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TOWARDS FARMERS' PARTICIPATORY RESEARCH:

Attempts and Achievements in the Central Highlands of Ethiopia

Ethiopian Agricultural Research Organization
(EARO)

Integrated Potato Late Blight Management: Experience of farmer field school (FFS) in Dendi District

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Summary

Farmers Participatory Research (FPR) on Integrated Management of Potato Late Blight disease through Farmers' Field School (FFS) approach was initiated in year 2000 (off and main season) in Dendi District. The purpose was to adress the causes, sources and management of late blight and many aspects of potato production such as seed quality, varital resistance, cultural practices, and post harvest practices. The initiation was implemented in six countries including Ethiopia and is funded by the International Fund for Agricultural Development (IFAD). The project involved partnerships among Ethiopian Agricultural Research Organization (EARO), Self-Help Development International (SHDI), and the International Potato Center (CIP). Full time facilitators were hired and trained. The first FFS cycle was started with an average 23-farmer participant per field school and seven schools were implemented. In year 2001 ten schools are in progress. An experiment comprised of Fungicide X varieties and /or clones were the corner stones for the FFS field and session activities. The learning approach was participatory and farmer's experiences were utilized in quantifying and addressing potato production constraints in the area. Fourteen sessions that coincides with the phenology of the crop was delivered in the school cycle. Farmers fully participated in experimenting on late blight life cycle, diagnosis and symptom identification, varital evaluation, fungicide application and its safe use, seed quality and post harvest considerations that help to reduce the disease and contribute to get higher tuber yield. The assessment of farmers' knowledge and practices prior to the sessions related to late blight indicated that all farmers (100%) have no knowledge of the causes and sources of late blight. However, some farmers had little knowledge on management (fungicide protection) of the disease. Based on the information obtained during internal self-monitoring and evaluation, the participating farmers recognized that the strategy of learning and exchange of experiences in groups was instrumental in enhancing their awareness and confidence in an integrated management of late blight. Though it is too early to conclude that the approach is best over previous extension approaches, it can help shift away from dependency on long term external support for late blight control technologies dissemination and adoption because the approach is based on learning by doing.

Introduction

Late blight is the single most destructive disease of potato the world over (CIP 1989) and crop loss due to this single disease in Ethiopia, on unimproved local cultivar, has been reported to be 100% (Bekele and Yaynu, 1996). Approaches

to reduce the effect of the disease on tuber yield are use of resistant varieties (Shtienberg *et al.*, 1994) and fungicides. Fungicide use was found to be economical (Bekele and Hailu, 2001). However, both methods are not efficient to use, as a control approach independently because varieties may become susceptible after some production period and high cost coupled with health risk and environmental damage are also negative consequences of fungicide use.

For these and other reasons, an integrated approach to control the disease became very important (Bekele and Gebremedhin, 2000) and more economical (Unpublished data). However, many potato farmers have very little knowledge of the causes, sources and management of potato late blight. Therefore, to reduce the effect of the disease on tuber production and increase tuber yield per unit area, it was found necessary to build the capacity of small holder farmers on the causes and sources of late blight. So far research and extension efforts aimed at addressing these constraints have achieved limited results. Insufficient agricultural services such as extension was recognized as a major cause not to empower the small-scale farmer to increase productivity (Cleaver and Donovan, 1995).

Top-down approach in promoting extension in agricultural development created gaps in the technology transfer (Habtemariam, 1996). This partly due to extension systems strategies that confounded to the limited linkage between research and extension organizations which is practiced in the country that met with limited success in the implementation of insect pest and disease control and over all crop management measures. Though it was not very comprehensive, some attempts have been made to promote extension with training concurrently (Marco, 1997).

An integrated disease management (IDM) approach for successful control of late blight is knowledge intensive. Hence, efforts should be made to increase the knowledge of farmers through participatory hands-on learning approach. In other words Farmers Participatory Research (FPR) through "Farmer Field School" (FFS) approach was believed to be a potentially appropriate extension approach for participatory training and research to address these needs. This approach is based on long training sessions linked to experimentation and has been used in integrated pest management of various crops (Gallangher, 1993; Ortez et al., 1999; Van de Fliert and Braun, 1999).

FFS have been started in Ethiopia to address late blight problem in integrated way to empower and encourage farmer participation and implementation of integrated management of potato late blight, and other potato production constraints. The project is funded by the International Fund for Agricultural Development (IFAD) in six countries of the world including Ethiopia and implemented by International Potato Center (CIP) in collaboration with other stake holders (farmers, Ethiopian Agricultural Organization and none governmental organization (Self Help Development International (SHDI). In addition, development agents of Ministry of Agricultural Bureau of respective districts were involved.

