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Demonstration of Bayleton Fungicide for the Management of Fababean Gall (*Olpidium viciae* Kusano) Disease at Meket District, Eastern Amhara Ethiopia

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ABSTRACT

Background: Fababean gall (*Olpidium viciae*) disease is a new disease in Ethiopia causing up to 100% crop losses. Treating seeds with Bayleton 25% WP fungicide was recommended for fababean growing areas. The objective of the study was to demonstrate the effectiveness of Bayleton fungicide as a seed dressing and foliar spray on fababean gall disease.

Methods: The demonstration was conducted on two farmers' field as replications at Meket District Warkaye and Agrit Kebele during 2016 cropping season. The treatments were Bayleton at the rate of 0.3 kg as seed dressing with 0.7 kg/ha as foliar spray and untreated control used as a check. Disease, yield and yield related data were calculated.

Result: Bayleton treated plot was completely inhibit the severity and maximum disease severity was scored from control treatment 45.43 and 51.5% at Warkaye and Agrit Kebele, respectively. The mean grain yield (kg/ha) of treated plot was 2910.7 and 1584.2. And also, untreated plot gave 1670.1 and 372.67 kg/ha at Warkaye and Agrit Kebele respectively. Therefore, Bayleton fungicide at the rate of 0.3 kg per 100 kg fababean seed as seed treatment can control the disease and has to be scaled out for the study area and similar agro ecologies.

Key words: Bayleton, Demonstration, Fababean Gall disease, Fababean, Farmers preference.

INTRODUCTION

Fababean (*Vicia faba* L.) is one of the earliest domesticated food legumes in the world, probably in the late Neolithic period (Metayer, 2004). China is the main producer of fababean in the world with 39% of the total world production (Metayer, 2004). Then, the major producers in order of importance are United Kingdom, Ethiopia, Egypt and France. Cultivated fababean is mainly used as human food in developing countries and as animal feed for pigs, horses, poultry and pigeons in industrialized countries (Metayer, 2004). Fababean (*Vicia faba* L.) is one of the earliest domesticated food legumes and is now cultivated on large areas in many countries due to its high nutritive value in terms of energy and protein contents (24-30%) (Bouhassan *et al*., 2004).

According to Teklay *et al.* (2014) survey report, six diseases; fababean leaf and stem gall chocolate spot (*Botrytis fabae)*, Ascochyta blight (*Ascochyta fabae* f. sp. Fabae), Alternaria leaf (*Alternaria alternata*) spot, black root rot (*Fusarium solani*) and rust (*Uromyces viciae-fabae*) were on their order of importance throughout the surveyed routes. Among which, fababean leaf and stem gall disease was the most frequently occurring and devastating disease.

Fababean gall disease *(Olpidium viciae* Kusano*)* is a new disease in Ethiopia100% crop losses (Dereje *et al.*, 2012, Endale *et al.*, 2014 and Bogale *et al.,* 2016). A survey of the disease in North and South Wollo shows very high incidence and severity even up to total fababean yield loss (Bogale *et al.*, 2016). The field experiment result revealed that Bayleton as a seed dressing fungicide was effective in reducing incidence and severity of the disease (Mulugeta *et al.*, 2014). Treating fababean with fungicides (like Carbendazim, Thiram and Bayleton) were also recommended and practiced in China (Lang *et al.,* 1993). Vitavax 75% WP, Bayton 25% WP and Bayleton 25% WP were highly effective in controlling foot rot of wheat when used as seed dressing (Kulkarni and Haplapur, 1992). Kelley and Williams (1985) reported an effective management of wheat rust using Bayleton 50% WP and Baytan 150 FS. Bayleton 25% WP at the rate of 0.3 Kg for 100 Kg fababean seed dressing is recommended for the management of the disease. Therefore, the objective of this experiment was to demonstrate the effectiveness of Bayleton fungicide as a seed dressing and foliar spray on fababean gall disease.

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MATERIALS AND METHODS

Demonstration of Bayleton fungicide for the management of fababean gall disease has been conducted in 2016 main cropping season. It was conducted on naturally infested soils of two farmer fields at Meket District Warkaye and Agrit kebele.

