Integrated Chickpea diseases management for Fusarium wilt and Ascochyta blight

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Outline

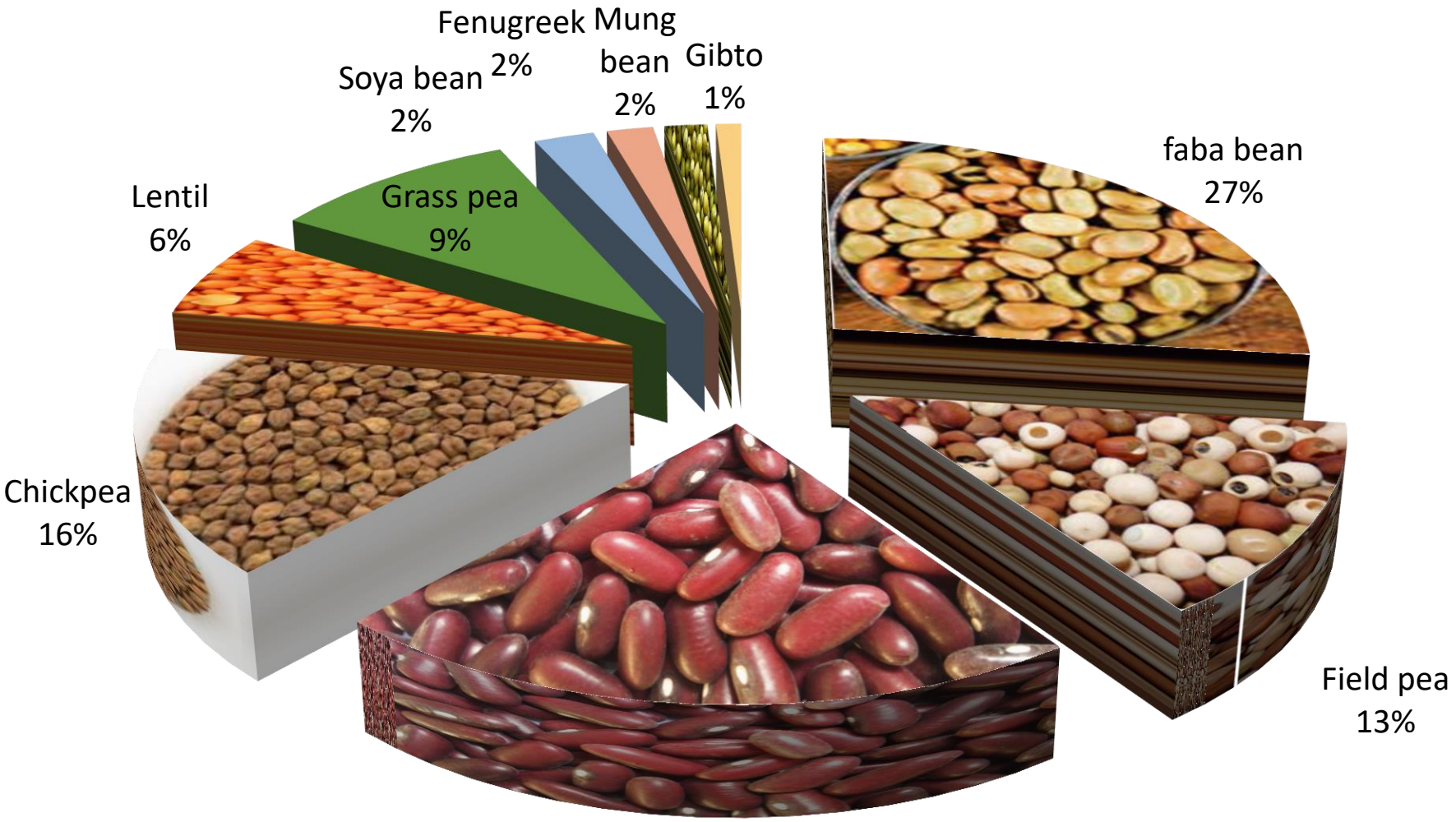
- Background
- Objectives
- Study sites
- Achievements
- Conference
- Papers under review
- Ongoing activities
- Acknowledgement

Background

- Chickpea is one of the most important pulses crops and significantly contribute to the livelihoods of smallholder farmers in Ethiopia.
- pro-poor crop in Ethiopia
- Over a million rural households are engaged

It covers:

- 2.1% of the total crop area cultivated
- 15.6% of area of pulse crops
- 14.3% pulse crops production (CSA, 2016).
- area increased by **43%** from 2005 to 2015 while yields increased from 964 kg/ha to 1913 kg/ha **(98%)**
- over 25 improved varieties were developed
- yield = 2.8 t ha^{-1} on research stations and 1.8 t ha^{-1} on farmers‘ field
- The gap could be due to the difference in management


Fenugreek 2%
Mung bean 2%
Gibto 1%
Soya bean 2%
faba bean 27%
Lentil 6%
Grass pea 9%
Chickpea 16%
Field pea 13%
Common bean 22%

