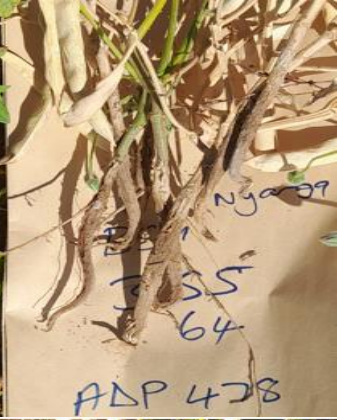


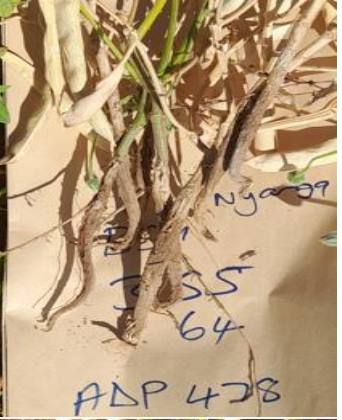
Efficacy of bean fly control methods in common bean- a meta analysis

Tsekenedza Shylet (PhD student)

Kirkhouse Trust Combined Meeting 2024

Arusha, Tanzania

17 June 2024

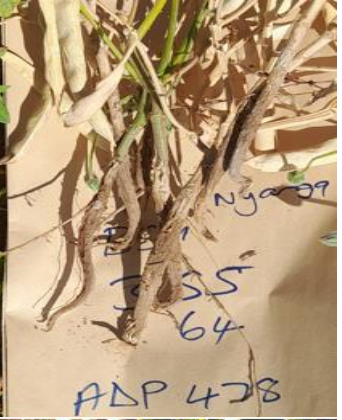



Presentation outline

Part 1: Meta analysis: Efficacy of bean fly control methods:

- Introduction
- Materials and Methods
- Results and Discussion
- Conclusion & recommendations

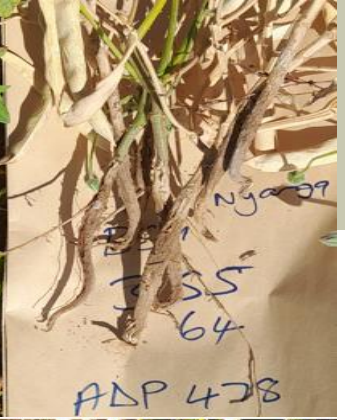
Part 2 : Progress on Breeding strategy for bean fly (Ophiomyia spp) in common bean in Zimbabwe



Introduction

❖ **Efficacy of bean fly control methods:**

- The bean fly (*Ophiomya* sp) is one of the most destructive field pests of the common bean and major legumes.
- The bean fly causes yield losses from 30% to 100% depending on cultivar susceptibility, drought, and poor soil conditions.
- Several research and experimental studies have recommended various control methods for the bean fly
- The effectiveness of these and their impact on grain yield (GY) is yet to be determined to prioritize and guide integrated management of the pest spearheaded by resistance breeding.




Meta Analysis- Materials and Methods

Literature search

- Primary criterion
  - ✓ Studies that test different control methods for bean fly.
  - ✓ Data bases-Web of science, Scopus
  - ✓ Cut off date- August 2023

Screening & selection of studies

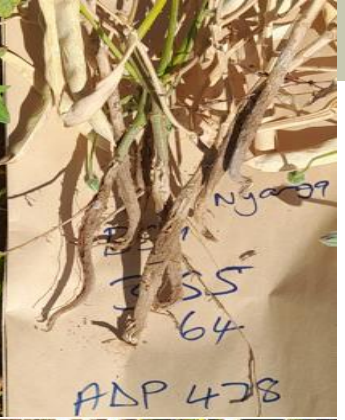
- Distiller SR. Version 2.35.Evidence Partners; 2023
- Inclusion & exclusion criteria
- 17 studies
  - ✓ 13 published in peer-reviewed journal,
  - ✓ 4 technical report & theses

Data extraction

- Manually by sorting data on
- pupa count
- larval count
- plant mortality rate
- bean fly damage, grain yield.