The treatments of the experiment were:

- Bayleton as seed treatment (300 gm Bayleton with 300 ml water for 100 kg fababean seed) and as foliar spray (700 g Bayleton with 200-liter water for one hectare).
- Untreated check (Control).

The demonstration had a plot size of 10 m × 10 m with 1m between plots. Local variety of Faba bean was used with spacing of 0.1 and 0.4 m between plant and row spacing, respectively. Foliar chemical sprays were done three times starting from the onset of the disease and seed dressing was done during planting.

Field days were organized for farmers, development agents, district administrator and agricultural experts, North Wollo Zone agricultural experts and other stakeholders to evaluate the demonstration site and to adopt and promote the technology.

Disease incidence percentage was assessed from 10 random pre tagged plants on the onset of the first symptom appearance. The disease incidence was calculated with the following formula:

Disease incidence (%) =

$$\frac{\text{Plants showing symptoms from samples taken}}{\text{Total number of samples taken}} \times 100$$

Disease severity was assessed from 10 plants randomly selected and tagged for data collection. The severity was scored four times in every seven days interval starting from the onset of the disease by using 0-9 scale to determine area of affected plant part (Bernier *et al.*, 1985). The following infection levels on the scale were used: 0, no visible infection on leaves; 1, a few dot-like accounting for less than 5% of total leaf area; 3-4, discrete galls less than 2 mm in diameter, accounting for 6-25% of leaf area; 5, numerous scattered galls with a few linkages, diameter 3-5 mm, on 26-50% of leaf area with a little defoliation; 6, confluent galls formation accounting for 51-75% of leaf/stem area, mild gall formation, half the leaves dead or defoliated; 7, complete destruction of the larger leaves, galls covering more than 76% of leaf area, abundant gall formation; 8, 80% of the defoliated and plants darkened and dead; 9, disease covering more than 80% of the foliar tissue heavy defoliation and plants darkened and dead.

The severity grades were then converted into percentage severity index (PSI) for analysis (Wheeler, 1969).

$$PSI = \frac{Snr}{Npr \times Msc} \times 100$$

Where,
Snr = Sum of numerical ratings.
Npr = Number of plants rated.
Msc = Maximum score of the scale.

Means of the severity from each plot were used in data analysis.

The area under disease progress curve (AUDPC) was calculated for each treatment from the assessment of disease severity using:

$$AUDPC = \sum_{i=1}^{n-1} 0.5[(x_{i+1} + x_i)(t_{i+1} - t_i)]$$ (Shaner and Finney, 1977)

Where,
x = Disease severity at i^{th} observation,
n = Total number of days disease assessed.
t = Time at the ith observation (in days numbered sequentially beginning with the initial assessment).

The cost benefit assessment of each treatment was analyzed partially and marginal rate of return were computed by considering the variable cost available in the respective treatment (CIMMYT, 1988). Marginal rate of return provides the value of benefit obtained per the amount of additional cost incurred percentage:

$$MRR = \frac{DNI}{DIC}$$

Where,
MRR= Marginal rate of returns.
DNI= Difference in net income compared with control.
DIC= Difference in input cost compared with control.

Relative yield loss assessment

Per cent relative grain yield loss was calculated as follows:

$$\text{Relative grain yield} = \frac{Yp - Yup}{Yp} \times 100$$

Where
Yp = Yield of protected (Treated) plot.
Yup= Yield of unprotected (Control) plot.

Farmers preference

Two field days were prepared for farmers and district agricultural extension experts. Farmers has listed about five evaluation criteria with their order of importance.

List of evaluation criteria

Diseases - 1st (weight=1).
Plant height - 4th (weight=4).
Leaf area - 3th (weight=3).
Pod number - 2nd (weight=2).
Glossy leaf (wezam) - 5th (weight=5).

Data analysis

Data on fababean gall severity from each assessment date, yield and yield components and agronomic data were subjected to by using Microsoft Excel 2007.

RESULTS AND DISCUSSION

The result indicated that Bayleton seed dressing completely inhibits the disease incidence and disease severity than untreated check. And also, gave higher plant height and grain yield than untreated check. The mean grain yield (kg/ha) of Bayleton treated plot was 2910.7 and 1584.2.

