

## Enhancing Faba Bean Production through Promoting Integrated Faba Bean Gall Management Practices in Eastern Amhara Region of Ethiopia

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**Article history:** submitted: January 27, 2022; accepted: July 30, 2022; available online: July 31, 2022

**Abstract.** In Ethiopia, a great variety of diseases affects faba bean production. However, gall forming faba bean new disease has become a very serious disease that seriously affected faba beans producing areas of Wollo. This prescalling up of integrated faba bean gall technology has been conducted at Meket and Wadla woredas of north Wollo in 2017/18 to create wider demand on the management of gall disease and to enhance integrated gall disease management technology dissemination. The study areas were selected purposively due to high infestation of the disease. A total of 32 farmers were selected based on a voluntary base. Adjacent farms of 5.7 ha at Wadla and 3 ha at Meket was selected and clustered accordingly. Integrated disease management i.e seed dressing with 300 gm Baylaton/100Kg seed, improved varieties and hand weeding were applied as a package for the control of the disease. Doshha with chemical gave an average gain yield of 2.2 tons/ha at Meket whereas Wolki with chemical gave an average grain yield of 2.5 tons/ha at Wadla woreda. However, the local variety with farmers' practice gave an average grain yield of 100 kg/ha and 900 kg/ha at Wadla and Meket woredas respectively. The result of economic analysis also indicate that the technology is by far advantageous than the local variety and practice. So, the technology should be further disseminated to other hot spot areas of faba bean gall diseases.

**Keywords:** baylaton chemical; dosha; technology and varieties; wolki

### INTRODUCTION

Faba bean (*Vicia faba* L.) is also referred to as broad bean, horse bean and field bean and it is the fourth most important pulse crop in the world (Solomon et al., 2019). The crop has a multipurpose use and is consumed as dry seeds, green vegetables, or as processed food. Its products are a rich source of high-quality protein in the human diet, while its dry seeds, green haulm and dry straw are used as animal feeds (Cholez, 2020; Dudek, 2018).

Ethiopia is the world's second largest producer of faba bean, but its share is only 6.96% of world production and 40.5% of Africa (Tilaye et al., 1994). It is a multipurpose crop which plays a vital role including soil fertility, human nutrition, animal feeding and industry purposes. Due to its paramount importance, it is cultivated in large areas in the country. It was the first crop among pulses in terms of area coverage and volume of annual production. Currently, they occupy about 443,107.88 hectares of land with an annual national production of 8,389,438.97 tones with an average yield of 1893 kg ha<sup>-1</sup> (Solomon et al., 2019).

The country's pulses production and productivity are constrained by several biotic and abiotic stresses, such as diseases, parasitic weeds, and lack of improved varieties and shortage of certified seeds. Among these factors, diseases such as chocolate spot, rust, Ascochyta blight, zonate leaf spot, and black root rot are reported on faba beans (Solomon et al., 2019).

In Amhara region, faba bean production is limited and fails to face the increasing local consumption of seeds due to gradual decreases far below its potential due to the new faba bean gall disease and Orobanchae parasitic weed (Bitew & Tigabie, 2016; Mekonnen, 2016). However, a new disease faba bean gall (*Olpidium viciae*) locally called "Kormid has become a very serious disease that significantly affected yield and devastating the crop in Amhara region; what makes faba bean gall differs from other disease in these areas is, it significantly affects production through total yield devastation (Bitew & Tigabie, 2016; Mulugeta et al., 2014).

In recent years, faba beans producing areas of *Wollo* especially *Wadla* and *Meket* districts are highly suffering from faba bean

gall diseases thereby the disease has caused a total yield loss for the local variety.

Regarding disease management, research results revealed that seed dressing and foliar fungicides have some effects against faba bean gall disease; chemical control showed better results in controlling gall disease in China and Japan (Samia, 2006).

