

## Research Article

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Faba Bean Gall; a New Threat for Faba Bean (*Vicia faba*) Production in EthiopiaEndale Hailu<sup>1\*</sup>, Gezahegne Getaneh<sup>2</sup>, Tadesse Sefera<sup>1</sup>, Negussie Tadesse<sup>1</sup>, Beyene Bitew<sup>3</sup>, Anteneh Boydom<sup>1</sup>, Daniel Kassa<sup>1</sup> and Tamene Temesgen<sup>1</sup><sup>1</sup>Ethiopian Institute of Agricultural Research, P.O.Box 2003, Ethiopia<sup>2</sup>Addis Ababa University, Salale Campus, P.O.Box 2003, Ethiopia<sup>3</sup>Debre Birhan Research center, Ethiopia

## Abstract

Faba bean ranks first in its production volume and cultivated land among pulse crops cultivated in Ethiopia and it is valuable as the cheap source of protein in most Ethiopian diet. It also plays a significant role in soil fertility restoration and in export market. Production of the crop is, however, constrained by several pests. The objective of this study was to find out the distribution and intensity of newly occurred epidemic faba bean gall disease and other diseases affecting faba bean in the major growing areas of central and northern part of Ethiopia. The survey was made in 2013 main cropping season (in September) along the main roads and accessible routes in each surveyed district at every 5-10 km intervals as per faba bean fields available. Five samples were taken in each faba bean field by moving "X" fashion. The mean prevalence of faba bean gall, Ascochyta blight, Chocolate spot and rust were 48.5%, 63.6%, 94.6% and 1.9%, respectively. The mean incidence of the formal all diseases were 15.4%, 30.3%, 42.4% and 0.1% in their previous order. Based on severity scale, mean disease severity of Ascochyta blight and chocolate spot were 1.9 and 1.5, respectively. Mean severity of faba bean gall and faba bean rust were 6.4% and 0.1% were recorded in their order. The disease was more severe in Amhara region with mean disease severity of 22.2% followed by Tigray and Oromiya region which had 11.3% and 7.8% severity value, respectively. The newly observed Faba bean gall disease was found the most devastating and widely disseminated in the area within a few years since its occurrence. The production of the crop is highly challenged and farmers are frustrated by the nature of the disease. Farmers witnessed the appearance of the disease three years ago in 2011 in Oromiya. They observed fast dissemination and increasing coverage of the pathogen in time and space. In fact the disease is epidemic and more serious from the record and the information from Faba bean growers in the surveyed areas. The epidemic conditions of the disease have significant implication on the production of Faba bean and on the country's economy. This survey information helps to consider the disease as serious pest in Ethiopia and in development of management options. In the future, ecology and biology of the causative agent, yield loss due to the diseases, breeding for disease resistance/tolerance and management strategies should get attention.

**Keywords:** Disease; Faba bean; Faba bean gall; Incidence; Prevalence; Severity

## 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. China has been the main producing country, followed by Ethiopia, Egypt, Italy and Morocco [1]. 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. According to Central Statistics Agency of Ethiopia 2012/13, Faba bean takes over 30% (nearly half a million hectares) of cultivated land with an average national productivity of 1.5 tons ha<sup>-1</sup>. Ethiopia is considered as the secondary center of diversity and also one of the nine major agro-geographical production regions of faba bean.

As the faba bean is familiar in Ethiopian feeding culture, the majority of the seed produced would be consumed domestically and only a smaller percentage of the crop is delivered to the export market. However, still this small portion of export volume put Ethiopia among the top broad bean exporting countries of the world [2]. Amhara and Oromia regions are the major faba bean producing regions. Within the regions some zones such as West Shoa, North Shoa, South Wello and East Gojjam are identified as major production areas of faba bean [2]. The growing importance of faba bean as an export crop in Ethiopia has led to a renewed interest by farmers to increase the area under production [3].

An average national productivity is 1.5 tons ha<sup>-1</sup>, while world

average grain yield of faba bean is around 1.8 t ha<sup>-1</sup> (ICARDA, 2008). However, the productivity of faba bean in Ethiopia is still, far below its potential due to a biotic and biotic factor. Among which diseases are the most important biotic factors causing faba bean yield reduction [4]. More than 17 pathogens have been reported so far on faba bean from different parts of the country. Diseases that are economically most important in the major faba bean growing regions including chocolate spot (*Botrytis fabae*), faba bean rust (*Uromyces viciae-fabae*), black rot (*Fusarium solani*), Ascochyta blight (*Aschochyta fabae*) and faba bean necrotic yellow virus (FBNYV) (Dereje and Tesfaye, 1994). In recent years, in addition to the previous common diseases, the crop is threatening by new gall forming disease with typical symptoms of green and sunken on the upper side of the leaf and bulged to the back side of the leaf, and finally develops light brownish color lesion, chlorotic galls, and progressively broaden to become circular or elliptical uneven spots.