Background…

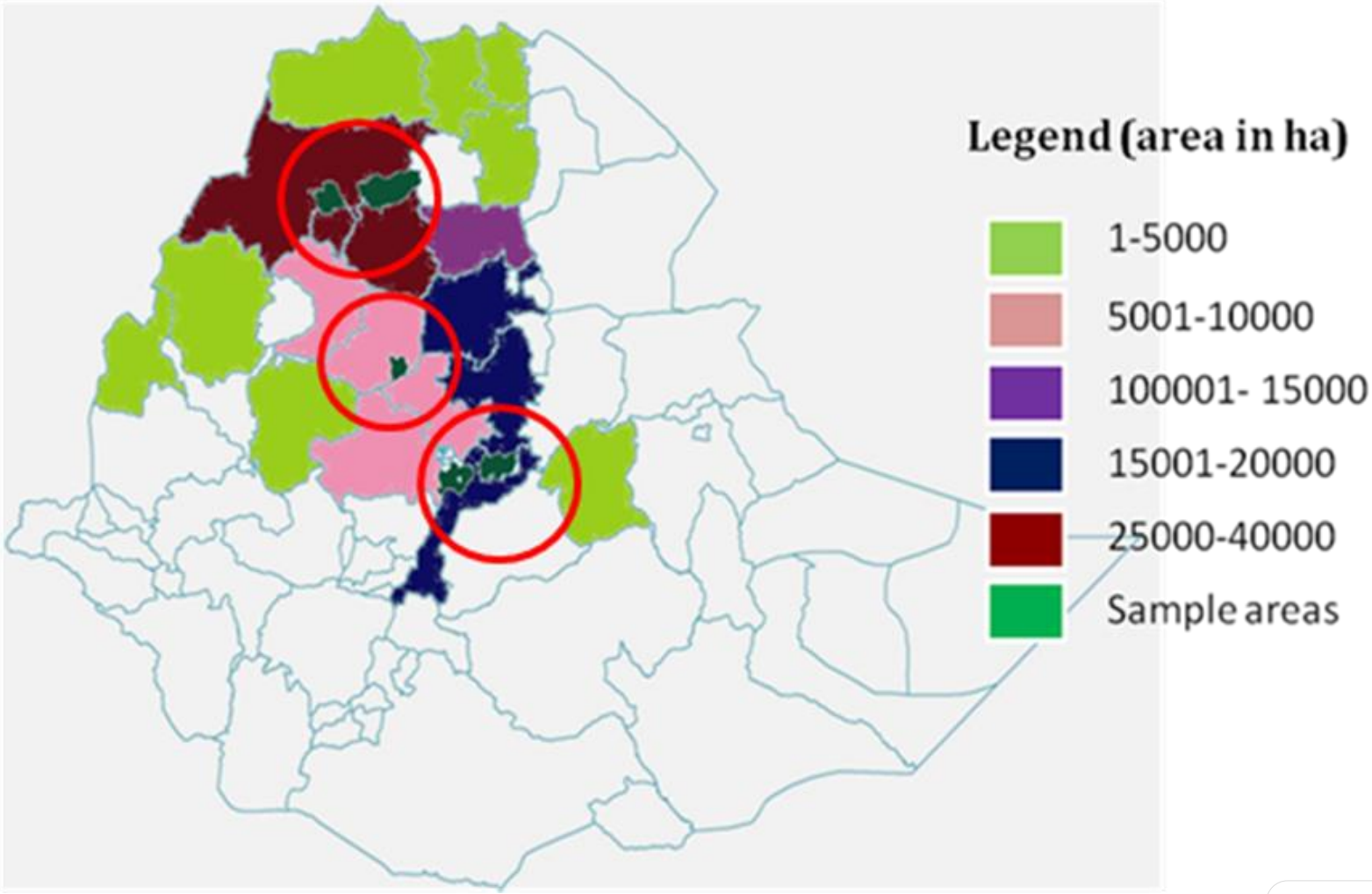
- Its productivity is below its potential and product quality, as the result of a several biotic and abiotic stresses.
- Over ten disease pathogens were reported in Ethiopia most of which are fungal.
- The major root diseases (fusarium wilt, collar rot and dry root rot) and foliar diseases (ascochyta blight) responsible for low yields.

Statement of the problem

- **Despite injection of some improved chickpea production technologies to the producers;**
- **Chickpea diseases are increasing overtime**
- **Chickpea diseases management were not well addressed**

Study areas

Chickpea production distribution and sample areas map (CSA. 2016/5/16)



Objectives

- **Major objective**: to develop, evaluate eco-friendly integrated chickpea disease management technologies

Specific Objectives:

- to determine the level of chickpea seed health in Ethiopia
- to characterize the diversity of the pathogen Ascochyta rabiei
- To Evaluate the bioagents (trichoderma) to manage fusarium wilt
- To assess Farmers perception on chickpea diseases and support service assessment
- To screen fungicide chemicals for ascochyta blight management
- To identify the Ascochyta rabiei mating type in Ethiopia

