



Research Article

Improving faba bean production and productivity through the integrated management of Orobanche Crenatae at Kutaber, Amhara Region, Ethiopia

Akalu Gebru^{1*} and Mekonnen Mesganaw²

¹Amhara Agricultural Research Institute, Sirinka Agricultural Research Center, Ethiopia

²International Center of Agricultural Research in the Dry land Area (ICARDA), Ethiopia

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***Corresponding author:** Akalu Gebru, Amhara Agricultural Research Institute, Sirinka Agricultural Research Center, Ethiopia, E-mail: akalugebru@gmail.com

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Abstract

Orobanche crenata (*parasitic weed*) is highly limiting factor for faba bean productions and the most serious agricultural economic importance pests in south wollo, eastern Ethiopia. Orobanche infested areas located in Eastern Amhara, Kutaber, Dessie zuria, Tenta and Mekedella distinct which are 40- 120 km far from the capital city of South Wollo zone Dessie. Kutaber and Dessie zuria districts were more infested for orobanche and makes out of production for the last 30 years. To regenerate faba bean production in the given districts Sirinka Agricultural Research Center in collaboration with ICARDA project have done different research activity on orobanche parasitic weed controlling methods using different synthetic chemical spray, chemical integrating with other cultural, and chemical methods, through different plant growth stage. Ashenge faba bean variety (orobanche tolerant) with two times of 0.3Lha⁻¹ glyphosate chemical in 250 to 300Lha⁻¹ water sprayed at faba bean flower starting & one week after first sprayed, and continuous hand weeding of orobanche weed before flowering. With these integrated management the Ashengie variety gave 22-26qtha⁻¹ in the orobanche infested areas. There was a wide training addressed for 112 male and 23 female. Total 135 participants attend at Kutaber district. The training addressed how to produce pure and quality seed production using 0.3L of Glyphosate chemical with Ashengie Variety to replace faba bean production and supplying for income generation of the farmer. Ashengie variety seed exchanged were 18.5 quintal among farmer using 4 male, 2 female, totally 6 in 2017 and the exchange in kind with any crop were 15.5 quintal seed for quality seed around Orobanche infested areas. From the above result total sale price reach 32000.00 Birr per 1 ton and farmer were more benefited in seed sales and used as seed source for Orobanche contaminated areas.

Introduction

World Faba bean growing area is concentrated in nine different agro ecological regions including Ethiopia, Central and East Asia, According to FAOSTAT (2015). China is the leading for both production and productivity followed by Ethiopia. In Ethiopia faba bean is grown in the highlands (1800–3000 m.a.s.l). Faba bean is the major pulse crop grown in the country. Ethiopia is considered to be one of the centers of secondary diversity for faba bean. Amhara region has the largest pulse area coverage (43.7%) and contributes to the highest production (47.0%) in the country followed by the

Oromiya region, with 38.0% of the area and contributing 39.0% of national production. Faba bean has an important pulse in the Ethiopian for export and nutritional diet and is consumed in various forms for its high protein content.

Orobanche crenata is highly limiting factor for faba bean production and the most serious parasitic weed and agricultural pests of economic importance. According to (El-rokieket, et al. 2015), it is an obligate holoparasitic weed that causes severe damage to many important vegetable and field crops. It is considered one of the major biotic limiting factors to the production of legumes such as faba bean. They are devoid



of chlorophyll and totally dependent on the host for organic carbon, water and nitrogen.

Faba bean is crucial for home consumption as well as soil fertility by absorbing atmospheric nitrogen. Faba bean crop able to fix up to $350\text{kgN}\cdot\text{ha}^{-1}$, removed up to $160\text{kgN}\cdot\text{ha}^{-1}$ in harvested grain and contributed up to $270\text{kgN}\cdot\text{ha}^{-1}$ to soil N after harvest (Rochester J, et al. 1998) [1]. However, with this important of faba bean production, the production and productivity of faba bean in eastern Amhara is reduced and in some district abandoned for the last 30 years due to *Orobanche crenata* infestation. Farmer totally abstained to produce faba bean production. According to woreda office of agriculture and the community total faba bean plant is out of production. According to indigenous farmer of the district said that 15 to 20 years old daughter or son do not have any chance to know vegetation of faba bean. However, Farmer try to relapse these faba bean productions using Dung spray, Ash spray, dry planting, very wet planting, crop rotation specially cereal crop. All the above farmer practices are not successful to reduce the seed bank of *orobanche crenata* and reproduce faba bean production.