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The disease affects leaves and stems. According to the information obtained from farmers and woreda agricultural office expertise, the disease existed for a long period in the region but well recognized after 2010. Locally, the disease is known by different names: such as *Qormid* (North Shewa and South Wollo), *Kolsim and Kortim* (North Gondar), *Aqorfid* (East Gojam), *Chimid and Kurnchit* (South Gondar); but in many places it is known by the name *Qormid* which is based on its symptoms on the leaf, in local Amharic language. The disease was highly expanding and distributing aggressively in the northern and central part of the country from year to year.

Even if the disease is disseminated at an alarming rate, there is no enough information on its status. Therefore, monitoring of the status of the disease is found to be crucial to draw management options. Hence, the present study was conducted to assess the distribution and intensity of the new Faba bean disease in central and northern Faba bean growing areas of Ethiopia.

## Materials and Methods

### Survey areas descriptions

The survey was conducted in 2013 main cropping season and covered three major Faba bean producing regional states (Amhara, Oromia and Tigray) of the central and northern parts of the country. A total of 278 faba bean fields in 66 Woredas (districts) of eleven zones from three regions were assessed of which 96 fields were in 18 districts, 192 fields in 44 districts and 10 fields in 4 districts of Oromia, Amhara and Tigray regional states, respectively. The altitude of study area was ranged from 1805 to 3332 m.a.s.l.

### Survey methodology

In each surveyed regions, 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 X 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 faba bean diseases in the surveyed areas were assessed and data on diseases prevalence, incidence and severity were recorded and evaluated.

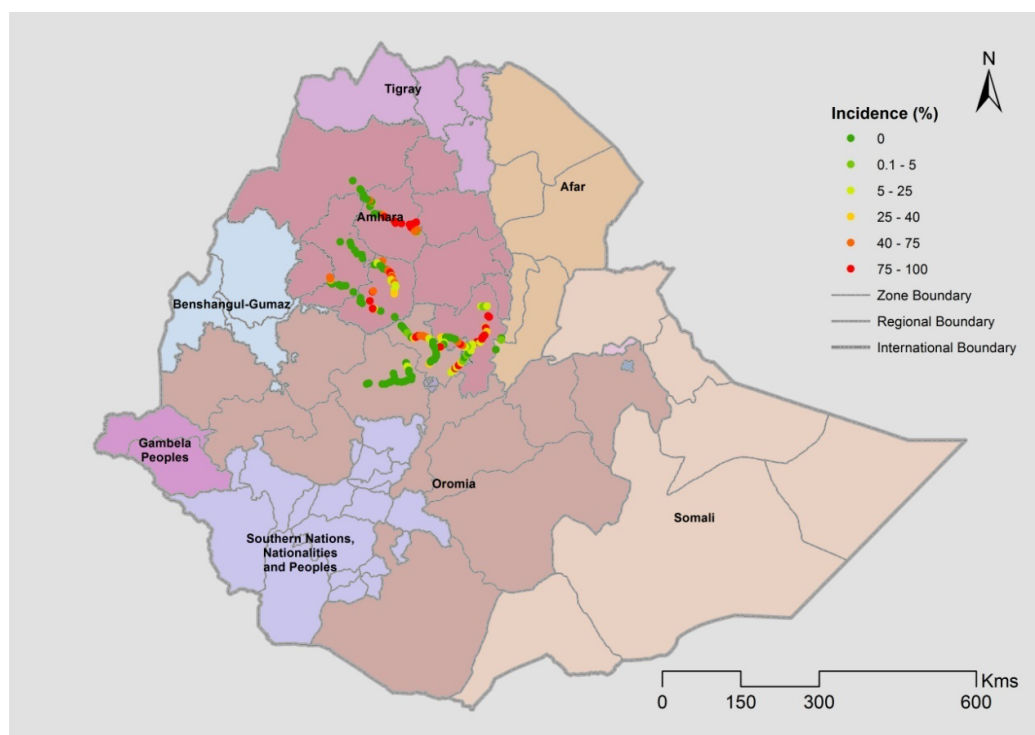
The prevalence of a disease was calculated using the number of fields affected divided by the total number of field assessed and expressed in percentage. Incidence was calculated by using the number of plants infected and expressed as percentage of the total number of plants assessed. Severity was recorded by examining visually the whole plants using percent leaf area affected in the quadrants for faba bean gall and rust; but for chocolate spot and Ascohyta blight 0–9 scale were used.