Achievements

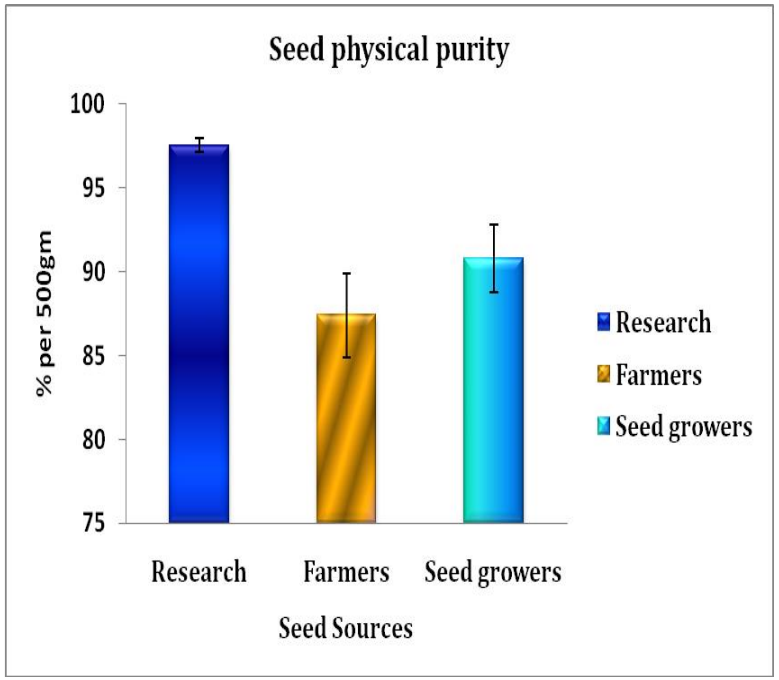
1. Seed Quality and Mycoflora Associated with Chickpea (*Cicer arientinum* L.) Seed in Ethiopia

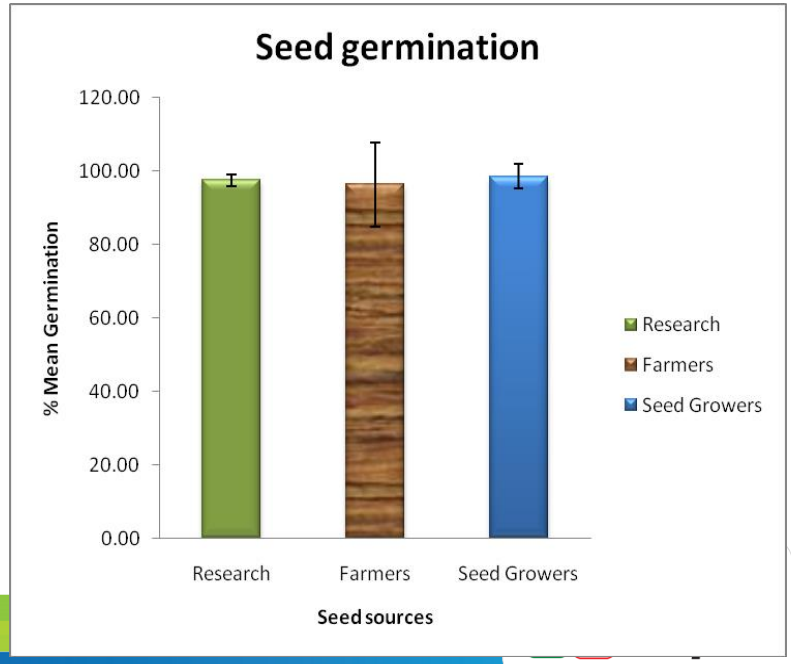
Materials and Methods

- **Ninety-nine seed sample for physical purity.**
- **While 76 seed samples were used for testing germination and seed health**
- **About 500g of seed lot was collected per sample**
- **The sample diagnoses were carried out at Haramaya University and Debre Zeit Agricultural Research and all testing were done following ISTA standard method.**

Results

- Chickpea seeds from research centre had the highest physical purity (97.5%) than seed from farmers (87.4%) and seed grower's (90.8%)
- The level of seed germination were ranged from 96% to 98% among the three seed categories





Results…

- **17 species of mycoflora recovered from the current test, 11 were common for all seed samples.**
- ***A. flavus*, *Penecillium* sp., and *Fusarium* sp. were the most dominant fungi recovered (61.7 - 63.9%) of seed lots.**
- **The highest seed infection by *A. flavus* was observed in farmers' seed (6.4%) compared to seed from research centers (3.1%) and seed growers (4%).**
- **The genus *Aspergillus* was the most dominant contaminant with seed lots followed by *Penicillium* sp. (4.2% and 3%) respectively.**