For the effort, Sirinka ARC had conducted a research at Meket district of north Wollo with an integrated disease management i.e. improved variety with Baylaton seed dressing (300gm chemical/100kg seed) was found to be the most promising technology in the area. The result of the demonstration revealed that the improved variety with chemical seed dressing gave a mean yield of 2.9 tons/ha while the local variety with chemical seed dressing gave on average 1.67 tons/ha.

Farmers' use of improved technologies is still remaining minimal due to fragile linkages between farmers and research as well as inadequate use of extension and research results (Hirich, 2014). With the aim of addressing this gap, dissemination of new improved varieties through pre-scaling up, is one of the strategies revealed by different authors for improving farmers' use of improved technologies and increasing productivity of the crops (Bezabih, 2022; Purba et al., 2020; Zekarias et al., 2018).

So, this pre-scaling up of integrated faba bean gall disease management was conducted at highly infected areas of Wadla and Meket woredas in north Wollo zone to create wider demand on the management of faba bean gall disease and to create and strengthen linkage among stakeholders for sustainable use of the technology.

The objectives of this study are 1) to create wider demand on the management of faba bean gall disease; 2) to create and strengthen linkage among stakeholders to improve the efficiency and effectiveness of the management in addressing faba bean Gall disease problem, and 3) to enhance the availability of integrated gall disease

management technology to Faba bean producers in north Wollo zone.

## METHODS

### Description of the Study Areas

This study was conducted at Meket and Wadla districts of Eastern Amhara Region. Geographically, Meket district is found in the North Wollo zone located at 11° 45' N latitude and 38° 45' E longitude and at an altitude of 2846 m above sea level. The soil type in Meket is generally characterized as clay texture. Wadla district is found in North Wollo and geographically situated between 12° 25' N and 40° 5' E with an average altitude of 3120 masl. The study areas are characterized by bimodal rainy seasons: the main rainy season (*Meher*) occurring from June to September, and the short rainy season (*Belg*) occurs from February to April. Ziguara and Warkaye kebeles at Wadla and Meket were selected respectively (M. D. O. of Agriculture, 2014; W. district office of Agriculture, 2014).

### Site Selection and Research Design

Study kebeles were selected purposively based on the infestation and severity of faba bean gall disease. Thus, Ziguara and Warkaye kebeles were selected from Wadla and Meket districts respectively. The hot spot area selection was carried out with close collaboration of the district office of agriculture.

Prior to conducting the experiment, an innovation platform was established by identifying possible actors that are involved in the project to create linkage among the stake holders. Thus, Sensitization workshop was organized at the beginning of the project in Dessie town whereby different stakeholders including selected kebele administrators, farmers, zonal and district office of agriculture, Woldia and Wollo Universities, Seed grower cooperatives, Unions, Amhara seed enterprise, Dessie seed quarantine; members of the platform were

agreed to participate, share responsibilities and act upon accordingly.

Host farmers were selected purposively; in one hand, thus who are voluntary to grow faba bean through clustering approach and who conduct a research effectively. On the other hand, based on the accessibility of their farms to form a cluster and close follow up. The selection process was employed with the help of DAs (Development Agent) of the respective kebeles. Thus, a total of 10 farmers at Warkaye and 22 farmers at Ziguara were selected based on a voluntary base. Adjacent farms of 5.7 ha at Ziguara (Wadla) and 3 ha at Warkaye (Meket) were selected to form clusters in order to bring a significant visual impact.

After selection of farmers and formation of clusters, training was provided to DAs and selected farmers on the integrated disease management and overall the experiment. On-farm method demonstration was conducted on the clustered fields to provide clear understanding to farmers and DAs on the application of the chemical through a step by step Baylaton chemical seed dressing to participant farmers.