The overall objective of this project is to increase potato production in the highlands of Ethiopia through the development & implementation of integrated management methods for late blight and other major potato diseases and insect pests to enable farmers make better management decisions.

The specific objectives include:

- To test the working modality of FFS under the Ethiopian farmers condition.
- Increase farmers' knowledge and practices on late blight and its control measures
- To enhance participatory variety and promising clonal evaluation and deployment
- To understand late blight biology and conditions favoring the development of the disease under farmers conditions
- To produce training materials for integrated management of late blight and potato crop management in general

In this paper technical aspect of FFS implementation, experiences and lessons learned during the execution of the activity on integrated management of potato late blight are highlighted.

Approach to Implement the Initiative

The FFS activity initiated in Dendi district at Galessa in year 2000 off-season. Prior to the execution of the activity two agricultural extensions facilitators were hired and a short training workshop of trainers was conducted to introduce the facilitators to the FFS approach, methodology and curriculum. During the period the numbers of schools were only four and in the main season three additional schools were organized and the numbers of schools were reached to seven. In these seven schools a total of 175 farmers completed the school cycle. In year 2001 main season in Juldu and Welmera Districs, eight and two schools were organized respectively and sessions are in progress for 240 school members.

Galessa PA was selected based on secondary information from the previous PRA results (Kindu et al., 1997), which revealed significant late blight constraint in the area. Additional appraisal of constraints related to potato production was also made through group discussion, questioner, and PRA methods, during earlier sessions of the FFS, for in-depth analysis of farmers' knowledge and practices with respect to late blight management and other potato production constraints. In this appraisal 20-25 farmers participated as respondents from each farmer field school.

Formation of FFS groups was implemented through negotiation among the farmers, Ethiopian Agricultural Research Organization (EARO), Self Help Development International (SHDI) and International Potato Center (CIP). Farmers group formation or FFS members identification was based on the voluntary basis. Initially in some schools the number of farmers registered were more than 50 farmers. But from international experiences the manageable size of the school member is between 25 and 30. Hence, obliged

to reduce the number of farmers to manageable size by lottery draw. After the group formation, diagnosis survey, guideline development, organizing the FFSs' and starting up the sessions using the developed guidelines (Table 2) were the major approaches used in the course of conducting the activity. Self-evaluation of activities was also conducted at the end of each session and towards the completion of the cycle of each school.

Fungicide by variety trial was also a method employed during the FFS implementation. Participants in each FFS group tested a set of promising potato varieties/ clones in 2 (in 2000) and in 4 replications (in 2001) in randomized complete block design under local conditions. In order to create scenario for farmers to understand the natural variability of varieties /clones in response to late blight one replication in 2000 and two replications in 2001 left with out fungicide application. To exercise and conduct session activities, (the safe use of fungicide, calibration and the efficacy of fungicides) the remaining one and two replications were sprayed with fungicide, respectively.

Materials used in FFS implementation includes, communal field plot, potato seed tubers, different varieties/ clones, fungicides, diseased potato plants,leaves, sprayers, protecting clothes, fresh samples of diseased tubers, flipcharts, markers, rulers, tapes, pens, pencils, exercise books, sugar, salt, biscuits, thermometer, rain gage, plastic boxes, paper towels, cards, and hand lenses. In addition to these during the evaluation session: T-Chart, Attainment of learning objectives exercises and questionnaires were the major tools.

Table 1. Structure of the sessions developed based on crop phenology, their objectives and methods used

Session title	Objective(s)	Methods
1. Introduction to FFS	Introduce the mode of operations of FFS	Discussion
2. Knowledge, Attitude & practice of farmers on late blight & potato production	Determine knowledge, attitude & practice of farmers Share experience	Group discussion, preference ranking etc.
3. Potato seed quality, sorting, handling potato seed and planting	To assist farmers to recognize late blight in tubers Determine quality of seed & planting	Group discussion, experimentation, planting according to the recommended spacing
4. Basic concepts of experimentation	To give farmers idea on basic aspect of experimental design	Group discussion, field exercise
5. Crop management and its application to potato (seedling emergence, weeding, hilling and soil fertility)	To encourage problem identification and make decision at field level.	Observation of the field (agro-ecosystem analysis), field activity, discussion, data collection
6. Role of organic fertilizer, compost preparation and use	To understand the ITK and improved compost preparation	Discussion, Activity and Experimentation.
7. Symptom and diagnosis of late blight and other potato diseases	Differentiate symptoms caused by insect pests and various diseases Learn about the disease in their fields	Discussion, observation, experimentation, data collection (rainfall, tempe-rature and relative humidity)
8. Late blight development & potato disease in relation to the environment and clonal / variatal evaluation	Learn the causes and life cycle of late blight pathogen Identify sources of inoculums and means of transmission	Observation, group discussion, presentation, field-lab exercise, data recording on late blight progress.
9. Field insect pests of potato (Cut worm)	Learn the different type of insects (harmful and harmless) and understand the life cycle of the major insect pests Identify type of damage caused	Observation, discussion on representative insect pest specimen.