- A detailed selection flowchart from identification, screening, through to Inclusion.

Meta Analysis Flowchart



Identification

Records identified through database searching
N = 1052

Additional records identified through other sources
N = 0

Records after duplicates removed
N = 961

Screening

Records screened
N = 961

Records excluded
N = 798

Eligibility

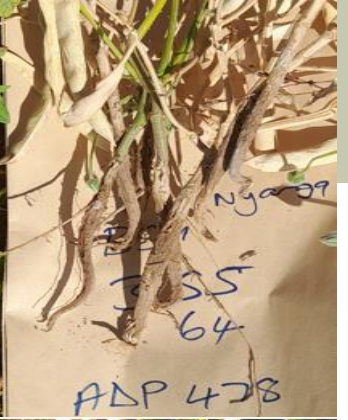
Full-text articles assessed for eligibility
N = 163

Full-text articles excluded, with reasons
N = 149
Records excluded due to no appropriate control or missing required data

Included

Studies included in qualitative synthesis
N = 17

Studies included in quantitative synthesis (meta-analysis)
N =17



Data Analysis

- Descriptive statistics were calculated using Jeffrey's Amazing Statistics Program (JASP)
- Mean effect size was computed for each control method

Cohen's d =

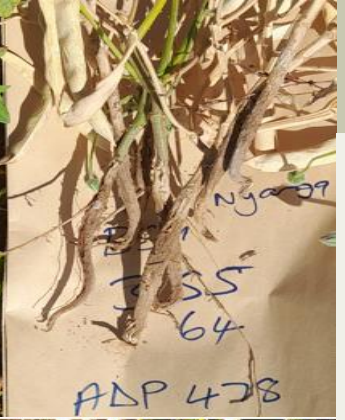
$$\text{Cohen's } d = \frac{\text{(mean of experimental group)-minus mean of control group}}{\text{Average standard deviation}}$$

- % difference between the control & the treatment was calculated

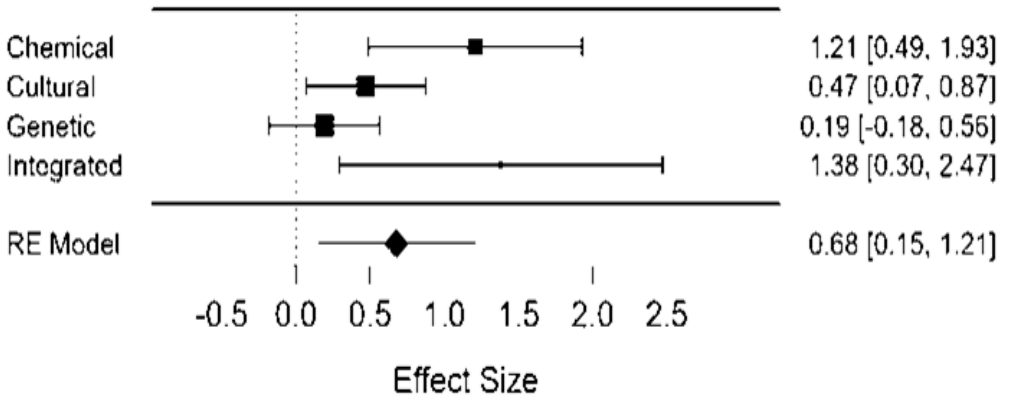
$$\text{Percentage difference} = (Vf\text{-}Vi/Vi) \times 100$$

where Vf = mean values of the treatments and Vi =mean values of the control based on the individual data to determine the absolute difference between the control and the treatment involved in each study.