The main objective of these experimental demonstration were to regenerate faba bean production in the given districts, Sirinka Agricultural Research Center in collaboration with International Center of Agricultural Research in the dry land Area project (ICARDA) have done different research activity on *orobanche* parasitic weed controlling methods using different chemical spray, with integrating and other cultural methods, through different plant growth stage.

Ways of approaching and practical application

Orobanche infested areas were located Eastern Amhara, kutaber,, Tenta and Mekedella district which are 40- 120 km far apart from the capital city of South Wollo, Dessie. The altitude range of these specific locations are 2868-3000 m.s.l. Average annual rainfall is reach 900mm, and 9°C to 20°C minimum and maximum temperature respectively. The soil type is from light vertisol and litosol, *Orobanche* infestation is very high and hard to produce faba bean (Tables 1,2).

In these on farm evaluation research using Varieties Ashengie and local varieties, fertilizers (DAP 100 kg ha^{-1}), Bio-fertilizer and untreated check evaluated on the control of *orobanche*. Ashengie variety is *orobanche* tolerate variety than local variety, which gave reasonable grain yield ($1375\text{kg}\cdot\text{ha}^{-1}$ with DAP, $1325\text{kg}\cdot\text{ha}^{-1}$ with BioF. and $1275\text{kg}\cdot\text{ha}^{-1}$ without, local variety gave $775\text{kg}\cdot\text{ha}^{-1}$ with DAP, $750\text{kg}\cdot\text{ha}^{-1}$ without any fertilizer and $450\text{kg}\cdot\text{ha}^{-1}$ with Bio-fertilizer).

Table 1: Evaluation of *Orobanche crenata* infestation using three sowing dates, three doses of glyphosate chemical spray at the beginning of flowering stage (0, 0.15 and $0.3\text{ L}/\text{ha}^{-1}$) with 250-300 L ha^{-1} water.

	Sowing time	0	0.15	0.3
1	Dry sowing	980 kg/ha	1230 kg/ha	2343 kg
2	Effective moist sowing	870 kg/ha	1025 kg/ha	2016 kg/ha
3	One week after moist sowing	980 kg/ha	1185 kg/ha	2050 kg/ha

Table 2: Evaluation of Ashengie *Orobanche* resistance variety, local varieties, with fertilizer and bio fertilizer on the control of *Orobanche*.

Treatment	Yield (kg/ha)
Ashengy+DAP+Bio	1375
Ashengie +DAP	1325
Ashengy+Bio	1265
Ashengy	1085
Local +DAP	750
Local variety	445
Local+Bio	450

Evaluation of sowing dates and glyphosate chemical spray on *Orobanche* control

Using three sowing dates; dry sowing, effective moist sowing and one week after effective moist sowing and three doses of glyphosate chemical spray at flowering stage (0, 0.15 and $0.3\text{kg}\cdot\text{ha}^{-1}$) with 250-300 $\text{L}\cdot\text{ha}^{-1}$.

From the above observations dry sowing with $0.3\text{L}\cdot\text{ha}^{-1}$ glyphosate sprayed showed better control for *orobanche crenata* weed and spray field score $2343.8\text{kg}\cdot\text{ha}^{-1}$ grain yield and the unsprayed also score $980\text{kg}\cdot\text{ha}^{-1}$.

Observation of spray frequency for the management of *O. crenata*

Using Ashengie variety and 0.3 liter of glyphosate chemical ha^{-1} with one spray, two times spray and without spray.

In this evaluation using Ashengie variety with one time spray of $0.6\text{L}\cdot\text{ha}^{-1}$ glyphosate chemical gave 33 quintal with two times spray 28 quintal and with no spray 22 quintal grain yield faba bean production. Ashengie variety is prominent variety in combat of a serious parasitic weed (*Orobanche*) around kutaber district. These parasitic weed totally eliminated faba bean production for last 30 years.