Seed sources and level of infection (%)						Overall (%)		% of	
Research	Isolated Fungi sp.	Farmers	Isolated Fungi sp.	Seed Growers	Isolated Fungi sp.	Mean	Isolated Fungi sp.	infected seed lots	Isolated Fungi sp.
3.13a	4	6.39a	4	4.00a	8	4.20a	4	63.88a	8
1.83b	8	3.32b	8	3.68ba	1	3.05ba	8	63.87a	1
1.50cb	11	2.47cb	2	3.08bc	4	2.43bc	1	61.69a	4
1.41cbd	9	2.38cb	1	1.90dc	2	1.65dc	9	46.26ba	2
1.23cbde	1	1.29cd	3	1.41dc	9	1.61dce	2	29.17bc	3
1.22cbde	12	0.59d	9	0.90d	10	0.80de	12	23.17dc	9
0.88cbde	3	0.50d	17	0.83d	12	0.75de	3	22.74dc	12
0.82cbde	17	0.45d	11	0.28d	16	0.72de	11	21.64dc	11
0.42cde	2	0.41d	13	0.22d	11	0.49de	17	17.56dc	16
0.22cde	7	0.36d	12	0.14d	17	0.32de	10	15.65dc	17
0.20cde	13	0.25d	7	0.09d	15	0.23de	13	15.05dc	13
0.18cde	16	0.12d	16	0.09d	3	0.20de	16	7.52dc	10
0.17de	6	0.09d	5	0.07d	13	0.16de	7	5.13dc	14
0.15de	14	0.08d	10	-	6	0.06e	6	3.87d	7
-	15	-	6	-	7	0.05e	14	2.78d	15
-	10	-	14	-	14	0.03e	5	2.56d	6
-	5	-	15	-	5	0.03e	15	0.65d	5

1.Fusarium sp.*; 2. Aspergilus* sp.*; 3. A. niger; 4. A. flavus; 5. A. nidulans; 6. A. candidus; 7. A. fumigatus; 8. Penecillium* sp.; 9. *Rhizopus* sp.; 10. *Verticilium* sp.; *11. Rhizoctonia* sp.*; 12. Pythium* sp.*; 13. Alternaria* sp.; 14. *Helmintosporium* sp.; 15. *Phylostica* sp., 16. *Cladosporium* sp.; 17. *Negrospora* sp.

(-): the specified pathogen was not recovered

Alpha=0.05 treatments with the same letter are not significantly different

Conclusion and recommendations

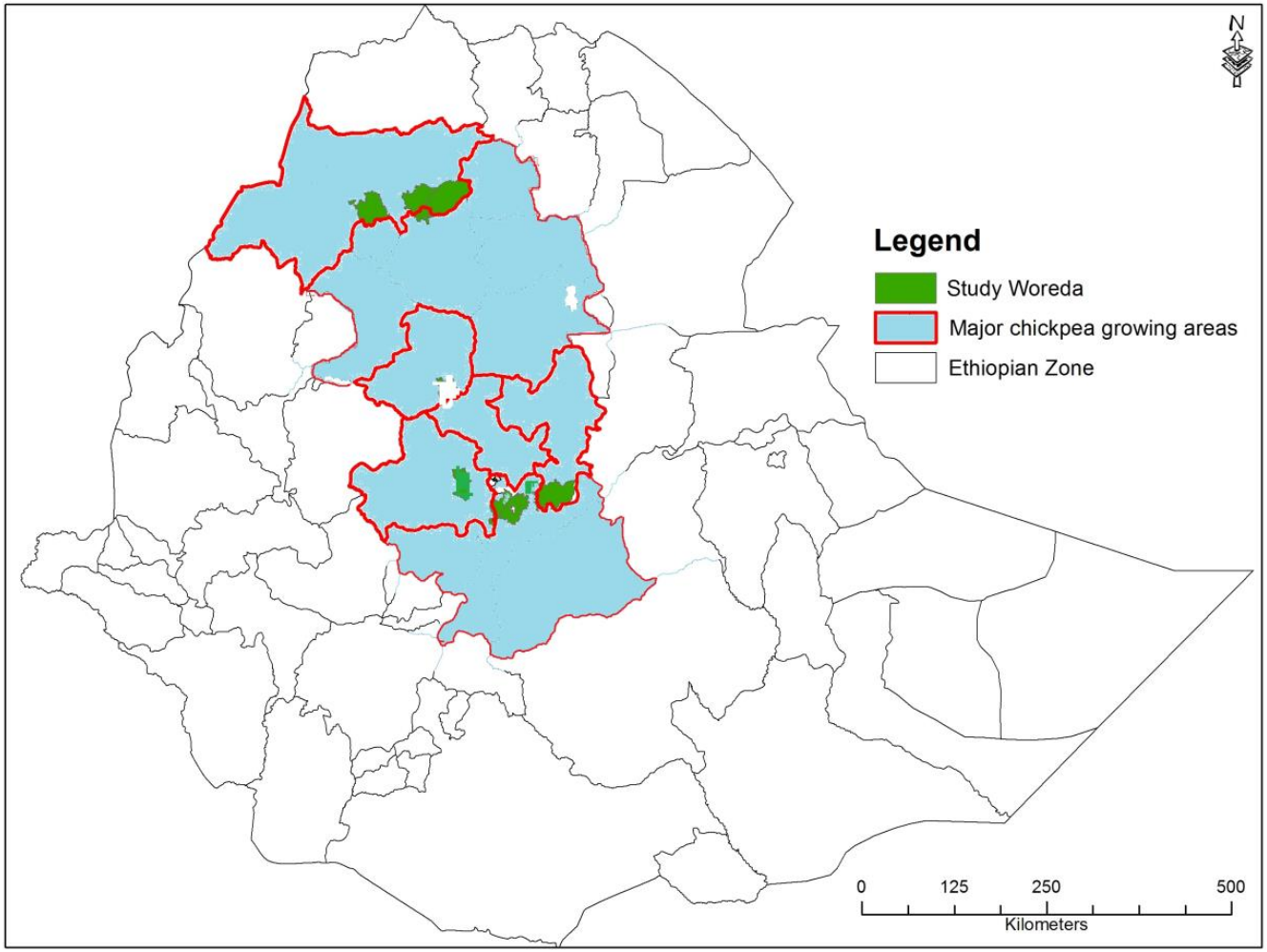
- **there is seed quality and seed health management issues with all different seed sources.**
- **This entails for strong seed quality control and growers awareness creation.**
- **Seed growers should keep wider interval of rotation and seed treatment by fungicides.**
- **Seed grading to avoid loss of physical purity**
- **Use of Appropriate storage container (ventilated and clean).**