Table 2. Continued

Session title	Objective(s)	Methods
10. Reaction of potato varieties to late blight under different fungicide management strategies	Test a set of promising potato varieties/ clones under local conditions Monitor disease & environmental conditions thro-ugh data collection	Field exercise, discussion, data collection on late blight severity, weather etc.
11. Fungicide application: nozzle selection, spray equipment calibration and safety precaution during transportation, storage application, and post application of fungicides	Learn the correct calibration of sprayers Understand safe use of fungicides/ toxic effects Improve fungicide application for late blight control	Demonstration, discussion
12. Harvest considerations: positive selection, sorting (blighted tuber), variety evaluation (yield, test, color, eye depth, stolen length)	To train farmers in producing healthy crop To produce quality /healthy seed high yield per unit area	Discussion, field exercise (card method), observations, selection, test evaluation storage (DLS), visits.
13. Measurement of potato yield (gains and losses) of fungicide by variety trial	To understand how production costs are calculated and cost components to be considered Evaluate varieties/ clones and fungicide protection, based on cost-benefit analysis	Discussion and exercise based on total yield obtained per treatment, cost of fungicide etc.

Results and Discussion

Organizing the FFS

In order to confirm commitments the FFS was started with By-law development and selection of committee members such as chairperson, secretary, and treasurer. The FFS group participants were with in the range of 12 to 27 farmers. The age of the farmers ranged from 17 to 61 and more than 90 % are male and the remaining 10 % female. More than half (54 %) of the members don't read and write while the remaining, 46% attended formal school in the range of 2 to 11th grade. Activities for FFS implementation were based on field sessions planed on the bases of the crop phenology. In year 2000, at Galessa, all 14 field sessions were conducted in 7 schools and currently the facilitators are visiting periodically and are giving technical advises. But in the new schools (8 in Jeldu and 2 in Welmera) which are started the field sessions in 2001 completed 7 field sessions and continue that up to November.

Major potato production constraints

Appraisal of farmers practices revealed that late blight as the first major constraint in the potato production followed by cut worm, mole rat, porcupine and red ant in descending order (Figer1). Other problems such as potato seed storage, pigs, and birds were also mentioned in two schools but were not considered, as a problem in all seven schools and not included in the curriculum.

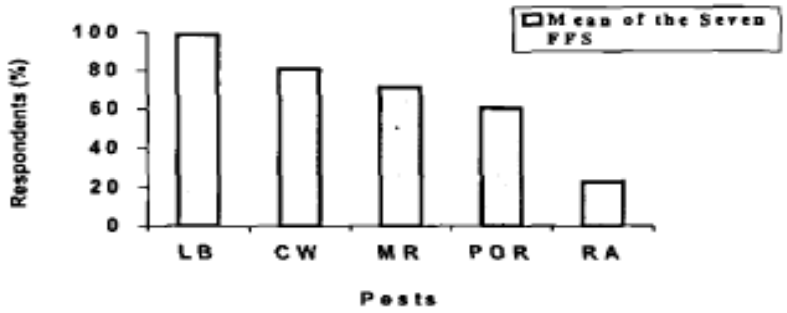

Figure 1. Potato production problems identified by FFS members in Galessa.
LB-Late Blight; CW -Cut worm; MR -Mole rat; POR-Porcupine; RA-Redant

The farmers practice appraisal indicated that unaware of the use of health seeds. Farmers obtain potato seed from previous harvest of own fields or from the local market. Farmers do not know the sources, causes and factors favoring or affecting late blight and believe that, fog and rain are the causes of the disease. Though some farmers are using fungicide to control late blight, most of the participants of the school have little or no knowledge on late blight management in general. At Galessa, all respondents did not have any concept about resistant or tolerant variety because for the past two decades they produce only one potato variety (variety *Dredaw*), which is highly susceptible to late blight.