Finally, Baylaton chemical and the improved faba bean variety were distributed to farmers of both districts. Integrated disease management i.e Baylaton chemical, improved faba bean variety and hand - weeding were applied as a package for the control of the disease. Seed was dressed with Baylaton at a rate of 300 gm of the chemical/100 kg of improved seed. A total of 0.48 ton seed of Dosha at Meket and 1 ton seed of Wolki at Wadla was used and planted with a rate of 175 kg/ha on a broadcast method of planting. All production costs other than seed and chemical were covered by the farmers themselves.

Field day was organized at pod setting stage of the plant by office of agriculture of both woredas whereby a total of 210 farmers (25 females) at Warkaye kebele of Meket and 345 farmers (32 females) at Ziguara kebele of Wadla. During the field day, Broachers on the production packages were distributed to

participants aiming to create wider demand on integrated gall disease management. Experience sharing was done among DAs and farmers nearby kebeles of both woredas to create wider demand among the farming community.

Technical evaluation was organized by SARC to evaluate the overall performance of the research. Field day was organized in collaboration with the district and Kebele Office of agriculture for the sake of gaining feedback from farmers and other stakeholders. Field and laboratory inspection was also carried out by Dessie seed quarantine and control laboratory technicians to assure seed quality.

Data on costs of labor, chemical, seed, price of grain as well as farmers feedback were collected; to this end, a representative sample on grain yield was obtained from the cluster and from farmers' own farm nearby the cluster having similar soil and slope for the sake of comparison. Finally, data was analyzed by using simple descriptive statics.

To sustain the seed system, seed grower cooperatives (Selam at Meket and Woira Sefer at Wadla) purchased seed from farmers for further scaling out. SARC was an agreed district office of agriculture and seed grower cooperatives to avail Baylaton chemical to farmers in the next production season.

## RESULTS AND DISCUSSION

### Productivity of Faba bean

Improved variety Dosha + Baylaton chemical + twice hand pulling/weeding as a package gave an average gain yield of 2.2 tons/ha at Meket district. On the other hand, improved variety Wolki + Baylaton chemical + twice hand weeding as a package gave an average grain yield of 2.5 tons/ha at Wadla district. The T-test result showed that the mean difference is significant at both locations (less than 5% significance level). In the study area, farmers cultivate local variety without any remedy for gall diseases. Hence, the damage level of the diseases is severe without applying integrated management of the disease. This can be indicated by the yield

gap resulting from application of integrated technology i.e. improved variety, chemical and hand weeding. The result showed that, application of integrated faba bean gall

disease management can increase the productivity of faba bean by 1.5 & 1.3 tons/ha at Wadla and Meket districts respectively.

**Table 1.** Average yield and yield advantage of improved technology in Wadla and Meket district

Varieties	Wadla		Meket	
	Integrated management (Wolki variety)	Farmers' practice (local variety)	Integrated management (Dosha variety)	Farmers' practice (local variety)
Mean	25	10	22	9
<b>Yield advantage (%)</b>	150	-	140	-
T-test	29.58	16.20	31.88	10.31
Sig-value	0.00	0.00	0.00	0.00
Std.	2.23	1.63	1.82	2.30

Source: processed data

### Profitability of integrated gall disease management technology

The result of economic analysis showed that applying the integrated faba bean gall diseases management (Dosha variety) reaps net economic gain of 44,480ETB/ha over the local variety. Whereas, applying the integrated faba bean gall diseases management (Wolki variety) can fetch a net economic gain of 45,240 ET Birr/ha over farmers' practice.

### Stakeholders' Linkage and seed system

The sustainability of the technology involved the involvement of vital stakeholders in the system. So far, two seed producer cooperatives were established in Wadla and Meket districts in collaboration with ISSD (Integrated local Seed System).