2. Farmers' perception of chickpea production, disease pest and management support services in Ethiopia

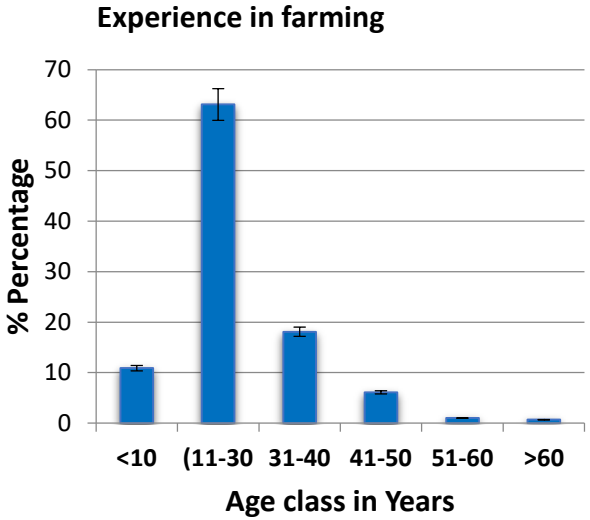
- **Materials and Methods**
- 2-3 Kebeles/ district and about 10-13 respondents were selected randomly per kebele a total of 293 sample households.
- Thirty respondents (from each) were selected randomly from nine districts only for the question "why farmers do not use pesticide for chickpea diseases?" and the responses were analyzed.
- areas were selected purposely based on their chickpea production potential
- Semi-structured questionnaire was developed
- Information on chickpea pests with their significance, management and support system were also assessed.
-

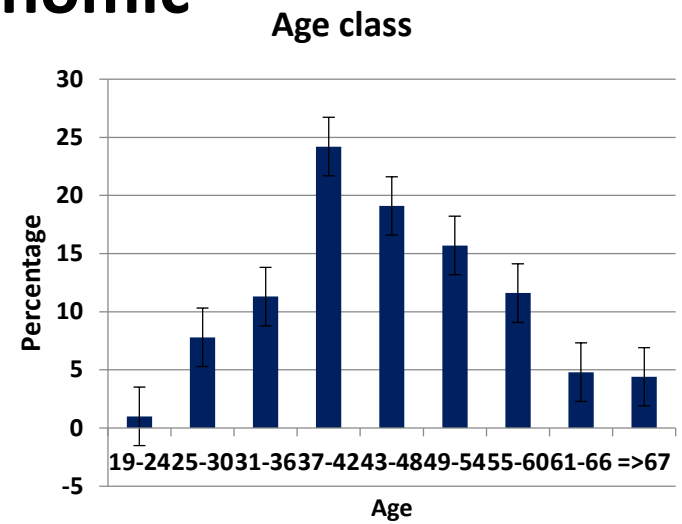
Materials and methods

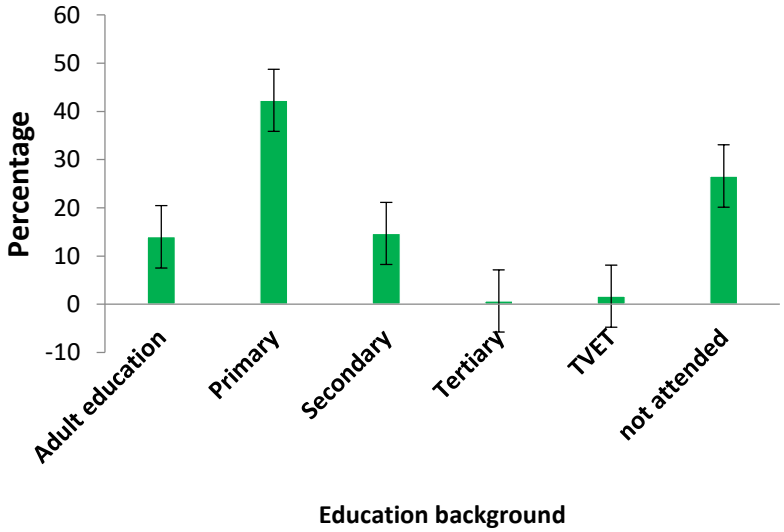
Study area



Results
Socio-economic







Cropping system

Character	Frequency	percentage
Subsequent crop		
• Wheat	55	18.8%
• Chickpea	9	3.1%
• Teff	151	51.5%
• Faba Bean	6	2.0%
• 1&3	16	5.5%
• Other	56	19.1%
Preceding crop		
• Wheat	64	21.8%
• Chickpea	20	6.8%
• Teff	141	48.1%
• Faba Bean	2	0.7%
• Wheat & Teff	12	4.1%
• Others	54	18.4%

