Advances in Crop Science and Technology

Bitew and Tigabie, Adv Crop Sci Tech 2016, 4:4
DOI: 10.4172/2329-8863.1000225

Research Article Open Access

Management of Faba Bean Gall Disease (Kormid) in North Shewa Highlands, Ethiopia

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Abstract

Production of faba bean is inhibited by several yield limiting factors, among which diseases are the main. In Ethiopia more than 17 disease causing pathogens were reported on faba bean. Major diseases recoded in faba bean includes, chocolate spot (Botrytis fabae), rust (Uromyces viciae-fabae), ascochyta blight (Ascochyta fabae), zonate leaf spot (Cercospora zonatae), and black root rot (Fusarium sp.). A new disease, faba bean gall locally called "Kormid in North Shewa was expanded in the highland faba bean growing areas. Studies showed that seed dressing and foliar fungicides have some effects against faba bean diseases. Field experiment was conducted in North shewa highlands to control faba bean gall disease at farmers' field. The experiment was conducted on farmers' fields in randomized complete block design in six replications. The treatments were arranged with different fungicides (spray and seed dressing), namely Mancozeb, Ridomil, Chlorotalonil, Bayleton wp 25 (Triadimefon 250 g/kg), Thiram, Apron star and control. Fungicides were applied as manufacturers' recommendations. Foliar fungicides were applied three times at seedling, flowering and podding growth stage on local faba bean variety. Disease score and other agronomic data were recorded at different plant growth stage. The highest disease score were recorded in control, Thiram and Apron star in 2013. The highest yield was also recorded in Bayleton and mancozeb sprayed plots respectively. In 2014 the disease prevalence and severity was similar to 2013. Maximum disease score were recorded on Control followed by Thiram and Apron star seed dressing plots. Minimum disease score were also recorded in Baylaton (2.66) and Ridomil gold (2.71) sprayed plots. There was a significant difference between biomass yield and grain yield. The highest grain yield was recorded in Baylaton (3129.8 kg) sprayed plot and followed by Ridomil gold (2708.3 kg) and Mancozeb (2705.7 kg) respectively. There was no significant difference between plots in plant height, pod per plant, seed per pot and seed per plant in both years.

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

Introduction

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 [1]. Faba bean (*Vicia fabae* L.) is the major cool season food legumes produced in Ethiopia next to cereals. It serves as major source of protein and income. The crop also fixes atmospheric nitrogen and improves soil fertility. Because of its wide importance to the nation it is cultivated in large area in the country as well as in Amhara region. Production of faba bean is inhibited by several yield limiting factors, among which diseases are the main [2]. In Ethiopia more than 17 disease causing pathogens are reported on faba bean [3]. Major diseases recoded in faba bean includes, chocolate spot (*Botrytis fabae*), rust (*Uromyces viciae-fabae*), ascochyta blight (*Ascochyta fabae*), zonate leaf spot (*Cercospora zonatae*), and black root rot (*Fusarium sp*).

Currently a new disease faba bean gall *Olpidium viciae* locally called "Kormid in North Shewa is expanded in the highland faba bean growing areas of North. It was first observed in Menze Mama District around Bash kebele in farmers' fields in 2010/2011 main cropping season [4]. Seed dressing and foliar fungicides have some effects against faba bean diseases [5,6]. Report reveals that, chemical control showed better results in controlling gall disease in China and Japan [7]. Hence this study was initiated with the following objectives: to select the right and effective fungicides on gall disease (kormid) on faba bean.

Materials and Methods

The experiment was conducted on farmers' fields in RCB design with six replication (one farmer field was used as one replication in 2013 and 2014 main growing season). The experiment was done with foliar and seed dressing fungicides. The treatments were arranged with different fungicides (spray and seed dressing), namely (a) Mancozeb 80% wp (contact fungicide with preventive activity. It inhibits enzyme activity in fungi by forming a complex with metal-containing enzymes including those involved in production of adenosine triphosphate), (b) Ridomil (Metalaxyl-M 4% +Mancozeb.64%), (c) Chlorotalonil, Bayleton wp 25 (Triadimefon 250 g/kg), (d) Thiram, (e) Apron star (seed treatment fungicide-insecticide mixture and its active ingredient is Thiamethoxam:200 g/kg, Mefenoxam: 200 g/kg , Difenoconazole: 20 g/kg) for controlling seed and soil born disease) & (f) control. The plot size was 3.2 m × 4 m and spacing between rows 0.4 m and 1 m between replications. Fungicides were applied as manufacturers' recommendations. Foliar fungicides were applied three times (at the time of diseases appearance (seedling) and repeated two times before start of flowering and podding stage). Local faba bean variety was used and seed rate was applied as recommendation in row planting.

