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Assessments of Distribution and Status of Major Pulse and Oil Crop Disease in West Shoa, Horro Guduru Wollega and East Wollega Zones, Ethiopia

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Abstract
Field survey was conducted in part of Western Oromia in West Shoa, Horro Guduru Wollega, East Wollega and Buno Bedele Zones covering 90 fields to assess diseases of faba bean, field pea, soybean, ground nut and sesame. Major diseases of faba bean recorded in Horro, Jimma Arjo and Chalia districts include Chocolate spot (Botrytis fabae S.), Ascochyta blight (Ascochyta fabae), Rust (Uromyces fabae) and faba bean Gall (Olpidium species). Similary, Powdery mildew (Erysiphe pisi var.), down mildew (Peronospora viciae), Septoria blotch (*Septoria* pisi) and Ascochyta blight () were the major diseases recorded on field pea in Chalia and Horro districts. Diseases recorded on soybean in Ilu Galan, Gida Ayana and chawaka districts include forage leaf spot (Cercospora sojina), Bacterial pustule (Xanthomonas axonopodis pv. glycines), Brown spot (Septoria glycines) and Cecospora leaf blight (Cercospora kikuchii.). Four major diseases were recorded on ground nut in Gida Ayana district and two diseases were recorded on sesame in Chawaka district. For all diseases, key parameters: prevalence, incidence and severity were described.

Keywords: Distribution, status, major pulse and oil seeds disease

Introduction

Agriculture is the fundamental driver for Ethiopia's economy and long-term food security as it offers about 80-85% of employment, more than 61% of the total export and 38.5% of gross domestic product of the country (Degaga & Angasu, 2017) [4]. Ethiopia has diverse agro-ecology that permits different agricultural systems and production of different crops. The existence of this diverse agro-ecology, together with diverse farming systems, socio-economic, cultures and climate zones provid Ethiopia with various biological wealth of plants, animals, and microbial species, especially crop diversity (Atnaf *et al*., 2015) [1].

Pulses are rich in proteins and serve as an economical source of nutrition: pulses can play a significant role in improving smallholders' food security as an affordable source of protein – in fact, pulses make up around 15% of the average Ethiopia diet (IFPRI, 2010) [5]. Pulses complement cereals as a source of protein and minerals as they provide 15-40% of protein (Monti and Grillo, 1983) [6] compared to 6 to 10% for cereals and contain essential amino acid lysine, which is missing in cereals. As a protein source, pulses are more affordable for smallholders compared to meat, fish, and dairy products. Pulses also provide complex carbohydrates, fiber, and several vitamins and minerals (iron, magnesium, phosphorus, zinc and other minerals), which play a variety of roles in maintaining good health.

Like other plant-based foods, they contain no cholesterol and little fat or sodium. The World Health Organization (WHO, 2008) [9] estimates that up to 80% of heart disease, stroke, and type 2 diabetes and over a third of cancers could be prevented by eliminating risk factors, such as unhealthy diets and promoting better eating habits, of which pulses are essential component. Pulses can help lower blood cholesterol and attenuate blood glucose, which is a key factor against diabetes and cardiovascular disease. Eating pulses as a replacement to some animal protein also helps limit the intake of saturated fats and increases the intake of fibers.

The diverse and important roles played by pulses in farming systems and in the diets of people make them ideal crops for achieving the Sustainable Developmental Goals of reducing poverty and hunger, improving human health and nutrition, and enhancing ecosystem resilience.

Moreover, many pulses can enhance soil fertility and improve productivity (Campbell, *et al*., 1992 and Schwenke, *et al*., 1998) [2, 7].