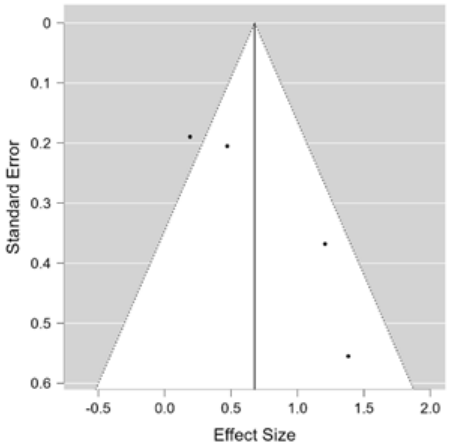
Meta-Analysis: Results and Discussions

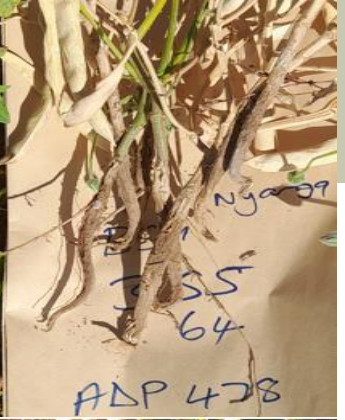


- The meta-analysis included 17 studies that applied bean fly control methods and deployed in Africa (K**enya, Ethiopia, Tanzania, Malawi & Rwanda)**
- This current study identified the inconsistency in data collection of the bean fly parameters
- The GY performance varied among studies under the different control methods
- The maximum attainable GY was **3761.00 kg/ha** (chemical control) & a minimum of **14.10 kg/ha** (genetic control), suggesting a lack of improved common genotypes with durable resistance.
- The four control methods had effect sizes (ES) ranging from small **(0.19)** to large **(1.38)**.
- The genetic control with an ES **(0.19)** , CI of **-0.8 and 0.56** that overlapped the null effect line, indicating that the ES is non-significant.
- This suggests that the level of bean fly resistance in the available genetic pool is still low, rendering low yield potential.



Rank correlation test for funnel plot asymmetry		
Variable	Kendall's	P-value
Rank test	0.667	0.33





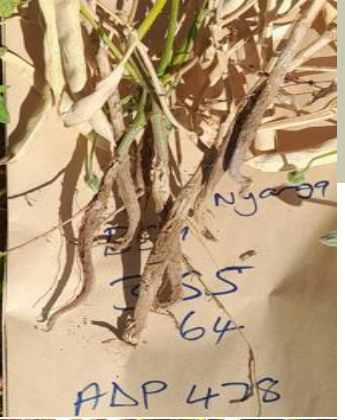
Effectiveness of the four control methods & impact on grain yield

Cultural control

- ES of 0.47 with a CI of 0.7 to 0.87
- A moderate effect size with a narrower CI, emphasizing a meaningful but slightly less pronounced effect.
- Yield improvement of 22.6%, significance of farmers' agronomic management strategies

Chemical control

- The maximum attainable GY was 3761.00 kg/ha
- ES of 1.21, but had wide confidence intervals (CI) of 0.49 and 1.93
- Yield improvement of 21.4% & the efficacy of selected chemicals is supported by the results of the current study.



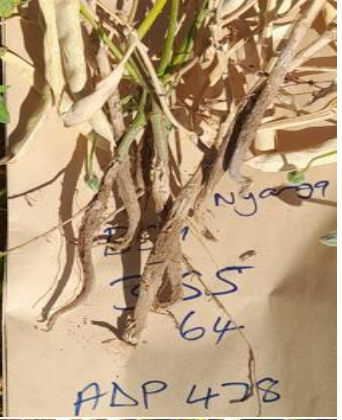
Effectiveness of the four control methods & impact on grain yield

Genetic control

- ES of 0.19 with CIs between -0.18 and 0.56 that overlapped the null effect line, indicating that the ES is non-significant.
- This suggests that the level of bean fly resistance in the available genetic pool is still low, rendering low yield potential.
- Gradual small changes over time, continued research may have a considerable cumulative impact