Description of test locations in which the proposed activity was done (in terms of soil type, texture class availability of quality irrigation water, altitude, temperature, rainfall distribution and amount); rainfall and temperature affect planting, harvesting and threshing, disease outbreak). Show how the productivity, production, food and nutrition security improvement is achieved by intensification through *orobanche* tolerant faba bean variety and improved *orobanche* management practices for production of faba bean.

Seed quality and quarantine

The seeds were pure no contamination with other faba bean because there is no faba bean grown in the *Orobanche* weed infested areas except Ashenge.

For Ashengie pure seed production, there should be different cultural and manual system were considered. Previous cultivation history, cultivation time, crop rotation and sowing time, border effect should considered.

Achievement

Planting of orobanche resistance Ashengie variety with 100kg DAP fertilizer, daily rough out of Orobanche creneta, parasitic weed at the same time of applying with 0.3ml glyphosate with 200ml pure water for one hectare with critical follow up and hand weeding practices.

At the time of field day all participant farmer surprised and express their feeling the regeneration of faba bean in this locality. All participants focused on the research output which tackled these parasitic weed and training should update to the expert and the farmer. All farmer try to produce faba bean by the helps of these technology, Participants focused on continuities of the seed supplementation by approving pure seed and establish seed production union and marketing enterprises, for the initial stage ICARDA provide two ton of initial pure and quality seed for kutber woreda and 1 ton for Tenta woreda which are highly infested and problematic for faba bean production. Other infected wereda bought more than 5 ton of faba bean seed for their infested parasitic weed like Tach Gayent, Mekedela, and Sayent woreda according to district agriculture and seed marketing enterprise kutaber Woreda. Involvement of Seed Quarantine and Certification Laboratory/Agency in providing training and inspection activities for certification and gave training on transfer and transport of these seeds in unaffected area. On-farm Evaluation of integrated management practices for the control of Orobanche crenata.

Ashengie faba bean (*Orobanche* tolerant variety) with two times of 0.3Lha⁻¹ glyphosate chemical in 250 to 300Lha⁻¹ water sprayed at faba bean flower starting & one week after first sprayed, and continuous hand weeding of *Orobanche* weed before flowering showed good control of the weed and obtained up to 26qtha⁻¹ grain yield.

Note: Glyphosate is a broad-spectrum and systemic herbicide. Due to systemic it could translocate through faba bean plants xylems in to the germinating orobanche weed seeds at the time of attachment and can damage the orobanche weed seedlings. In small dose of glyphosate did not damage the faba bean plants but controlled the weed (Singh M. *et al.*, 2012) [2-5]. If the rate is increased even though it can control the weed completely, it affects the faba bean. The smaller plants are susceptible to glyphosate chemical and the grater plants have glyphosate resistant at some level of glyphosate dose (www.glyphosateweeds crops.org).

Variety and available technologies distributed as a package

In the first year Ashengie varieties was scale out 0.8t through 24 male and 6 female in small pack technology addressing system at first year. At the second year 2t through 55 male and 25 female farmers in small pack seed distribution system.

Through seed exchange Ashengie 18.5 quintal seed were exchanged among farmer using 4 male, 2 female, totally 6 in 2017 and Using bartering in kind and any crop 15.5 quintal seed

Ashengie variety exchanged for quality seed around Orobanche infested areas. From the above Result total sale price reach 3200.00 Birr qt⁻¹ and farmers are more benefited in seed sales and used as seed source for Orobanche contaminated areas.

Training and physical capacity building

There is wide training addressed for 112 male and 23 female, total 135 farmer, extension worker and woreda expert participants and attend both at Kutaber and legambo district. The training addressed favorable environment for faba bean production, appropriate soil temperature at time of planting is 15 and at flowering continuous weeding and time of roug out of the parsitec weed is essential for reduce the parasitic weed. how to produce faba bean from from abandon and quality seed production using 0.3L of Glyphosate chemical with Ashengie Variety to replace faba bean production and supplying for income generation of the farmer. These training helps to increase the gross income of the farmers' in line with income from sale of seed, sale of straw, and other service and more focused on sustainability of livelihood of the community. As we know faba bean is a good source of protein for smallholder farmers.

