean production and it will be needs the management option.

Faba bean rust (*Uromyces fabae*)

The distribution of faba bean rust disease in the surveyed areas was less when compared with Chocolate spot and Ascochyta blight. The mean prevalence was 35.7% in which the maximum prevalence value (55.6%) was observed in Uraga woreda and the minimum was recorded in Dama woreda with the prevalence value (16.3%).

The recorded mean incidence (21%) of faba bean rust disease was less. This result indicated that faba bean rust was not highly affected the faba bean production in the areas and categorized under minor faba bean diseases. The maximum incidence was recorded in Anna Sorra woreda's with the incidence value (28%). Incidence of 12.0%, 17.3% and 26.5% of the disease was recorded in Bore, Dama and Uraga districts respectively. Generally, the occurrences of faba bean rust in the surveyed area were less as compared to the above two faba bean diseases (Table 1).

Faba bean rust disease the overall mean severity (11.2%) which was low. The maximum severity recorded in Anna Sorra followed by Uraga districts (Fig. 2). 7% of mean severity was the minimum recorded in Bore woreda's. This result showed that faba bean rust was rarely occurred during these two years. This could be due to the cool environmental conditions as most fields were surveyed at higher elevation (>2100m). According to Nigussie *et al*. (2008) report that faba bean rust has no significant effect in the highlands of Ethiopia . This might be due to unfavorable weather conditions to rust development in this cropping season as it is known to favor by high humidity, cloudy and warm weather condition (Hawthore *et al.,* 2004).

Status of Field Pea Diseases

Ascochyta blight (Ascochyta pisi)

The mean prevalence of Ascochyta blight in the surveyed areas were significant. The highest prevalence value 90% was recorded in Bore woreda's. The minimum prevalence (25%) was recorded in Dama. The overall mean Ascochyta blight of field pea prevalence in all surveyed districts was 62.4% (Table 2).

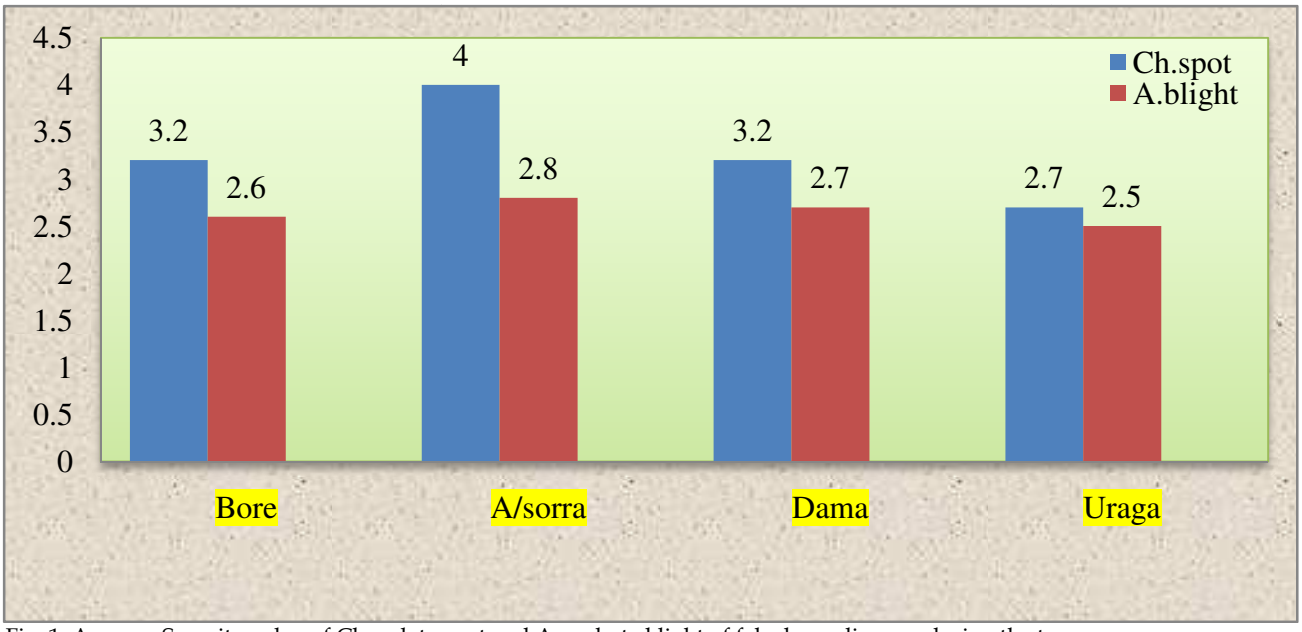

Fig. 1. Average Severity value of Chocolate spot and Ascochyta blight of faba bean diseases during the two years.