The results of the survey were summarized by zones in the regions. The geographic coordinates (latitude and longitude), and altitude were recorded using Geographic Positioning System (GPS (ddd.WGS-84)) unit. The latitude and longitude coordinates were used to map the distribution of the new gall forming faba bean disease in the surveyed areas of the country.

## Result and Discussions

### The status of faba bean gall forming disease

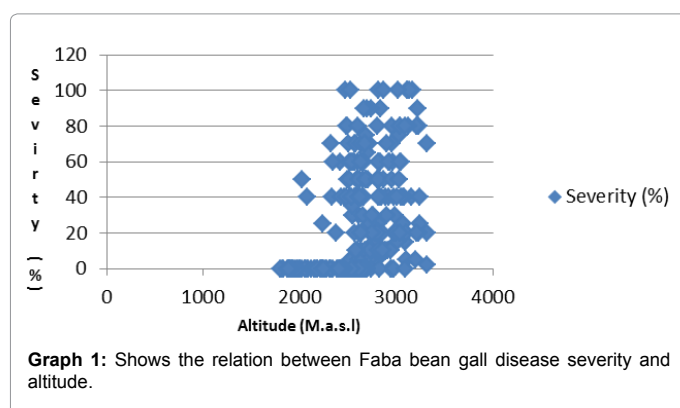
The prevalence of the new disease was in the range of 0 and 100% (Figure 1). The overall average percent prevalence was about 48.5% in the surveyed areas. It was more prevalent in Awi zone of Amhara region with prevalence value of 100%. Prevalence percentage of 95.2, 91.7, 86.7 and 85.7 were recorded in north Shewa of Oromia region, north Shewa of Amhara region, south Wollo and south Tigray, respectively. Less



**Figure 1:** Distribution and incidence of faba bean gall disease in central and northern Ethiopia.

Region	Zone	Altitude (m.a.s.l)	Faba bean gall					
			No of field assessed	Prevalence (%)	Incidence Range (%)	Mean Incidence (%)	Severity range (%)	Mean Severity (%)
Amhara	Awi	2501-2564	4	100.0	10-70	42.5	40-80	57.5
	East Gojam	2223-3318	36	69.4	0-100	37.4	0-100	39.9
	North Gondar	1873-1974	5	0.0	0	0	0	0.0
	North Shewa	2539-3324	60	91.7	0-100	32.6	0-80	13.6
	South Gondar	1805-3232	38	71.1	0-100	43.44	0-100	40.7
	South Wollo	1805-3232	15	86.7	0-100	41.5	0-80	14.6
	West Gojam	1825-2397	14	0.0	0	0	0	0.0
	Mean	1805-3332	172	72.1	0-100	29.9	0-100	22.2
Oromia	North Shewa	2528-3099	71	95.2	0-100	25	0-80	11.6
	West Shewa	2159-3090	25	36.0	0-40	3.0	0-50	4.0
	Mean	2159-3099	96	65.6	0-100	14.09	0-80	7.8
Tigray	East Tigray	2537-2724	3	66.7	0-60	26.7	0-5	8.3
	South Tigray	2247-2755	7	85.7	0-20	37.4	0-35	14.3
	Mean	2247-2755	10	80.0	0-60	32.05	0-35	11.3
Over all mean		1805-3332	278	48.5	0-100	15.4	0-100	6.4

**Table 1:** Distribution of faba bean gall disease in central and northern part of Ethiopia in 2013/14 cropping season.



disease prevalence was observed in west Shewa zone with prevalence value of 36% but no new disease was observed in north Gondar and west Gojam zones (Table 1).

The overall mean incidence of faba bean gall in central and northern part of the country was 15.4% in which the disease incidence ranged from 0 to 100%. The maximum mean incidence of 43.4%, 42.5% and 41.5% were recorded in south Gondar, Awi and south Wollo zone, respectively. Among the three regions the highest mean incidence of 32.05% were recorded in Tigray.