Field days and experience sharing

Wide and remarkable field days were conducted at Kutaber district by participating large number of farmer from each kebele these parasitic weed infestation area, development agent from each participating kebele, experts from wereda and zonal level, higher authority, from zone and regional level, other stockholder, researcher and CGIAR attained on these field days. At these time there are different issue raised and discussed about the continuity of this important work by allocating responsibility. From these office of of agriculture continued the production, union and cooperative gather the seed and re allocate the seed to unaddressed kebele, research center give training and replace pure breeder and pre basic seed.

Participant farmers and invited experts and guests had taken great lessons from the field days on showing great remarkable achievement Ashengie variety with 0.3ml glyphosate on reducing Orobanche infestation and good production (Table 3).

Table 3: Number of participant in the regional filed day in collaboration with ICARDA and Research Center.

	Participant institutions	Male participant	Female participant	Total participants
1	Farmer from different kebele	85	23	108
2	Development agent from different kebele	17	5	22
3	Woreda expert	6	1	7
4	Zone expert	4	0	4
5	Union and cooperative	2	0	2
6	Dessie Seed inspection and quarantine	1	0	1
7	Researcher	8	0	8
8	CGIAR	1	0	1

Promotion of bio fertilizer

Total Bio fertilizer distributed at this woreda reach 2600 pieces in 650 farmers. From these 123 were female and the remaining is male. The performance of the faba bean which planted by bio fertilizer at Kutaber woreda very astonishing. And feedback of the farmer is very good.

Challenges

- Less awareness of agricultural experts about the correct use of the technologies.
- Wrong perceptions of farmers that the variety alone can give good results.
- Zonal and woreda experts not give attentions as the problems seriousness.
- As the project stops, attentions towards the problems stop as we have seen practically.

Opportunities

- The number of orobanche infestation on Ashengie faba bean variety was minimum than the local variety this indicated that Ashengie variety reduce the infestation of orobanche weed seeds to germinate,
- 0.3 L ha⁻¹ glyphosate spray is a minimum dose that can decrease the germination of orobanche weed seeds and the chemical is available in the market with low price,
- The integrated of the three (Ashengie faba bean, 0.3Lha⁻¹ glyphosate chemical two times spray and continuous hand weeding) was better package at this time,
- Continuous hand weeding has an additional advantage in that orobanche seed bank can be reduced over time if seed production is prevented as per recommended,

- If the technology is properly applied, it is two birds with one stone; it means grain production and *Orobanche* weed seeds reduction from the soil bank at the same time.

The way forward

Participant farmer from infested kebele, responsive zonal and kebele public responsible person loudly speak the scale out of these technology. There for, all concerned body who have ability to support the poor farmer should provide the technology with full of package and training to continued faba bean production on by the helps of Ashengie variety with 0.3Lha⁻¹ glyphosate chemical to regenerate faba bean production and to alleviate food security and nutritional deficiency at kutaber woreda and in Amhara region.

References

1. Rochester J, Peoples MB, Constable GA, Gault RR (1998) Faba beans and other legumes add nitrogen to irrigated cotton cropping systems. *Australian Journal of Experimental Agriculture* 38: 253-260. [Link: https://bit.ly/3ceQR1L](https://bit.ly/3ceQR1L)
2. Bayaa B, El-Hossein N, Erskine W (2000) Attractive but deadly. *ICARDA Caravan* 12.
3. Abdel-Kader MM, El-Mougy NS (2007) Applicable control measure against *Orobanche ramosa* in tomato plants. *Plant Pathology* 36: 160-164. [Link: https://bit.ly/38pNZhf](https://bit.ly/38pNZhf)
4. Rubiales D (2001) Parasitic plants: an increasing threat. *Grain Legumes* 33: 10-11. [Link: https://bit.ly/30rbEJN](https://bit.ly/30rbEJN)
5. Sauerborn J (1991) The economic importance of the phytoparasites *Orobanche* and *Striga*. In: Ransom, J. K., Musselman, L. J., Worsham, A. D., Parker, C. eds. *Proc. 5th International Symposium on Parasitic Weeds*. Nairobi: CYMMYT 137-143. [Link: http://bit.ly/3er3pWC](http://bit.ly/3er3pWC)

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