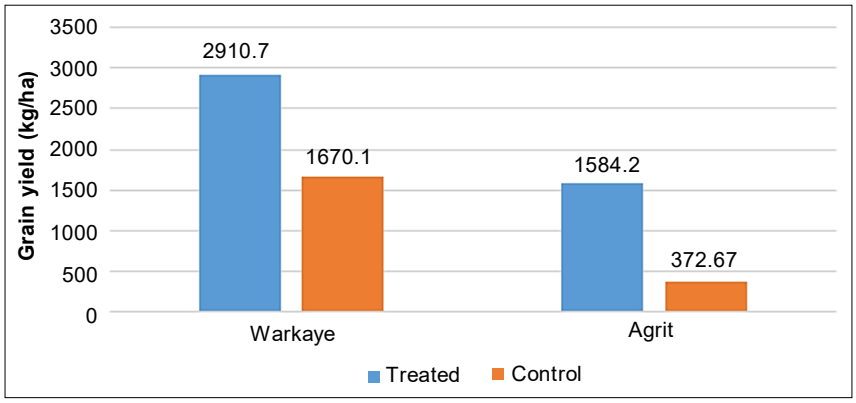

Fig 1: Average grain yield result of the treated and control plot both at Warkaye and Agrit Kebele.

And also, untreated plot gave 1670.1 and 372.67kg/ha at Warkaye and Agrit Kebele, respectively (Fig 1).

Disease intensity score was taken at four-time weekly interval start from 48 and 50 days after sowing (DAS) at Warkaye and Agrit Kebele, respectively. The result of disease severity from treated plots were zero at both locations due to complete inhibition of the disease and 31, 50, 52.2, 48.5% and 24, 49.5, 54, 78.5% were scored from the untreated (control) plot at Warkaye and Agrit kebele, respectively. Vitavax 75% WP, Bayleton 25% WP and Bayleton 25% WP were highly effective in controlling foot rot of wheat when used as seed dressing (Haplapur and Kulkarni, 1992). These result in lined with Lang *et al.,* 1993, treating fababean with fungicides (like Carbendazim, Thiram and Bayleton) were also recommended and practiced in China. In both locations seed treated treatments have not shown the disease incidence.

The area under disease progress curve (AUDPC) is used to combine multiple observations of disease progress into a single value. The area under disease progress curve (AUDPC) as a measure of quantitative disease resistance entails repeated disease assessments and is a quantitative measure of disease intensity with time. Bayleton seed treated plot completely inhibit AUDPC values compared to untreated (control) plot (Table 1 and 2).

Yield losses were computed relative to the average yield from treated and control plot treatments. Bayleton seed treatment reduced fababean grain yield loss as compared with untreated plot. Relative yield loss due to fababean gall disease, 42.6 and 76.5% was occurred on the untreated control plots at Warkaye and Agrit Kebele, respectively.

Partial budget analysis

Results from assessment of economic returns in this study indicated that Bayleton seed treatment for fababean gall disease management in fababean could be profitable. The marginal net benefit obtained from the application of Bayleton seed treatment were Birr 16217.01 and 15679.98 from Warkaye and Agrit Kebele, respectively. Partial budget analysis indicated that additional 1 ETB will get positive return of 5.87 and 5.67ETB at Warkaye and Agrit Kebele (Table 3).

Field day

Field day was prepared twice for farmers, agricultural officers, district and Kebele leaders and development agents. 40, 9, 4 and 2 farmers, agricultural officers, district and Kebele leaders and development agents were

Table 1: Mean of disease intensity, yield and yield components data at Warkaye Kebele 2016.

Trt	DE	DM	PH (cm)	PPP	GY (kg/ha)	DI%	DS%	AUDPC
Treated	9	133	113.5	17.6	2910.7	0	0	0
Control	7	129	88	10.2	1670.1	100	45.43	2209.9
Diff.	2	4	25.5	7.4	1240.6	-100	-45.43	-2209.9

Where: Trt= Treatment; DS= Disease severity; AUDPC= Area under disease progress curve; DI= Disease incidence; DE= Days to emergency; DM= Days to emergency; PH= Plant height, GY= Grain yield and PPP= Pod per plant.