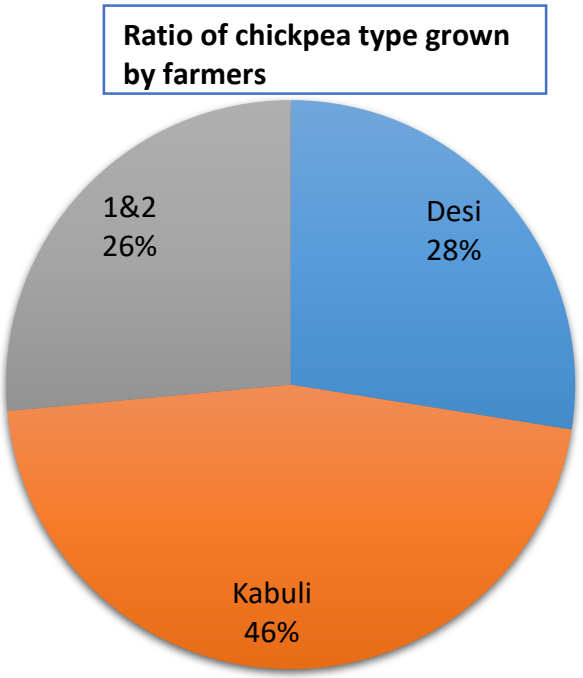
Character	Frequency	percentage
Use of Fertilizer		
• Yes	100	34.1%
• No	193	65.9%
Amount per hectare		
• 100-150kg	68	23.2%
• 151-201kg	23	7.8%
• >202kg	4	1.4%
• Not using	198	67.6%
Type of fertilizer		
• Organic	21	7.2%
• Inorganic	78	26.6%
• Not using	194	66.2%
Use of Irrigation		
• Yes	50	17.1%
• No	243	82.9%

Chickpea storage type and duration of chickpea in Ethiopia

Character	Frequency	percentage	Chi-square	P<0.0001
Storage			130.186	0.000
• Bags/plastic	188	64.2%		
• Granaries/ traditional	102	34.8%		
Duration			133.413	0.000
• 3-6months	193	65.9%		
• 1-1.5yr	80	27.3%		
• 1.6-2.5yr	7	2.4%		
• >2.6	7	2.4%		

Seed sources

Character	Frequency	percentage
Seed Sources		
• Research center	73	24.9%
• cooperatives	69	23.5%
• locals/relatives	121	41.3%
• unions	25	8.5%
• NGO	3	1.0%
Frequency to change seed		
• every year	56	19.1%
• every two years	109	37.2%
• every three years	94	32.1%
• every four years	12	4.1%
• never change	20	6.8%



Major Chickpea production constraints at studied districts of Ethiopia

	Character	Frequency	percentage
	Production Constraints		
	• climate change	38	13.17%
	• drought	7	2.2%
	• weeds	14	4.72%
	• insects	8	2.8%
	• diseases	37	12.8%
	• vertebrates	62	23%
	• shortage improved seeds	59	20%
	• land shortage	5	1.68%
	• excess RF	45	15.55%

Pest Advisory system of chickpea growing areas of Ethiopia

	Variables	Frequency	percentage
	Pest Advisory services		
	• yes	280	95.6%
	• no	13	4.4%
	Source of advisory		
	• DA	97	36.89%
	• relatives	30	10.46%
	• neighbor	35	13.12%
	• field day	29	9.9%
	• PHC	1	0.3%
	• radio	21	7.32%
	• farmers field school	23	7.96%
	• Television	18	6.11
	• Farmers Group	22	7.66

Chickpea diseases and their Management options

Variables	Frequency	percentage
Chickpea diseases		
• yes	267	91.1%
• no	26	8.9%
Type diseases		
• wilt complex	134	45.7%
• Ascochyta blight	14	4.8%
• virus	8	2.7%
• damping off	21	7.2%
• Rust	46	15.7%
• no diseases	20	6.8%
• 2,3	14	4.8%
• 1,2	31	10.6%
• 1,3	5	1.7%

Fungicide application for chickpea diseases in Ethiopia

Variables	Frequency	percentage
Use of Fungicide		
• Yes	109	37.2%
• No	184	62.8%
Crop stage to spray		
1. seed	20	6.8%
1. seedling	26	8.9%
1. flowering	27	9.2%
1. podding	10	3.4%
1. maturity	7	2.4%
• 2,3	37	12.6%
• not using	166	56.7%

Pesticide spray volume determination, personal protective material and pesticide product information of chickpea diseases in Ethiopia

Variables	Frequency	percentage
Reading of labels during purchase		
• yes	167	57.0%
• no	126	43.0%
Spray amount determination		
• label recommendation	190	64.8%
• guessing	81	27.6%
• other	21	7.2%
Empty container		
• burying	64	26.25%
• burning	59	24.55%
• home service	100	34.1%
• others	38	13.0%

Cont….