Data collected

Date of seedling emergence, first date of bean gall disease appearance, faba bean gall score (1-9) scale and; 1 means no or few symptoms and nine means dead plant). Faba bean gall disease recorded

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Received April 22, 2016; **Accepted** May 16, 2016; **Published** May 26, 2016

Citation: Bitew B, Tigabie A (2016) Management of Faba Bean Gall Disease (Kormid) in North Shewa Highlands, Ethiopia. Adv Crop Sci Tech 4: 225. doi:10.4172/2329-8863.1000225

was converted to percent incidence and severity. Plant height, Number of pod per 10 plant, number of seed per pod, thousand seed weight, biomass and seed yield (grain yield) were recorded.

Data analysis

Analyses of variances for the experiment was done and mean comparisons were carried out using Duncan's multiple range test (DMRT) at 5% level of probability. The statistical analysis system (SAS) software [8] was used for all statistical analyses.

Results and Discussion

Foliar fungicides were applied at the beginning of symptom appearance. All foliar fungicides were applied at seedling, flowering and podding growth stage. The disease was very serious in first year (2013). But due to higher rainfall, there was high erosion problem and hail damage at seedling stage. The symptom of the disease starts from seedling stage and more severe up to flowering growth stage. In severely infected fields, the disease expands to the stem and the whole plant showed shrinked, shortened and died on control plots. The lowest disease score were recorded on Bayleton, chlorotalonil and mancozeb sprayed plots (Table 1). Among fungicides sprayed better grain yield were recorded on bayleton (2124.0 kg), Mancozeb (1702.3 kg), Ridomil gold (1471.7 kg) and chlorothalonil (1470.9 kg) respectively. Apron star and Thiram seed dressing fungicides were not effective against the disease. It was similar with control plots (Table 1).

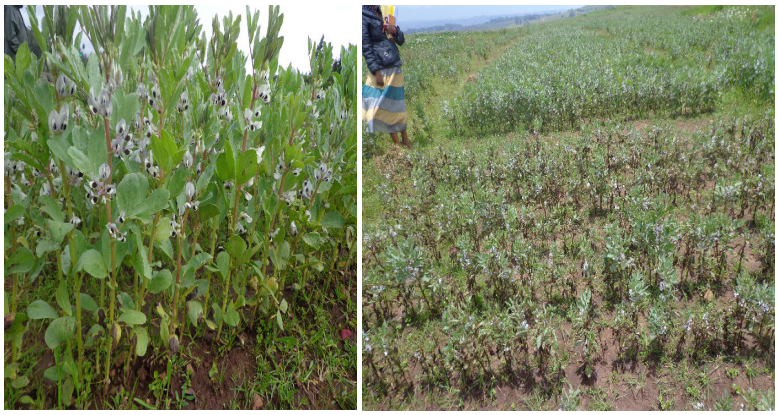
Values within a column followed by same letter do not differ significantly at 5% level of Duncans multiple range test

In 2014 the disease prevalence and severity was similar to 2013. Disease score and other agronomic data were recorded at different

No.	Treatments	Disease score (1-9)	Ph (cm)	Pod/pl	Sdp (gm)	Hsw (gm)	Gy (kg/ha)
1	Apronstar	4.5ab	37.0ab	8.53b	2.17b	38.86b	811.8bc
2	Baylaton	1.66c	54.8a	19.4a	2.68a	40.13ab	2124.0a
3	Chlorotalonil	2.83c	46.53ab	19.46a	2.55ab	39.83ab	1470.9abc
4	Mancozeb	2.83c	51.93ab	16.66a	2.35ab	42.73a	1702.3ab
5	Ridomil	3.16bc	44.13ab	11.93ab	2.55ab	39.83ab	1471.7abc
6	Thiram	5.16a	34.06b	8.26b	2.50ab	37.66b	1317.4abc
7	Control	5.66a	34.4b	5.73b	2.42ab	39.03b	554.1c
	Mean	3.69	43.26	12.85	2.46	39.72	1351.97
	Cv (%)	23.87	23.64	34.17	8.87	5.04	40.49

Ph=plant hieht, pod/pl=pod per plant, sdp=seed per pod, Hsw=hundred seed weight and Gy=grain yield

Table 1: Disease score and yield of faba bean in North Shewa 2013.