Table 2: Mean of disease intensity, yield and yield components data at Meket, Agrit Kebele 2016.

Trt	DE	DM	PH (cm)	PPP	GY (kg/ha)	DI%	PSI	AUDPC
Treated	9	128	112.3	13.1	1584.2	0	0	0
Control	7	125	85.6	5.3	372.67	100	51.5	2745
Diff.	2	3	26.7	7.8	1211.53	-100	-51.5	-2745

Where: Trt= Treatment; DS= Disease severity; AUDPC= Area under disease progress curve; DI= Disease incidence; DE= Days to emergency; DM= Days to emergency; PH= Plant height; GY= Grain yield and PPP= Pod per plant.

Table 3: Partial budget analysis for Meket 2016.

	Warkaye kebele		Agrit kebele	
	Treated	Control	Treated	Control
Average grain yield (kg/ha)	2910.73	1670.13	1584.16	378.67
Adjusted grain yield (kg/ha) (Average yield × 0.9)	2619.66	1503.13	1425.74	340.80
Gross field benefit (ETB/ha)	44534.22	25553.21	24237.58	5793.60
Chemical cost (ETB/ha)	2220	-	2220	-
Labor cost (ETB/ha)	544	-	544	
Total cost that vary(ETB/ha)	2764	-	2764	
Net benefit (ETB/ha)	41770.22	27491.21	21473.58	5793.60
Marginal cost (ETB/ha)	2764	-	2764	-
Marginal net benefit (ETB/ha)	16217.01		15679.98	
Marginal rate of return (%)	587	-	567	-

participated, respectively. In addition, 4 researchers from Sirinka agricultural research center were participated and demonstrated the result to visitors. During field days participants observed and selected Bayleton treated plot by their evaluation criteria (Table 4). They accepted and appreciate the Bayleton seed treated plot. They were very eager and promised to scale up this technology to all fababean growing areas with the support of respective districts.

In addition to the on-farm demonstration, the technology has been transferred through distributing 200 leaflets for farmers and stakeholders.

Table 4: Farmers evaluation result by direct matrix ranking.

	Treated	Control
Diseases	1	2
Plant height	4	8
Leaf area	3	6
Pod number	2	4
Glossy leaf (‘*wezam*’)	5	10
Total	15	30
Rank	1st	2nd

Farmers preference

As it has been shown from (Table 4), farmers have listed about five evaluation criteria with their order of importance. Based on the selection criteria the treated plot was by far better preferred by the participant farmers than that of the control (untreated plot). Farmers have easily observed the difference between the treatments even they were considering the treated plot as if it is due to the difference in variety. the fact is that the difference was due to the chemical treatment with the same variety *i.e.* local fababean.

Farmers’ feedback

Farmers were very impressed by the performance of the fababean treated by Bayleton chemical. They were considering the performance difference come due to improved variety not by chemical treatment. Fababean farms cultivated by farmers without chemical treatment were totally devastated by kormid diseases. Generally, farmers and development agents of each respective Kebele have become very keen to adopt the technology (Fig 2).



Fig 2: Farmers participation during the field evaluation.

CONCLUSION

The analysis of variance showed that, there is statistically significant mean difference between treated and untreated treatments at all locations. Bayleton 25% WP fungicide treated as seed dressing and foliar spray showed best result than control treatment. Partial budget analysis indicated that additional 1 ETB will get positive return of 5.87 and 5.67ETB at Warkaye and Agrit Kebele. Relative yield loss due to fababean gall disease, 42.6 and 76.5% was occurred on the untreated control plots at Warkaye and Agrit Kebele, respectively. Generally, farmers and development agents of each respective Kebele have become very keen to adopt the technology. Therefore, 0.3 kg with 300 ml water for 100 kg seed as a seed treatment and 0.7 kg with 200 ml water as foliar two times spray at fifteen days interval were recommended and has to be scale out for the study and similar agro ecology areas.

Conflict of interest: None.

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