Demonstration and scaling of integrated management of parasitic weeds on faba bean in Northern Ethiopia

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Rational: Parasitic weeds (*Orobanche* and *Phelipanche* spp) are key production challenges in the norther parts of Ethiopia. In addition to parasitic weeds, faba bean gall disease is doubling the challenge on faba bean. Besides reduction in yield, the two non-endemic pests are threatening the genetic diversity of food legumes since the land races are highly susceptible. This report covers activities conducted in 2021/22 cropping season.

Objective

- To develop inclusive and affordable Integrated parasitic weed management on food legumes to reduce yield gaps

Activity 1. Scaling and demonstration and of integrated management of parasitic weeds affecting faba bean in the highlands of Amhara region

Activity 1.1*. Scaling of integrated management of parasitic weeds and faba bean gall diseases management on faba bean*

Scaling of IPDM of parasitic weeds and emerging faba bean gall disease was implemented in three districts of South Wollo zone, Amhara region (**Table 1**). The IPDM components were partially resistant faba bean variety *Hashengie* (ILB-4358), two sprays of sub lethal doses of glyphosate (0.30 l/ha) at early flowering stage of the crop and one hand weeding. The partially resistant variety was selected from ICARDA international *Orobanche* nursery and released in 2015 by the national program. Fungicide seed treatment with (150 g/100kg seeds) was included to control faba bean gall disease. The availability of certified seeds was enough only to scale the innovation on 11 host farmers and one farmer training center (FTC). At crop physiological maturity, field days were organized.

Table 1. Lists of IPDM scaling sites in south Wollo , 2021/2022 cropping season

SN	Districts	Name of villages	#Host farmers	Area planted (m^2)
1	Kutaber	Flago Ber	3	2961
2	Dessie Zuria	Daba	3	5304
		Kedijo	2	800

			FTC	400
3	Mekdela	Dedere	3	1200
Total	3	4	11	10665

Results

The productivity of the innovation ranged from 1.4 to 3.7 t/ha in different districts where the innovation was scaled on 11 host farmers (**Table 2**). The average productivity of neighboring farmers who grew their local variety and without applying Integrated Pest and Disease Management (IPDM) options was 1.3t/ha. This indicated that the innovation could double faba bean productivity and can bring back the crop in the cropping system in the northern highlands of Ethiopia.

Two field days were organized to create awareness for farmers and development agents in Dessie Zuria district, south Wollo. A total of 158 farmers (101 male and 57 female farmers), three development agents and 11 researchers participated the field days and showed interest to adopt the IPDM packages in their fields next cropping season. Moreover, development agents and district experts agreed to demonstrate the innovation in new areas where parasitic weeds are a major problem. The addition of fungicide seed treatment in the IPDM to manage the new faba bean gall disease showed good promise to protect the crop during seedling and vegetative stages of the crop.

Table 2. Effects of IPDM innovation in protecting faba bean from parasitic weeds and gall disease in three intervention districts, 2021/22 cropping season, south Wollo Zone

Districts	#Host farmers	Yield ranges (t/ha)	Average yield (t/ha)
Kutaber	3	0.9-2	1.4
Dessie Zuria	5	1.7-2.9	2.5
Mekdela	3	2.1-2.4	2.2
Farmer training Center	1		3.7
Neighboring farmers	3	0.6-2	1.3

Photo 1: Field day on IPDM innovations to creat avawraenes on manage parastic weeds on faba bean, south Wollo

Activity 1.2. *Demonstration of integrated management of parasitic weeds and gall disease on faba bean*

Demonstration of Integrated Pest and Disease Management (IPDM) options to manage *Oronbanche* and gall disease on faba bean was implemented in south Gondar (three districts) and south Wollo (three districts) zones in Amhara region. The IPDM components were:

1. Partially resistant faba bean variety *Hashengie*
2. Two foliar sprays of sublethal glyphosate at the rate of 0.30l/ha mixed in 300 l water.
    - The first application at early flowering stages and two weeks after first application
3. Fungicide seed treatment (150 g/100kg of seeds) with Noble 25%WP fungicide (a.i. Traidimefon) to protect the new faba bean gall disease

The demonstrations of parasitic weed and faba bean gall management options were hosted by seven farmers in south Wollo and five farmers in two villages in Tach-Gaint district in south Gondar. Each farmer used $100m^2$ plot per component to demonstrate the innovations.

In south Wollo, qualitative data (*Orobanche* population, faba bean gall severity and agronomic traits) were collected by researchers and at crop maturity, invited farmers evaluate the innovations. In South Gondar, Tach-Gaint district 15 (10 male, 5 female) farmers grouped in to three (five farmers/group) evaluated the innovations using the following criteria in their order importance.