Sprayed **Unsprayed**

Figure 1: Bayleton Sprayed plots **a)** Sprayed and **b)** Unsprayed.

No.	Treatments	Disease score(1-9)	Ph (cm)	Pod/pl	Seed/pl	Sdp (gm)	Hsw (gm)	Bm (kg/ha)	Gy (kg/ha)
1	Apronstar	4.04b	82.13a	15.56a	41.5a	2.63a	32.28ab	4067.7ab	2247.0abc
2	Baylaton	2.66c	82.86a	14.23a	35.5a	2.48a	32.60a	5446.6a	3129.8a
3	Chlorotalonil	2.91c	79.33ab	15.90a	39.70a	2.42a	29.68bc	5080.7a	2632.9ab
4	Mancozeb	2.91c	74.96ab	14.20a	36.43a	2.68a	31.40abc	5445.7a	2705.7ab
5	Ridomil	2.70c	82.43a	15.13a	38.8a	2.59a	31.61abc	5542.2a	2708.3ab
6	Thiram	6.00a	68.66b	12.80a	32.86a	2.50a	29.46c	2679.1b	1815.16c
7	Control	6.08a	69.70b	12.93a	31.43a	2.39a	31.73abc	2539.5b	1369.2c
	Mean	3.90	77.15	14.39	36.60	2.53	31.39	4400.21	2372.58
	Cv (%)	19.75	13.06	26.83	30.19	9.90	7.27	35.65	37.71

Ph=plant hieht, pod/pl=pod per plant, sdp=seed per pod, seed/pl=seed per plant, Hsw=hundred seed weight, Bmy=biomass yield and Gy=grain yield

Table 2: Disease score and yield of faba bean in North Shewa 2014.

plant growth stage. Maximum disease score were recorded on Control followed by Thiram and Apron star seed dressing plots. Minimum disease score were also recorded in Baylaton (2.66) and Ridomil gold (2.71) sprayed plots. There was a significant difference between biomass yield and grain yield. The highest grain yield was recorded in Baylaton (3129.8 kg) (Figure 1) treated plot and followed by Ridomil gold (2708.3 kg) and Mancozeb (2705.7 kg) respectively (Table 2). There was no significant difference between plots in plant height, pod per plant, seed per pot and seed per plant. Chemical control: treat seeds with fungicides. Studies showed that Thiram, at a dosage of 0.6-1.0 kg/100 kg of seed, 25% Bayleton or 15% Bayleton, at a rate of 0.3% to seed weight, are effective in controlling galls (ICARDA), but thiram was not effective against the disease.

Values within a column followed by same letter do not differ significantly at 5% level of Duncans multiple range test, economic analysis of management options, cost benefit analysis, related terms in cost benefit analysis

Total variable costs: the costs of chemicals, fertilizer and labor.

Gross yield: the total output per hectare of the produce of grain and straw.

Adjusted yield: The difference that gross yield is reduced by 10% from the actual due to risk and uncertainty.

Gross benefit: is the product of output and farm get prices of the produce.

Net benefit: is the difference between the gross benefit and the costs of production that vary.

Rate of return (RR): is the rate net benefit to cost of production or benefit cost ratio (BCR).

Information generated from cost benefit analysis is the most important factor to take into account when making correct decision and lack thereof will inevitably lead to suboptimal allocation of limited resources. The only way of determining how the resources allocated for the production of crops for small holder farmers should be put to use based on evaluating the costs and benefits of all (possible) ventures and selecting treatments having the highest return. Cost benefit analysis can be calculated using partial budget analysis method. Partial budgeting is a planning and decision-making framework used to compare the costs and benefits of alternatives faced by a farm business. Gross yield was adjusted from the output obtained lowered by 10% from the actual yield due to management and other production risks (Table 3).

Partial budget analysis

Partial budget analysis is concerned with evaluating the consequences of changes in treatments that affect only parts than whole. It is budgeting in relation to a partial change to a given farm inputs/budgets. For the evaluation of each treatment only variable costs were included and fixed costs were excluded. The net benefit or farm profit was calculated as net benefit is equal to gross benefit reduced by the costs of inputs and labor. The result was obtained from the farm get price at immediate harvest of grain and straw with 6 and 1.65 Birr per kg, respectively. Labor cost is related to chemical applications and fertilizer cost is the costs incurred for the amount of fertilizer applied based on recommendation. The analysis considers only the treatments that are most candidates having the market prices for full cost information. The result indicated that the treatments that have high net benefit are recommended for future technology packages. From the evaluation bayleton, mancozeb and redomil gold were the most competitive treatment evaluated against the control (Table 4).