The mean disease severity was also ranges from 0 to 57.5%. The maximum mean severity of 57.5% was observed in Awi zone followed by south Gondar zone with mean severity of 40.7%. The overall mean faba bean gall severity of 6.4% was observed in the surveyed areas of central and northern part of the country. In Amhara region, 22.2% mean severity was recorded and the disease was more severe in this region as compared to other regions (Table 1).

The faba bean gall disease incidence and severity was related to altitude. At altitude above 2400 m.a.s.l the disease became more Sevier. This showed that faba bean gall disease incidence has direct relation with altitude. The distribution and severity of the disease was high at higher altitude (Graph 1).

In general, faba bean production in Ethiopia is highly challenged by new faba bean gall forming disease. The disease was widely disseminated in the country and cause epidemic in short period of time.

Yet, the mechanism of introduction of the disease into the country and its transmission is not known. It was first reported in north Shewa zone of Oromiya region in 2011 in some pocket areas [5]. In 2013, the same problem with a significant magnitude was reported from Tigray Region [6]. In Chaina Xing reported the occurrence of gall forming disease on faba bean in Chaina and was identified as *Olpidium viciae*. In Ethiopia, it is not proved weather the causative agent similar to this pathogen.

#### The status of other faba bean diseases (chocolate spot, rust and aschoytha blight)

**Chocolate spot (*Botrytis fabae*):** Chocolate spot was widely distributed and the most prevalent in all Faba bean growing areas of the region. The recorded mean prevalence value ranged from 57.1 to 100%. The highest prevalence value of 100% was recorded in north Shewa, south Wollo, east Gojam and Awi zone of Amhara, north and west Shewa of Oromia and east and south Tigray zone of Tigray region. The minimum prevalence (57.1%) was recorded in west Gojam. The overall mean chocolate spot prevalence in all surveyed areas was 94.6%.

The overall mean chocolate spot incidence 42.4% was recorded in the surveyed areas of central and northern part of the country. The maximum incidence (100%) was recorded in Awi zone; whereas the minimum incidence (26.3) was recorded in north Gondar. Among the three regains surveyed, the highest mean incidence (70.8%) was recorded in Oromia followed by Amhara region with 70.6%.

Mean chocolate spot severity scale ranged from 1.1 to 5.4 in which the maximum was recorded in north Shewa zone of Oromia region and the minimum was in south Wollo zone (Table 2). Past study showed 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 [6,7]. It also indicated that the disease was the most important and widely prevalent in the faba bean growing regions of central and northern highlands of Ethiopia [8,9].

**The status of faba bean rust (*Uromyces fabae*):** The overall distribution of Faba bean rust disease in the surveyed area of the country was less with the mean prevalence of 1.9%. The disease prevalence was ranged from 0-50% in which the maximum rust prevalence was recorded in Awi zone. Mean rust disease prevalence of 15.3%, 1.4% and 0% was scored in Amhara, Oromia and Tigray regions (Table 2)

Faba bean rust mean disease incidence recorded in the range of 0

Region	Zone	Altitude range (m.a.s.l)	No of field assessed	Chocolate spot			Rust			Ascochyta blight		
				Prevalence (%)	Incidence (%)	Severity (1-9)	Prevalence (%)	Incidence (%)	Severity (%)	Prevalence (%)	Incidence (%)	Severity (1-9)
Amahara	Awi	2501-2564	4	100	100.0	4.0	50	0.0	0.0	25	17.5	1.5
	East Gojam	2223-3318	36	100	79.1	3.6	5.5	2.5	1.6	91.7	9.5	0.6
	North Gondar	1873-1974	5	60	26.3	2.1	20	26.1	28.5	0	3.8	0.3
	North Shewa	2539-3324	60	100	61.2	2.5	0	0.0	0.0	3.3	26.0	1.0
	South Gondar	1805-3232	38	78.9	64.0	2.8	31.6	22.6	15.2	5.3	1.3	0.1
	South Wollo	1805-3232	15	100	65.0	1.1	0	0.0	0.0	100	49.3	1.0
	West Gojam	1825-2397	14	57.1	88.6	4.0	0	1.4	0.7	0	12.1	0.8
	Mean	1805-3332	172	83.7	70.6	2.9	15.3	5.3	4.4	32.2	21.3	0.9
Oromia	North Shewa	2528-3099	71	100	70.7	5.4	2.8	0.7	0.5	97.1	31.3	1.9
	West Shewa	2159-3090	25	100	70.9	2.8	0	0.0	0.0	20	20.8	1.1
	Mean	2159-3099	96	100	70.8	4.1	1.4	0.4	0.3	58.5	26.1	1.5
Tigray	East Tigray	2537-2724	3	100	43.3	2.0	0	0.0	0.0	100	46.7	3.0
	South Tigray	2247-2755	7	100	69.3	1.3	0	0.0	0.0	100	82.8	3.0
	Mean	2247-2755	10	100	56.3	1.7	0	0.0	0.0	100	64.8	3.0
Over all mean		1805-3332	278	94.6	42.4	1.9	1.9	0.1	0.1	63.6	30.3	1.5