1. *Orobanche* and faba bean gall
2. Number of pods/plant
3. Branching ability
4. Number of seed/pod

Farmers used 1-4 scaling where 1 excellent , 2 very good , 3 good and 4 poor and weighted score value was used to rank the innovations.

Results

In two districts of south Wollo, the *Orobanche* population ranged from 13-40 shoots m-2 and percent severity of faba bean gall ranged from 3-23% (**Tables 3&4**). The most effective options in reducing parasitic population are the integration of Variety *Hashengie* with two sprays of sublethal doses of glyphosate at early flowering stages of the crop. Additional fungicide seed treatment with IPDM of parasitic weeds helped farmers to control faba bean gall disease which

can devastate the crop before the appearance of *Orobanche* on the crop. In south Gondar zone, farmers (male and female) ranked Variety *Hashengie* and two sprays of glyphosate and fungicide seed treatment to management parasitic weeds and faba bean gall disease (**Table 5**). In both zones selected IPDM options were similar and will be scaled in 2023/24 cropping season.

Table 3. Effects of integrated management of parasitic weeds on yield components, parasitic weed population and faba bean gall severity, 2021/22 cropping season, Kutaber district, south Wollo*

IPDM components	Stand count	Pods/plant	Seeds/pod	#Orobanche shoots/m^2	Faba bean gall severity (%)
Variety *Hashengie*	21.9	10.4	2.1	39.8	23.4
Variety *Hashengie* + 2 glyphosate applications	24.5	15.8	2.5	15.0	20.3
Variety *Hashengie* + fungicide seed treatment	17.5	12.2	2.1	28.8	3.8
Variety *Hashengie* + 2 glyphosate sprays + fungicide seed treatment	20.1	15.8	2.6	13.3	3.3
Average	21.0	13.6	2.3	24.2	12.7

*****All values are averages of three host farmers' plots

Table 4. Effects of integrated management of parasitic weeds on yield components, parasitic weed population and faba bean gall severity, 2021/22 cropping season, Dessie Zuria district, south Wollo*

IPDM components	Stand count at harvest	Pods/plant	Seeds/pod	#Orobanche shoots/m^2	Faba bean gall severity (%)
Variety *Hashengie*	23.0	13.7	2.2	26.7	19.2
Variety *Hashengie* + 2 glyphosate application	26.6	18.9	2.7	12.8	15.9
Variety *Hashengie* + fungicide seed treatments	22.7	15.8	2.4	35.2	3.7
Variety *Hashengie* + 2 glyphosate sprays +fungicide seed treatment	25.6	18.3	2.7	14.0	1.8
Average	24.5	16.7	2.5	22.2	10.2

*****All values are averages of four host farmers' plots

Table 5. Matrix ranking of parasitic weed management innovations by famers, 2021/22 cropping season, Tachi-Gaint district, south Gondar zone.

Treatments	Weighted scores					Total score	Ranking
	Disease and Orobanche resistance	No. of pod/plant	Branching	Number of *Orobanche* shoots/ plot	Seeds/ pod		
Variety *Hashengie* + Glyphosate	5	4	3	5	3	20	1

Variety *Hashengie* + fungicide seed treatment	15	12	12	18	12	69	3
Variety *Hashengie* + fungicide seed treatment + Glyphosate	8	8	10	6	10	42	2
Variety *Hashengie*	12	20	12	20	12	76	4

Photo 2. Demonstration of integrated management of parasitic weeds option (right) to control parasitic weeds on faba bean, Tach-Gaint district, south Gondar zone

***1.3. Awareness creation of Integrated Pest and Disease Management innovations*:** Field days were organized in the two zones to create awareness about integrated parasitic weeds management on faba bean. In south Wollo, 40 farmers (32 male and 5 female farmers) and three development

agents were participated the field day. Participants were interested on the performance of the innovations in reducing *Orobanche* and faba bean gall diseases. They also appreciated the partially resistant variety *Hashengie* for its levels of resistance to the parasitic weed, large seed, plant height, plant vigor and number of pods/plant. In South Gondar, a field day was organized to farmers , village level development agents, researchers and experts from region, zones and district offices of agriculture. A total of 63 farmers and experts participated the field day where six are female participants.

Activity 1.4. Early generation seed production: Partial resistant variety is a critical component of the IPDM options to manage parasitic weeds in faba bean. To expand the scaling and demonstration efforts by PHI partners, early generation seeds (pre-basic and certified seeds) were produced by Sirinka research centre and by community seed growers. Over 2.3t of seeds (0.8t of pre-basic and 1.5 ton of certified seeds) is produced for 2022/23 crop season scaling efforts.

Photo 3. Performance of cv. *Hashengie* early seed production in Dessie Zuria district, south wollo zone.

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