The legume crops are severely damaged by a number of fungal, bacterial and viral diseases. Cool climate pulses are immensely damaged by Ascochyta blight as it is the most severe disease that attacks on leaves mainly attacking chickpea, faba bean and field pea and it may lead to total crop failure. The strains of these fungi are spread worldwide and host specific (Davidson *et al*., 2007) [3] The pathogenic fungus starts sexual reproduction on the damaged residue that provides the space for accommodation of ascospores that are airborne and have potential to spread to longer distances. Then these fungi spread themselves within short range through splash borne asexual conidia. This disease damages all the aerial parts of the plant and symbolized by necrotic lesions and drops the yield to drastic limits. The quality of seed is damaged or it may poorly develop affecting seed viability (Davidson *et al*., 2007) [3].

As diseases are key biotic constraints to the production of pulses, significantly limiting yield, it is quite important to conduct disease assessments. Although major diseases of some pulse crops have been on record, periodical surveys and quantification are very important as there is pathogen dynamism due to climate change, farm activities and other form of human interventions in the ecosystems. Thus the main objective of this study was to make assessments and quantification of pulse diseases in different Zones and districts of Western Oromia.

Materials and Methods

Description of the study area

The Field survey was conducted in parts of Western Oromia i.e West Shoa, Horro Guduru Wollega, East Wollega and Buno Bedele Zones during 2019 and 2020 main cropping season. The disease assessment survey was conducted in two districts of West Shoa Zone Chalia and Ilu Galan Districts; in one district of Horro Guduru Wollega Zone-Horro District; in two districts of East Wollega Zone namely Gida Ayana and Jima Arjo Districts and Chewaka District of Buno Bedelle Zone (Table 1). The annual mean minimum and maximum temperature of the area is 12^0C and 27.4^0C, respectively, while the annual rainfall is 1415.2 mm. The surveyed areas are geographically located in a range of latitude and longitude of $08^0$34.70'- $09^0$40.41'N and $036^0$06.47'- $037^0$29.30'E, respectively.