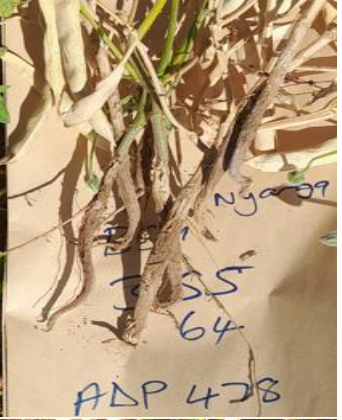
Integrated control

- ES of 1.38, but had wide CI of 0.49 and 1.93, at the 95% limit
- Had an impressive yield improvement of 86.3%
- More effective, maximize bean yields cfd to the individual control strategy



Conclusions and Recommendations

- The chemical and integrated studies were ‘low powered’ and provided less information regarding the grain yield response of common bean under bean fly infestation.
- There is a need to include diverse and representative studies to reliably quantify the effect of the bean fly control methods on the GY of common beans.
- The small and non-significance effect size of the genetic control method suggests that bean fly resistance in the current generation of the genetic stocks is still low, rendering low yield potential.
- The metadata suggests variable efficacy of the control methods and breeding for host resistance is yet to be implemented to effectively control the bean fly and bolster grain yield.
- No studies reported the effectiveness of biological control against the bean fly based on the grain yield response of candidate common bean genotypes.

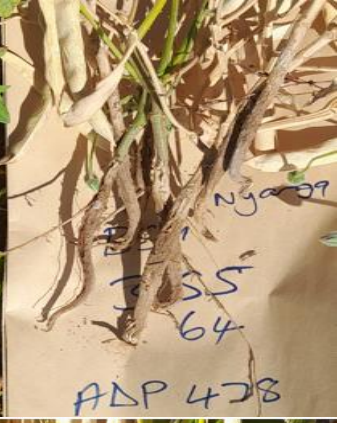


Part 2:Breeding strategy for bean fly resistance in Zimbabwe

With Support from:

- **Supervisor**: Prof Shimelis Hussein (UKZN)
- **Co-Supervisor**: Dr C. Mukankusi (Alliance Bioversity International and CIAT)
- **Co- Supervisor**: Dr Wilson Nkhata (Alliance Bioversity International and CIAT)

Research Goal: *To help improve common bean production in Zimbabwe and other common bean ecologies in Southern Africa by developing market-preferred bean fly resistant bean varieties.*

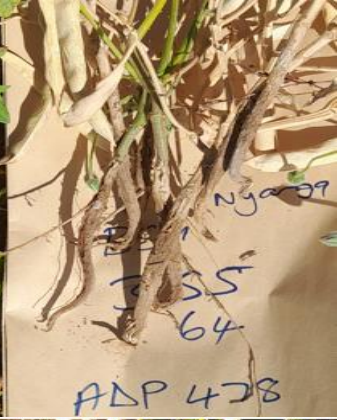


Progress: Objective 1-

To evaluate farmers' perceptions of production constraints, cropping systems, and awareness of bean fly in Zimbabwe.

Materials and Methods	Summary of Results	Conclusions

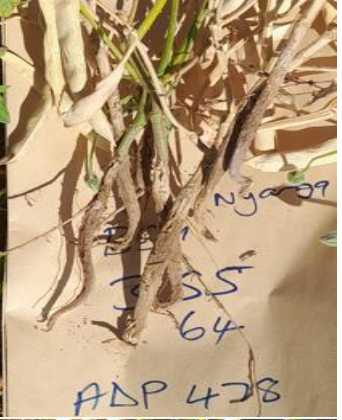
• PRA conducted in 6 purposively selected Districts
• Use of a Semi-structured questionnarre.
• Data Analysis- SPSS V22
	• 241 farmers responded (85% F and 15%M)
	• **Major Production constrains** include:
	  • High cost of inputs
	  • Pest and Disease damage
	  • Heat and Drought
	• **Cropping systems**:
	  • Crop rotation (53.5%)
	  • Monocroping (43.2%)
	  • Intercroping (3.3%)
	• **Bean fly awareness**
	  • **97.9%**
		• Reducing reliance on chemical control methods.
		• Breed cultivars with bean fly resistance, desirable agronomic traits, and market preferred attributes.