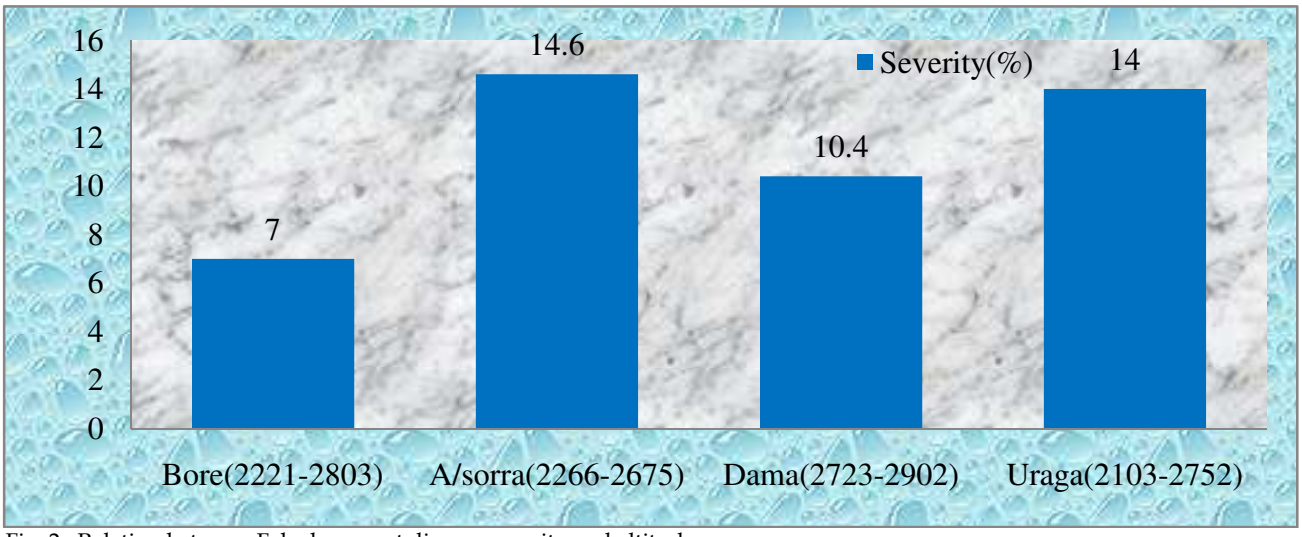

Fig. 2. Relation between Faba bean rust disease severity and altitude

Table 1. Average value of diseases prevalence and incidence of Faba bean in four districts of Guji highlands during 2014 and 2015 cropping season.

District	Altitude range (m.a.s.l.)	Field assessed	Chocolate spot		Aschochyta blight		Faba bean rust	
			Prevalence (%)	Incidence (%)	Prevalence (%)	Incidence (%)	Prevalence (%)	Incidence (%)
Bore	2221-2803	31	100	100	100	100	29	12.0
A/Sora	2266-2675	24	96	95.8	91.7	91.7	41.7	28.0
Dama	2723-2902	14	100	100.0	100	100.0	16.3	17.3
Uraga	2103-2752	15	91.7	100	94.4	100	55.6	26.5
Total/ Mean	2103-2902	84	97	99	96.5	98	35.7	21.0

Status of Field Pea Diseases

Ascochyta blight (Ascochyta pisi)

The mean prevalence of Ascochyta blight in the surveyed areas were significant. The highest prevalence value 90% was recorded in Bore woreda's. The minimum prevalence (25%) was recorded in Dama. The overall mean Ascochyta blight of field pea prevalence in all surveyed districts was 62.4% (Table 2.)

Among the four districts the highest mean incidence of 90% was recorded in Bore. In Dama woreda the minimum incidence of 25% was observed. The overall mean incidence of 64.6% was observed in the surveyed areas of highland part of Guji zone (Table 2.). The maximum mean severity scale of 2.5 was observed in Uraga woreda followed by Bore with mean severity scale of 2.1. In Dama, 1.0 mean severity was recorded and the disease was less severe in this district as compared to other districts (Fig. 3).