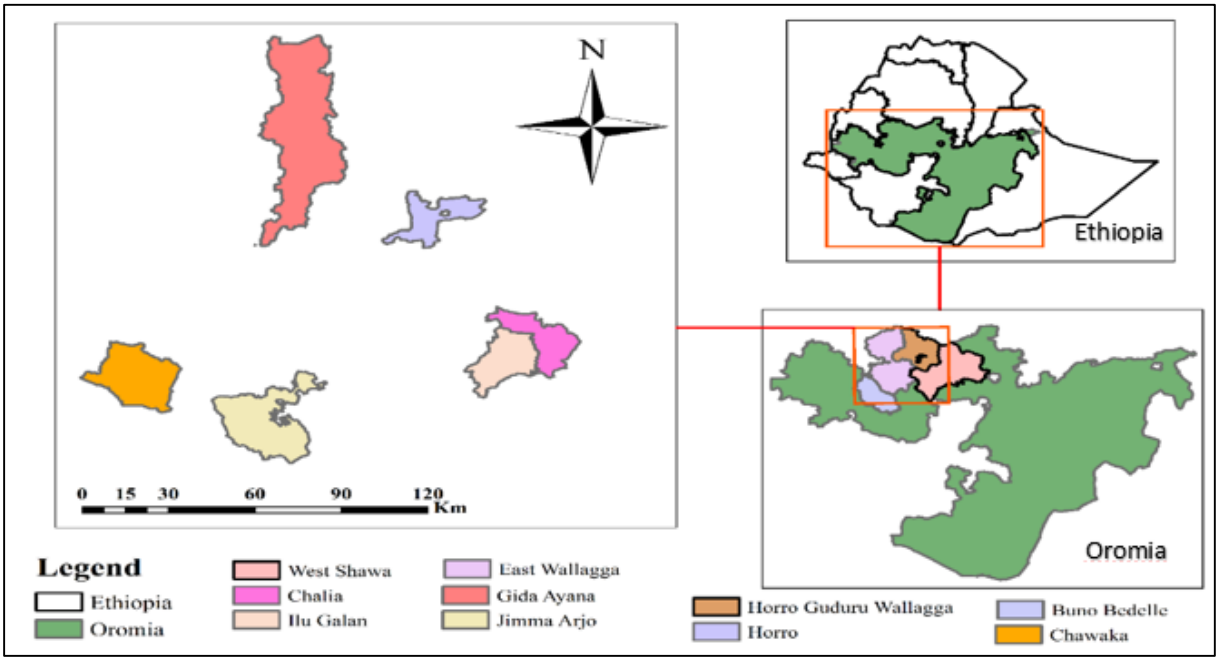

Fig 1: Map of site

Field survey

Field survey was conducted in six districts of four zones to assess diseases of pulses and oil crops. The six districts lie in lowland, midland and highland agro-ecologies. The study area lies in altitude range of 1219-2788 m.a.s.l in four Administrative Zones (Table 1). The disease Survey was conducted to assess the prevalence, incidence and severity of major pulse and oil crops (faba bean, field pea, soybean, sesame and ground nut). In most of the areas, the survey was conducted after dough to maturity growth stages of crops. The survey was conducted from 20th to 27th September for low land, from 16th to 23rd October for mid land and 1st to 8th November 2019 and 2020.

In this area most farms are covered by faba bean followed by field pea, soybean and oil crops. The survey was conducted in 41 Kebeles and 90 fields in the five districts of the four Zones. Purposive sampling technique was applied for Zones and Districts. Kebeles were randomly selected from each district and based on the representativeness of pulse and oil seeds production of the area. As a result, crops were assessed as follows: faba bean 31 samples, field pea 19 samples, soybean 20 samples, sesame 12 samples and groundnut 8 samples (Table 1). Any two consecutive locations sample or crop were at least 4-6 km apart depending on the topography and the relative importance of the particular crop within each location. The disease assessment was made along the two diagonals (in an "X" pattern) of the field from five points using 1m × 1m (1 m^2) quadrates with their GPS and soil types recorded.

Farmers were interviewed using pre-developed questionnaire to collect information on management practices, variety sown, proceeding crop, planting date (sowing), weed

management, fertilizer type and rate, fungicide used and their general perception of crop diseases. In each field, plants within the quadrates were counted and recorded as healthy and diseased.

Table 1: Characteristic features of surveyed pulse and oil seed fields in four Zones, Western Oromia

Zones	Districts	Crops	Altitude (m.a.s.l)	No. field assessed
West Shoa	Chalia	Faba bean	2435-2614	9
		Field Pea	2464-2619	8
	Ilu Galan	Soybean	1704-2615	7
		Mean	**1704-2619**	**24**
Horro Guduru Wollega	Horro	Faba bean	2377-2788	13
		Field Pea	2370-2717	11
		Mean	**2370-2788**	**24**
East Wollega	Jima Arjo	Faba bean	2347-2476	9
	Gida Ayana	Soybean	1345-2451	6
		Groundnut	1350-1469	8
		Mean	**1350-2476**	**23**
Buno Badalle	Chawaka	Sesame	1219-1270	12
		Soybean	1222-1250	7
		Mean	1219-1270	19
		Over all mean	**1219-2788**	**90**

m.a.s.l= meters above sea level

Disease scoring

Visual identification of the disease was used on all visited fields. The assessment was done for disease prevalence, incidence and severity for each crop.

Disease Prevalence was calculated using the formula:

Disease prevalence (%) =

$$\frac{\text{Number of locations showing plant disease}}{\text{Total number of location or fields}} \times 100$$

Disease Incidence

Disease incidence was determined in each field on the basis of visual symptoms and by counting the number of symptomatic or infected plants in a sample of total plants. An overall disease incidence value was obtained by averaging the incidence among all the fields (including disease free fields). Disease incidence was calculated using the formula:

Disease Incidence (%) =

$$\frac{\text{Number of Diseased plants in the quardateor field}}{\text{Total number of plant in the quardate or field}} \times 100$$

Disease Severity was calculated using the formula (Wheeler, 1969).

$$\text{Disease Severity (\%)} = \frac{\text{Area of plants tisseu affected}}{\text{Total number of plants affected}} \times 100$$

Data analysis

Data was analyzed using SPSS. Analysis was conducted by disaggregating important relevant information by district and region so that comparison could be made.