Progress: Objective 2-

To determine the efficacy of existing bean fly resistance screening protocols in common bean.

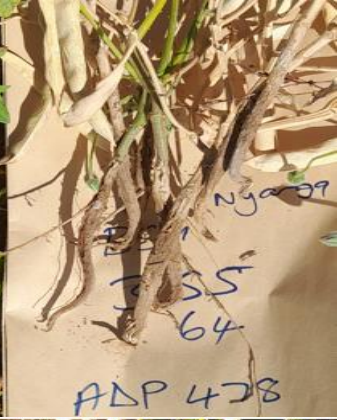
Materials and Methods	Summary of Results	Action Points
• Screening of ADP lines under natural infestation • Location- Nyanga • Records- bean fly parameters: GY, Stem diameter, and agronomic traits	• Harvesting recently done- • **All lines were infested** • **Data analysis-** To determine Bean fly parameter scores is still **Pending-**	• Repeat the experiment at two more sites during the 2024/25 agricultural season. • Set up artificial screening facility at **Kutsaga Research Station**



Progress: Objective 3-

To identify genomic and candidate genes linked to bean fly in common bean for gene introgression into susceptible varieties.

Planned Action: Repeat the experiment at two more sites during the 2024/25 agricultural season.



Progress: Objective 4-

To identify genomic and candidate genes linked to bean fly in common bean for gene introgression into susceptible varieties.

Plan:

1. Formation of Recombinant Inbred Lines
2. Selection of susceptible and resistant parents from the ADP panel
3. Crosses scheduled to be done in July 2024.