Sensitivity analysis

Sensitivity analysis is important to evaluate the impact of such changes on economic parameters on the net returns for each treatment studied. Farm budgets may not expect positive net profits as a result of unexpected changes in yield, market prices or production costs. Those can quickly turn the expected benefit into a loss. Analyzing how changes in key budgeting assumptions/components affect income and cost projections is called sensitivity analysis. One way of trying to handle the problems of applying correct weights to risk is checking the outcomes using sensitivity analysis for future production guarantee. Sensitivity analysis allows the producer to have such information to control probabilities of calculating risks. Such changes are evaluated by creating future assumptions that are more or less dubious "scenarios". Hence, sensitivity analysis was carried out to assess the

Treatments	Treatment cost Birr/ha (ETB)	Gross grin yield/ha	Adjusted yield/ha	Gross biomass yield kg/ha	Adjusted yield kg/ha
Apronstar	980	2247.0	2022.3	4067.7	3660.93
Baylaton	420	3129.8	2816.82	5446.6	4901.94
Chlorotalonil	-	2632.9	2369.61	5080.7	4572.63
Mancozeb	240	2705.7	2435.13	5445.7	4901.13
Ridomil	1575	2708.3	2437.47	5542.2	4987.98
Thiram	-	1815.1	1633.59	2679.1	2411.19
Control	0	1369.2	1232.28	2539.5	2285.55
Mean	643	2372.57	2135.31	4400.21	3960.19

Table 3: Chemical costs and yields of faba bean for treatments.

Treatments	Total Costs that vary Birr/ha (ETB)	Adjusted Yield of grain KG/ha	Adjusted yield of Bio Mass kg/ha	Gross benefit	Net befit
Apronstar	2680	2022.3	3660.93	18235.35	15555.35
Baylaton	2120	2816.82	4901.94	25070.82	22950.82
Chlorotalonil**	1700	2369.61	4572.63	21838.71	20138.71
Mancozeb	1940	2435.13	4901.13	22779.33	20839.33
Ridomil	3275	2437.47	4987.98	22938.12	19663.12
Thiram**	1700	1633.59	2411.19	13820.19	12120.19
Control	1400	1232.28	2285.55	11202.93	9802.93

**The chemicals are not found in the market and the cost of chemical didn't included in the calculation due lack of information.

Table 4: Cost benefits analysis of treatments.

Treatments	Gross benefits and cost of production			Net benefits in different Scenarios		
	1	2	3	1	2	3
Baylaton	22490.21	2332	22490.21	20370.21	22738.82	20158.21
Mancozeb	20427.88	2134	20427.88	18487.88	20645.33	18293.88
Ridomil	20569.49	3602.5	20569.49	17294.49	19335.62	16966.99
Control	10048.35	1540	10048.35	8648.354	9662.93	8508.354

Table 5: Sensitivity analysis result for the best treatments against the changes assumed compared with the check.

Treatments	Net benefits		Cost		Rate of return	
Apronstar	15555.35	13408.9	2680	2948	5.804235	4.548474
Baylaton	22950.82	20158.21	2120	2332	10.82586	8.644172
Mancozeb	20839.33	18293.88	1940	2134	10.74192	8.572577
Ridomil gold	19663.12	16966.99	3275	3602.5	6.004006	4.709782
Control	9802.93	8508.354	1400	1540	7.002093	5.524905

The first columns of net benefit cost and rate of return indicated the values of each component at normal condition while the second column is the value at sensitivity analysis result.

Table 6: Rate of return analysis.

changes in net benefits of treatments based on the scenarios assumed to be changed. The scenarios cover at least a couple of possible outcomes, usually including a "worst case" scenario and "normal" scenario. The normal considers the existing situations in the given time period. This analysis focused on the following scenarios.

1. When yield reduced by 10% but, cost of production remain unchanged.
2. When cost of production increased by 10% while yield is remain unchanged.
3. When both changes happen at a time.

Based on these situations the gross benefit and the net benefit can be changed accordingly. The result indicated that yield reduction of faba bean for all treatments are highly sensitive than cost of production changes. Baylaton and Mancozeb chemicals are more profitable than other management alternatives in all circumstances (Table 5).