Variables	Frequency	percentage
• **Personal protective**		
• yes	89	30.4%
• no	203	69.3%
Information about the product		
• DA	86	29.57%
• Agents	29	10.12%
• Neighbor	34	11.65%
• TV	50	17.2%
• Experience	8	2.7%
• Research	45	18.2%

Conclusions

- Chickpea research has collaboration with ICRISAT, ICARDA, USAID, ADA, BMGF…
- pest management technologies (support service) were not equally addressed.
- Effective and affordable methods for controlling pests poorly disseminated in comparison to the investment on chickpea variety.
- disease management support service should be communicated as full-flagged holistic approach.
- The collaborating projects need to revise their strategy to include the pest management support service together with breeding

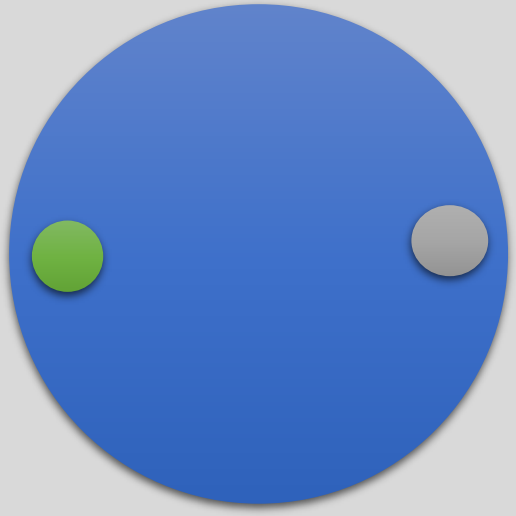
3. Evaluation of the antagonistic property of *Trichoderma isolates a*gainst *Fusarium oxysporum* f.sp*. ciceri* at different temperature ranges

- **Objective: To evaluate the antagonistic property of *Trichoderma isolates a*gainst *Fusarium oxysporum* f.sp*. ciceri* at different temperature ranges**

Materials and Methods

Control test pathogen

Test pathogen and the bioagent



❖Antagonistic potential of the *Trichoderma* isolates were tested by dual culture technique on PDA.

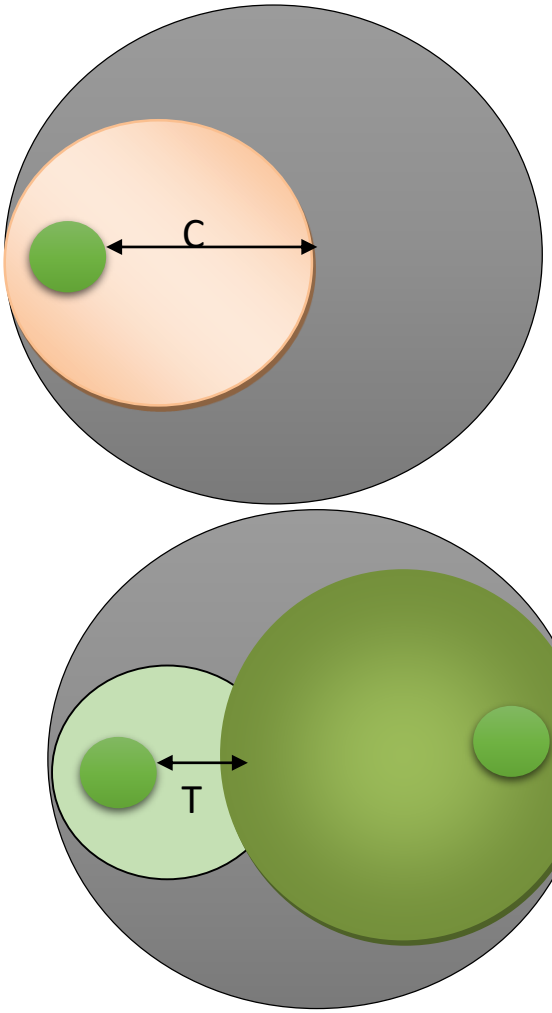
❖Pure culture of the wilt fungus isolates were used

❖at opposite ends at equal distance from centre were incubated at 25 ± 1^0C

❖at different temperature ranges where both organism can grow well

❖Percent growth inhibition was recorded on 3^{rd} to 8^{th} day

Cont…



L (%inhibition)= $\frac{C - T}{C}$ X 100

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Inhibition level

In dual cultures, *Trichoderma* spp. were categorized as effective, based on their:

- ability to over grow and
- inhibit the growth of the pathogens (radial growth)

Where R1 =100% over growth, R2 = 75% over growth, R3 = 50% over growth, R4 = locked at the point of contact.