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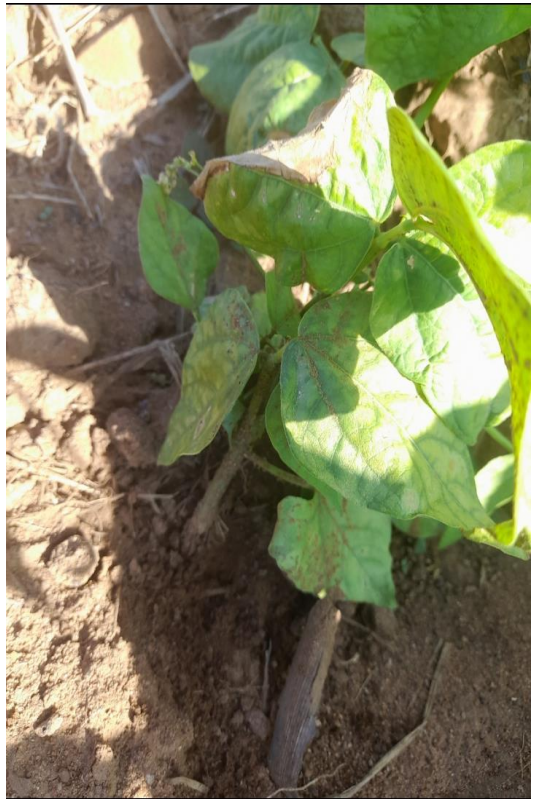
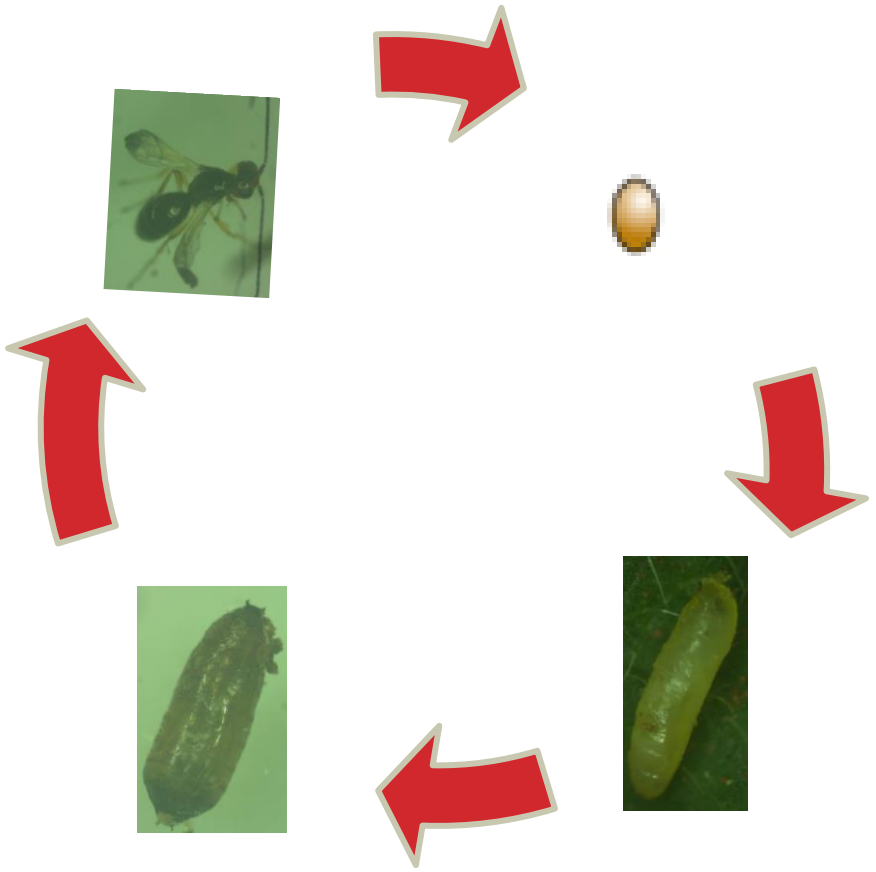
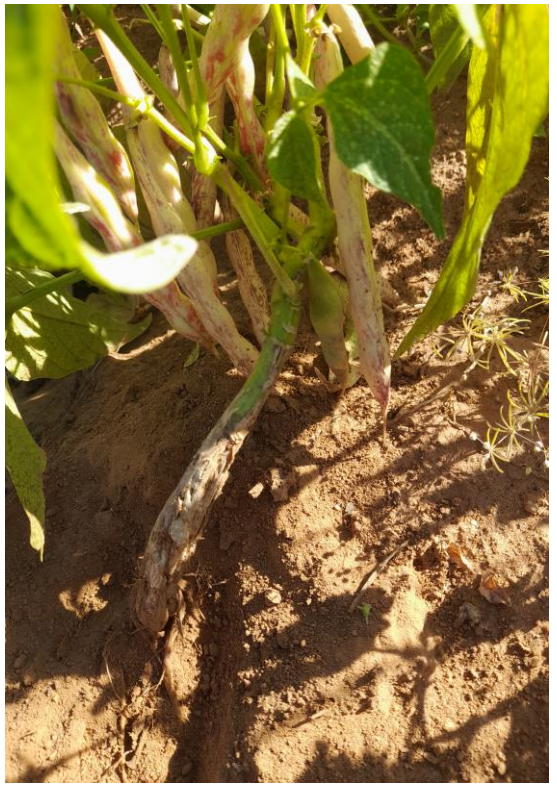
INYUVESI YAKWAZULU-NATALI

Alliance
Bioversity International
CIAT
International Center for Tropical Agriculture
Since 1967 Science to cultivate change

Most destructive field pest of common bean







THANK YOU