Hence to sustain technology transfer of integrated gall disease management, these cooperatives were used as an exit strategy. Moreover, the office of agriculture took the responsibility of wider disseminating the result. A total of 21.7 tons seed of improved faba bean variety from which 7.5 tons seed of Dosha at *Meket* and 12.0 tons seed of *Wolki* at *Wadla* were produced so far. A total of 5.2 tons seed was exchanged among 104 farmers of nearby kebeles at both districts for further dissemination of the technologies. With the pursuit of introducing the technology to other hot spot kebeles of gall disease, Wadla woreda office of agriculture purchased 2.0 tons seed of Dosha variety with a budget support of SLM project (Table 2). A total of 50 Farmers at Meket district have requested kebele DAs to collect money together for purchasing Baylaton chemical.

**Table 2.** Seed production and exchange

Woreda	Variety	Seed produced (ton)	Seed exchanged (ton)	No. farmers Exchanged (ton)	Seed purchased by WBOA(ton)
Meket	Wolki	7.5	1.8	3.6	-
Wadla	Dosha	12.0	3.4	6.8	2.0
Total		21.7	5.2	10.4	2.0

**Table 3.** Economic analysis

Description	Meket		Wadla	
	Integrated management (Wolki variety)	Farmers' practice (local variety)	Integrated management (Wolki variety)	Farmers' practice (local variety)
Average grain yield in ton/ha	2.2	0.9	2.4	1.0
Price of grain birr/100 kg	3,100	2,500	3,000	2,400
Income from sale of grain (birr/ha)	68,200	22,500	72,000	24,000
Total costs of inputs	12,240	11,020	14,280	11,520
Seed cost (birr/ ha)	3300	2,900	3,150	2,500
Chemical cost birr kg <sup>-1</sup> ha <sup>-1</sup>	330	-	330	-
Labor cost (birr/ha)	8,610	8,120	10,800	9,020
Net income	<b>55,960</b>	<b>11,480</b>	<b>57,720</b>	<b>12,480</b>

Source: processed data. Ethiopian Birr (ETB) currency at the time of the study i.e 2018/19, is average 1 USD = Br28.2694.

### Field days and Stakeholder Analysis

A total of 571 different stakeholders from which, 555 farmers (57 females) participated and provided feedback about the overall research work. Participants of the field day were the followings: a) Farmers,

DAs, Kebele administrators, Woreda agricultural and cooperative experts; b) Administrative officials of north Wollo zone; c) District agricultural and cooperative office from both districts; d) Woldia university, Dessie seed quarantine laboratory; e) North Wollo communication affairs.

**Table 4.** Participants of field day

No.	Participants	No. of participants		
		Male	Female	Total
1	Farmers	498	57	555
2	Expertise	10	3	13
3	Administrative officials	6	-	6
4	N/Wollo Communication	3	-	3
	Total	571	12	571

Source: processed data

Farmers had provided the following feedbacks to the integrated faba bean gall disease management, i.e: a) Farmers suggest that the improved variety with chemical dressing gave the highest yield they had

never gained before; b) They were very impressed with the effectiveness of the technology in full controlling of the disease; c) The application of Baylaton chemical was found to be easy so can dress the seed with

minimum labor cost; d) The cost of the chemical is not being taken as expensive as compared to the grain yield and economic gain from the technology; e) They strongly request office of agriculture to avail the chemical ahead of time for the coming planting season with the pursuit of scaling out the technology. According to El-Ghany (2020), the combined use of bacteria and melatonin exhibited the highest stimulating effects. It is recommended the combined use of exopolysaccharide-producing bacteria and melatonin for the salinity stress management strategy of faba bean. Meanwhile (Mansour, 2014) stated that the effect of water management by drip irrigation automation controller system on faba bean production under water deficit.

## CONCLUSION

In conclusion, using integrated gall disease management (i.e. using improved variety, Baylaton and hand weeding) was very effective in gall disease controlling and enhancing Faba bean production. In addition, the technology brought higher economic return and better acceptance by Faba bean producing farmers as compared to the local practices. Therefore, to alleviate the chronic Faba bean production problem in the study area, concerned bodies should work in a collaborative manner in creating awareness and supplying inputs for the technology.

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