Where
L = Percentage inhibition of radial growth of pathogen
C = Radial growth of the pathogen (cm) in control
T = Radial growth of the pathogen (cm) in treatment

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Cont…

- The radial growth of the test pathogen were measured and analyzed at different temperature ranges *viz*., 5ºC, 15ºC, room temperature (23ºC), 30°C and 40°C were tested.
- **Test bio-agent (From APPRC)**
- *T.atroviride*
- *T.longibrachatum*
- *T.harzianum*
- *T.viride*
- *T.hamatum*
- *T.asperilum*
- Control

Results

Radial growth on the 8th day after inoculation

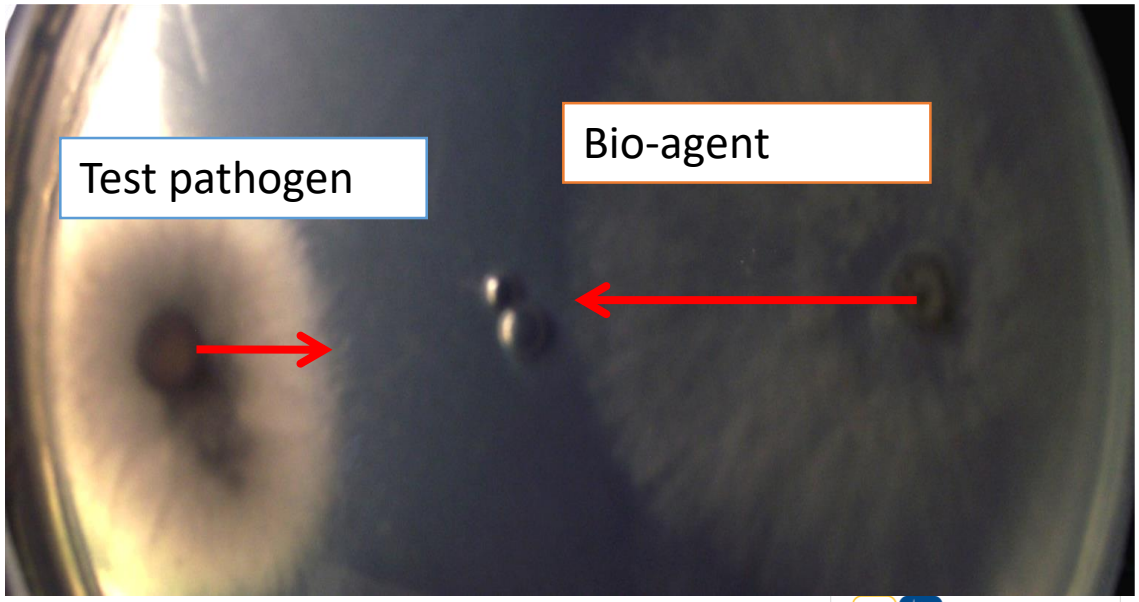
	Bio-control Agent	Average Radial Growth of the pathogen (mm) at different Temp on 8th day			Inhibition (%) At Different Temp		
		15°C	**23**°C	**30**°C	**15**°C	**23**°C	**30**°C
1	*T.atroviride*	1.50	2.13	1.27	68.28	54.29	70.8
2	*T.longibrachatum*	1.43	1.87	1.00	69.66	60.00	76.9
3	*T.harzianum*	1.60	2.07	1.47	66.90	55.71	66.2
4	*T.viride*	1.60	1.87	1.13	65.52	60.00	73.8
5	*T.hamatum*	1.61	1.93	1.67	66.90	58.57	61.5
6	*T.asperilum*	1.61	1.83	1.40	66.90	60.71	67.7
7	Control	4.85	4.67	4.33	0	0.00	0.0

The Trichoderma isolates that incubated in 5°C and 40°C temperature, were not germinated on daily observation till 10th day after inoculation.
Maximum inhibition zone were recorded for *T.longibrachatum* that was 76.9 % at 30°C and the least inhibition zone was recorded from *T.atroviride* with the value of *54.29% at* 23°C.

Cont…

❖Interaction between pathogen and antagonist under microscope showed that *Trichoderma* spp. were interacting with Fusarium wilt hyphae.

❖Antagonist hyphae were observed to be growing towards Fusarium wilt hyphae and coiled around the hyphae.



Conclusion

- Most the Trichoderma species were found significantly different
  - In their radial growth and
  - to inhibit the wilt pathogen at in-vitro test on different temperature ranges.
- The temperature ranges may help to correlate with soil temperature of the growing areas
- The hottest temperature (40^{o}C) and the lower (cooler) 5^{o}C were not suitable for Ethiopian collection isolates to grow.
- Relatively *T. viride* has got better performance in its growth ratio and efficacy.
- Two of the bio-agent isolates will be further tested at in-vivo on micro plot with standard design and carriers to enhance their efficacy.

Paper under review

- **Seed Quality and Mycoflora Associated with Chickpea (*Cicer arientinum* L.) Seed in Ethiopia**

Presentations

- **It was presented at seed technology workshop held in Ethiopia which organized by ICRISAT and EIAR (DZ center).**

Ongoing experiments

- **Characterization of the pathogen type/diversity of ascochyta blight from chickpea growing areas of the country**
- **Ascochyta blight mating type identification**
- **Evaluation of bio-agents (Trichoderma) against chickpea Fusarium wilt disease**
- **Integrated (fungicide with variety) Ascochyta blight chickpea disease management**

Acknowledgements

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FROM THE AMERICAN PEOPLE

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IPM
Integrated Pest Management

FEED THE FUTURE
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Thank you

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