**Table 2:** Distribution of other common Faba bean diseases in northern and central part of Ethiopia, 2013 cropping season.

to 26.1% in all surveyed areas. The maximum incidence was recorded in north Gondar. Mean incidence of 5.3% and 0.4% of the disease was recorded in Amhara and Oromia regions, respectively. Insignificant result was observed in the surveyed areas of Tigray region. The overall mean incidence was less than 1%. Generally, the occurrences of the faba bean rust in the surveyed area were less (Table 2).

Faba bean rust disease severity was also ranged from 0 to 28.5% in which the maximum severity recorded in North Gondar zone. Mean rust disease severity of 4.4% and 0.3% were recorded in Amhara and Oromia regions, respectively. The overall disease severity in the surveyed areas of the country was 0.1% which was very low (Table 2). Past result also showed that the disease prevalence was less [6]. 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 conditions [10].

**The status of ascochyta blight:** The disease was distributed in all faba bean growing areas with over all mean prevalence value of 63.4%. The recorded prevalence ranges from 0-100 in which the maximum score recorded in east & south Tigray and south Wollo zones.

The mean incidence of Ascochyta blight in the surveyed regions ranged from 0 to 82.8%. Incidence of 21.3%, 26.1% and 64.8% was recorded in Amhara, Oromia and Tigray regions respectively. Tigray region was highly affected by Ascochyta blight as compared to the two regions.

The mean severity value of 1.5 was scored in the surveyed areas. Low severity was observed in the surveyed areas with a range of 0 to 3 in which the maximum was scored in Tigray region. The overall mean incidences of 30.3% were scored in the surveyed areas. Previous study indicated that Ascochyta blight was categorized as minor diseases [11]. Dereje and Tesfaye [8] indicated as Viruses and Ascochyta blight will be the potential treat for faba bean Production in Ethiopia. The recent studies indicated that the disease became among the major treats of faba bean production in the country [6].

## Conclusions

The main purpose of this field inspection was to study the status of unidentified new gall forming faba bean disease which occurred in recent years and in the meantime observation of other most important

faba bean diseases. As a result, the new unidentified pest was found an epidemic and becoming a serious pest in the country within short period of time. Chocolate spot, Ascochyta blight and Faba bean rust are still the most common diseases of Faba bean in Ethiopia [12-14]. The mean prevalence of faba bean gall, Ascochyta blight, Chocolate spot and rust were 48.5%, 63.6%, 94.6% and 1.9% respectively. The mean incidence of all former diseases was 15.4%, 30.3%, 42.4% and 0.1% in their previous order. Based on severity scale, mean disease severity of Ascochyta blight and chocolate spot were 1.5 and 1.9, respectively. Mean severity of faba bean gall and faba bean rust were recorded as 6.4% and 0.1% in their order.

Faba bean gall was prevalent and the most challenging diseases and threatening faba bean production in the country. The severity of the disease has gone up to 57.5% (Awi zone). Among the three regions surveyed, it was more severe in Amhara region followed by Tigray and Oromiya regions. The mean disease severity of 22.2%, 7.8% and 11.3% were recorded in Amhara, Oromiya and Tigray regions, respectively. All improved and local faba bean varieties affected by the diseases indifferently.

The new gall forming disease recorded lower prevalence and incidence values, but in its area of destination it has got higher severity among all recorded common faba bean diseases, in which severity has direct impact on crop yield. The new disease is wider, fast coverage in time and space and so far the causal agent and the spread mechanism of this disease is unknown [15]. In fact the disease is epidemic and more serious from the record and the information of Faba bean growers in the surveyed areas. The epidemic conditions of the disease have significant implication on the production of Faba bean and on the country's economy. This survey information helps to consider the disease as serious pest in Ethiopia and in development of management options. Joint work on lab analysis and identification by all experts is crucial.

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