Powdery mildew (*Erysiphe polygoni*)

Powdery mildew disease, insignificant prevalence value was observed in all surveyed districts and almost the prevalent fields of field pea were not observed by powdery mildew disease.

The mean incidence of Powdery mildew in the surveyed areas ranged from 0 to 17%. The incidence value of 17% and 6.1% were observed in Anna Sorra and Uraga, respectively. In Bore and Dama districts incidence were not recorded. This result showed that the occurrences of Powdery mildew in these two districts were low (Table 2).

Powdery mildew severity was also ranged from 0 to 0.3. Severity scale of 0.2 and 0.3 were recorded in Uraga and Anna Sorra respectively while in Bore and Dama were not observed. The overall disease severity in the surveyed areas of four districts was 0.1 which was very low (Fig. 3).

Other Unidentified Diseases

From this survey work of field inspection unidentified foliage diseases of faba bean and field pea were observed. Other diseases found in the fields were not recorded.

Cultivars grown in the Surveyed Areas

The growers in the surveyed areas mostly used the local faba bean and field pea cultivars. Chocolate spot is the most important disease of faba bean and causes a significant yield loss up to 61% on susceptible and local cultivars in Ethiopia. Another problem identified during surveying was lack of long-term rotation, it is possible to re-emergence of diseases in the fields from the previous plant residues.

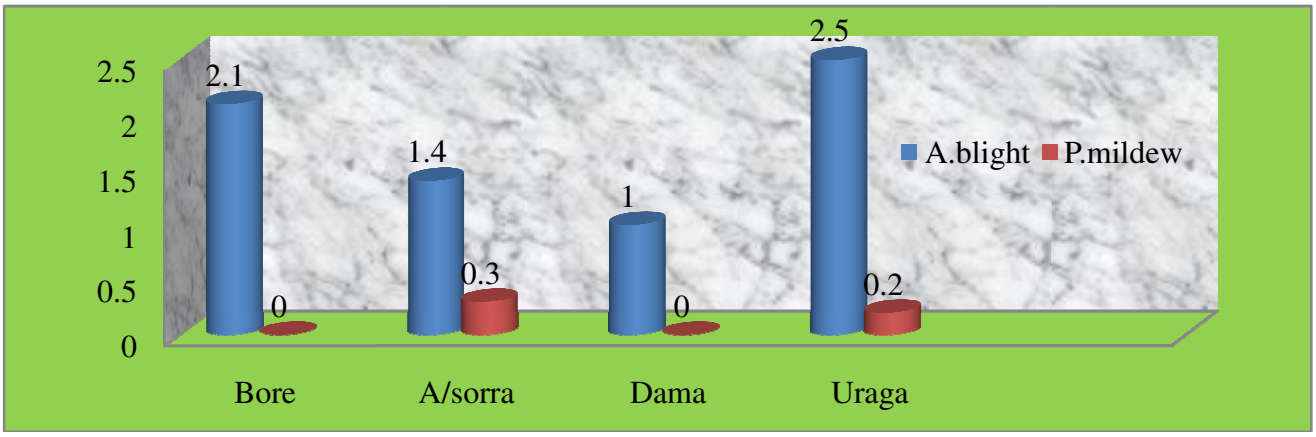

Fig 3. Average Severity value of Ascochyta blight and Powdery mildew of field pea diseases during the two years.

Table 2. Average value of diseases prevalence and incidence of Field pea in four districts of Guji highlands during 2014 and 2015 cropping season.

District	Altitude range (m.a.s.l.)	Field assessed	Aschochyta blight		Powdery mildew	
			Prevalence (%)	Incidence (%)	Prevalence (%)	Incidence (%)
Bore	2644-2845	8	90.0	90.0	0	0.0
Anna Sorra	2368-2678	19	72.2	76.7	0	17.0
Dama	2821-2843	4	25.0	25.0	0	0.0
Uraga	2246-2738	14	62.5	66.7	0	6.1
Total/Mean	2246-2845	45	62.4	64.6	0	5.8

Conclusion

Diseases are the most devastating agents from an economic standpoint and the most difficult to protection efforts. It is mainly associated with lack of detailed information of economically important faba bean and field pea disease that cause yield loss of the areas. Chocolate spot, ascochyta blight and Faba bean rust were most common faba bean diseases whereas Ascochyta blight and powdery mildew are the two identified field pea diseases of Guji highlands.

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