Results and Discussion

Faba bean Diseases

A total of 31 faba bean fields were surveyed across three districts during 2019 and 2020 cropping season to document the occurrence of faba bean diseases. Chocolate spot (*Botrytis fabae* S.), Ascochyta blight (*Ascochyta fabae*), Rust (*Uromyces fabae*), and Gall (*Olpidium species*) were the major diseases recorded in the three districts i.e Horro, Jimma Arjo and Chalia (Table 2).

The prevalence and incidence level of chocolate spot disease was found to be 100% in all the three districts while its severity ranged from 35.4% to 54%. Likewise, the prevalence and incidence of Ascochyta blight was 100% in Jimma Arjo and Horro districts while prevalence and incidence of Ascochyta blight were 80% and 90%, respectively in Chalia district. Ascochyta blight severity generally ranged from 30% to 47% in the three districts. Faba bean rust prevalence, incidence and severity were generally found to be lower as compared to the other two diseases but were quite high in Jimma Arjo (Table 2). Faba bean gall disease was observed in Horro district with 37.5%, 40% and 22.3% of prevalence, incidence and severity levels, respectively.

Field pea disease

Major diseases of field pea recorded during this survey are indicated in Table 2 along with their prevalence, incidence and severity values scored. Powdery mildew (*Erysiphe pisi* var.), down mildew (*Peronospora viciae*), Septoria blotch (*Septoria pisi*) and Ascochyta blight (*Ascochyta mycosphaerella*) were the major diseases recorded.

Powdery mildew was 100% prevalent in both districts-Chalia and Horro surveyed for field pea diseases where as its mean incidence was 100% and 89.17%, respectively. The corresponding severity level was 46% and 34% in that order. Downy mildew mean prevalence was 66% and 50% for Chalia and Horro districts, respectively whereas mean incidence level of the disease in the two districts was 80% and 100% in that order. The mean severity level rather appeared to be lower – 30% for Chalia and 11% for Horro districts. Ascochyta blight mean prevalence level was 90% and 72% in Chalia and Horro districts, respectively; its incidence level was 86% and 60% whereas the severity was 42% and 32% in that order. Septoria blotch of field pea was 100% prevalent in both surveyed districts while its incidence level was 75% and 76.17% for Chalia and Horro districts, respectively; the severity level appeared to be lower – 38% and 24.83% in that order.

Table 2: Prevalence, Incidence and Severity Index of Faba bean and field pea diseases

Zones	Districts	types of crops assessed	types of disease	Prevalence%	Incidence %	Severity %
West Shoa	Chalia	faba bean	Chocolate spot	100	100	54
			Ascochyta blight	80	92	47
			Rust	27	38	26
		Field pea	powdery mildew	100	100	46
			down mildew	66	80	30
			Septora blotch	100	75	38
			Ascochyta blight	90	86	42
Horro Guduru Wollega	Horro	faba bean	Chocolate spot	100	100	45
			Ascochyta blight	100	100	34
			Rust	62.5	43.63	11.2
			Gall	37.5	40	22.3
		Field pea	powdery mildew	100	89.17	34
			down mildew	50	100	11
			Septora blotch	100	76.17	24.83
			Ascochyta blight	72	60	32
East Wollega	Jima Arjo	faba bean	Chocolate spot	100	100	35.4
			Ascochyta blight	100	100	30
			rust	80	75	41.4

Soybean Diseases

Soybean (*Glycine max L. Merr*) disease prevalence, incidence and severity surveyed on 20 farms in three districts is presented in Table 3. Frogeye leaf spot (*Cercospora sojina*), bacterial pustule (*Xanthomonas axonopodis* pv. *glycines*), brown spot (*Septoria glycines*) and cecospora leaf blight (*Cercospora kikuchii*.) were the major diseases recored in the three districts – Ilu Galan, Gidda Ayana and Chawaka surveyed for soybean.