Rate of Return (RR) analysis

Rate of return is the rate of change of returns to the rate of change of investment costs. Calculations of returns on investment resulted the value of each crop enterprises tells which production decision allow to make the highest return, taking costs into considerations. As always, it is not wise to overemphasize the usefulness and accuracy of any single measure. The rates of return analysis on total variable cost for those treatments were evaluated. The rate of return analysis result indicated that Bylaton and Mancozeb has high rate of return than other alternative while Redomil has the rate of return value below the control treatment (Table 6).

Conclusion and Recommendation

The primary aim of this experiment was to select the effective fungicide to control faba bean gall. Among treatments the highest disease score were recorded in control, Thiram and Apron star plots in 2013. The highest yield was also recorded in Bayleton and mancozeb sprayed plots respectively. In 2014 the disease prevalence and severity was similar to 2013. Maximum disease score were recorded on Control followed by Thiram and Apron star seed dressing plots. Minimum disease score were also recorded in Baylaton and Ridomil gold sprayed plots. There was a significant difference between biomass yield and grain yield. The highest grain yield was recorded in Baylaton sprayed plot and followed by Ridomil gold and Mancozeb respectively. There was no significant difference between plots in plant height, pod per plant, seed per pot and seed per plant in both years. Seed treatment fungicides were not effective. Even foliar spray fungicides were also less effective except Bayleton.

Usually no single practice will control faba bean gall disease, when different approaches are combined, losses will be minimized. Consequently sustainable disease management has to be focused on a system approach against this disease by suppressing the pathogens before it reaches to economic threshold level. Such a system approach should incorporate various components like selection of variety, crop rotation, field sanitation and time of planting. Thus by manipulation of different integrated disease management (IDM) approaches, it is possible to minimize the risk of the disease. However the success would depend largely on an effective diseases monitoring system, frequent communication among the various disciplines involved in program and active link between research scientists, extension group and farmers.

Future Directions

The study gives clues about faba bean gall disease management with different fungicides, time of application, and different efficacy of fungicides to control the disease. However, testing this fungicides, current rate and frequency may not be enough to recommend full control package, but this information may lead to start further research direction in the area. Then further disease management studies have to be conducted in the area. Moreover efforts should be focused on applying cultural practice and different disease management activities to minimize the pathogen inoculums level in the field. The epidemiology study, environmentally safe and affordable fungicides should be further studied.

Acknowledgements

The author would like to acknowledge, Debre Birhan Agricultural Research Center and ICARDA ADA for technical and financial support during the execution of the experiments in the field.

References

1. Tilaye A, Demisu B, Getachew T (1994) Genetic and breeding of field pea. First National Cool-season Food Legumes Conference. Addis Ababa, Ethiopia. ICARDA/IAR. ICARDA: Aleppo Syria, pp: 122-137.
2. Beyene B (2015) Survey and identification of new Faba bean Disease (Kormid) in the Highlands of North Shewa Ethiopia. Australian Journal of Industry Research.
3. Gorfu D, Beshir T (1995) First National Cool-season Food Legumes Review Conference. Addis Abeba (Ethiopia), 16-20 Dec. ICARDA, Aleppo, Syria.

4. Dereje G (1999) Survival of Botrytis fabae Sard. Between seasons on crop debris in field soils at Holetta, Ethiopia. Phytopathologya Mediterranean 38: 68-75.

5. ICARDA (1993) International Centre for Agricultural Research in the Dry Areas. Faba Bean in China: State-of-the-art Review. Special study report Aleppo Syria.

6. Samia Z (2006) Production and productivity of pulse crops in Ethiopia. In: Kemal Ali (ed.), Cool–season Food Legumes of Ethiopia. Proceedings of the workshop and forage legumes 2003, Addis Ababa, Ethiopia. ICARDA/EIAR. ICARDA, Aleppo, Syria, pp: 1-5.

7. Sahile S, Fininsa C, Sakhuja PK, Seid A (2008) Effect of mixed cropping and fungicides on chocolate spot (Botrytis fabae) of faba bean (Vicia faba) in Ethiopia. Crop Protection 27: 275-282.

8. SAS Institute (1999) SAS/Stat User's Guide. Version 9.1.3. Cary NC: SAS Institute.

Citation: Bitew B, Tigabie A (2016) Management of Faba Bean Gall Disease (Kormid) in North Shewa Highlands, Ethiopia. Adv Crop Sci Tech 4: 225. doi:10.4172/2329-8863.1000225