Frogeye leaf spot and bacterial pustule diseases of soybean were 100% prevalent in all the three districts. The incidence of both diseases was also 100% in Ilu Galan district; the incidence of forage leaf spot and bacterial pustule were 100% and 67%, respectively in Gidda Ayana where as it was 86.5% and 100% in and chawaka district in that order. The severity of both diseases appeared to show little variation across the districts. Brown spot and cercospora leaf blight of soybean occurred only in Ilu Galan district with lower severity level.

Groundnut diseases

Ground nut (*Arachis hypogeaL.*) diseases were assessed in Gida Ayana district on nine farms. The results of disease assessment are shown in Table 3. Four major diseases were recorded: early leaf spot (*Cercospora arachidicola*), late leaf spot (*Cercosporidium personatum*), irregular leaf spot and leaf scroch. Early leaf spot and irregular leaf spot both had high mean prevalence and incidence but lower severity level. On the other hand, late leaf spot and leaf scrotch both appeared to have mean lower prevalence and severity. However, incidence of late blight was high.

Sesame diseases

Sesame (*Sesamum indicum L.*) diseases were assessed in Chawaka district on 12 farms. The results of disease assessment are shown in Table 3. Two major diseases were recorded: bacterial blight (*Xanthomonas campestris* pv. Sesame*)* and bacterial leaf spot (*Pseudomonas syringae* ***pv. Sesame***) with high and nearly equal level of disease prevalence and incidence. Severity was 45.43% and 32% for bacterial blight and bacterial leaf spot, respectively.

Table 3: Percentage of Prevalence, Incidence and Severity Index of soybean, ground nut and sesames diseases

Zones	Districts	types of crops assessed	types of disease	Prevalence%	Incidence %	Severity %
West Shoa	Ilu Galan	Soybean	Frogeye leaf spot	100	100	46
			Bacterial pustule	100	100	43
			Brown spot	60	50	25
			Cecospora leaf blight	60	55	23
East Wollega	Gida Ayana	Soybean	Frogeye leaf spot	100	100	56
			Bacterial pustule	100	67	40.6
		Groundnut	Early leaf spot	85.71	83.33	47
			late leaf spot	14.29	100	30
			Irregular leaf spot	84	50.67	39
			Leaf scroch	28.57	43	41
Buno Bedelle	Chawaka	Soybean	Frogeye leaf spot	100	86.5	44.5
			Bacterial pustule	100	100	47
		Sesame	Bacterial blight	100	100	45.43
			Bacterial leaf Spot	100	89	32

Conclusion and Recommendation

In the current study, a total of 83 pulse and oil seeds fields were assessed and different diseases were identified. The importance of each disease was determined by calculating the prevalence, incidence and severity values. Major pulse and oil seeds; Faba bean, Field pea, Soybean, Sesame and Groundnut fields were assessed and different diseases were identified. From faba bean fields, Chocolate spot, Ascochyta blight, Rust and Gall disease were recorded and quantified. From field pea powdery mildew, down mildew, Septora blotch and Ascochyta blight diseases were assessed and quantified. Diseases of soybean observed in the current study

include Frogeye leaf spot, Bacterial pustule, Brown spot and Cecospora leaf blight. From sesame fields; Bacterial blight and Bacterial leaf spot disease were assessed and quantified. From groundnut fields; early leaf spot, late leaf spot, Irregular leaf spot and Leaf scorch diseases were assessed and quantified.

The current field survey has enabled to identify major diseases of faba bean, field pea, soybean, ground nut and sesame crops in selected districts. In the future other districts that offer high potential for a particular crop but which was not addressed through this study need to be assessed to get complete information on the particular crop-disease combinations. Moreover, yield loss assessments should be conducted for those crop-disease combinations that lack this information in order to further categorize diseases into economically important and less important in an effort to enhance prioritization of future research work.

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