Fungicide by variety trial

In all the FFS, the most important disease observed by farmers during the cropping cycles was caused by *Phytophthora infestans*. In the unsprayed treatments late blight severity expressed as area under the disease progress curve (AUDPC) ranged from 222.7 to 402.3 in all field schools whereas in the fungicide treated treatments mean late blight severity were in the range of 30.3 to 224.6 (data not presented). A difference in the tuber yield among clones and/or varieties was also significant. Mean tuber yield in non-fungicide treated plots ranged from 14 t ha $^{-1}$ to 37.2 t ha $^{-1}$ while in the fungicide treated plots the range were 18.9 to 40.3 t ha $^{-1}$.

Based on the level of tolerance to late blight, tuber yield, test and color of the tuber, in each school, 5 to 6 clones and / or varieties were selected. The variety Tolcha was selected in all the schools whereas KP-90134.2 and KP-90138.5 were selected in four and three of the schools, respectively. The clone CIP-392622.514 that represents population B (field resistant clones) was selected in two schools. Farmers decided to store the selected clones in diffused light stores (DLS) and agreed to reevaluate and multiply in the coming season.

Evaluation of farmers at the end of the school cycle

The major results obtained after the implementation of FFS activities in the 7 schools were assessed in December 2000 during evaluations session (Table 2). Generally, during the FFS implementation the mode of FFS operations were introduced and participants discovered the advantage of working in-group. Moreover, 33% of the participants able to recognize late blight on tubers and the characteristics of quality seed. More than half of the school members (62%) were also able to differentiate symptoms of late blight from other potato diseases or physical damages and 100 % able to understand the cause of late blight as a living organism and 62 % of the school members understand its life cycle and from where the inoculums comes in the subsequent year. And basic aspects of experimental design were also additional areas of learning for 58 % of farmer respondents. The concept of economics particularly when they are using fungicides as control measure was discussed and exercises during harvest were delivered however about 64 % of the farmers need additional session and exercise.

Forty one percent of the participants were also found to be skilled at the correct calibration of sprayers and identify the correct dose of fungicide application in contrast with the 1kg/ha Ridomil MZ 63.5% WP application they were using against the recommended 2kg/ha rate. They are also made to understand the risks of improper handling of fungicide and their toxic effects to human, animals and the environment.

Table 2. Percent mean of the seven school members on attainment of learning objectives of the sessions and related practices.

Session	New Knowledge (A)	Need additional session (B)	Ready to practice(C)
Introduction to FFS	-	-	-
Knowledge, attitude & practice of farmers on late blight & potato production	33	77	25
Potato seed quality, sorting, handling potato seed and planting.	44	56	60
Basic concepts of experimentation	28	72	34
Crop management and its application to potato (seedling emergence, weeding, hilling and soil fertility)	34	66	17
Role of organic fertilizer, compost preparation and use	58	42	16
Symptom and diagnosis of late blight and other potato diseases	62	38	16
Late blight development in relation to the environment and its life cycle and clonal / variatal evaluation	100	0	0
Field insect pests of potato (Cut worm)	41	59	41
Reaction of potato varieties to late blight under different fungicide management strategies and the presence of different level of varietal responses to late blight	75	25	25
Fungicide application: nozzle selection, spray equipment calibration and safety precaution during transportation, storage application, and post application of fungicides	41	59	25
Harvest considerations: positive selection, sorting (blighted tuber), variety evaluation (yield, test, color, eye depth, stolen length)	43	67	57
Measurement of Potato yield (gains and losses) of fungicide by variety trial	36	64	25
Mean	47.5	52.5	28.4

New knowledge = participants had no knowledge before on the area under the session; Need additional sessions = participants who need revision of sessions; Ready to practice = participants have found the session and session related practices are useful and promised to practice the knowledge gained in their potato fields. Column A & B considered as 100% but percent data in column C was generated by considering column A as 100 %.

Perception of participants about the school

More than 15% of participants developed courage and mentioned the value of the school in terms of the knowledge gained from the session and exercises related to each session and want to share the knowledge gained for their none member neighbors and friends by organizing new schools that will be facilitated by them selves. However such farmers requested periodic supervision by facilitators or researchers. In order to encourage and support such farmers, an attempt have been made to generate some information related to the cost of materials needed for the entire school cycle and was estimated about 2700 Birr. This indicates that if those farmers who have completed the FFS School cycle committed to be a facilitator and handle school sessions, the expenses to make materials available look not expensive. Hence this approach can be used as an option for farmer-to-farmer extension. The remaining 75 % of the members would like to continue as members of the existing group though they have completed the school cycle and graduated.

Twenty eight percent of the school members mentioned what they gained knowledge/experience by being a member in the FFS. They confidently put their vision in the way that they can reduce the yield loss significantly due to late blight in their potato fields. To do so they said, we are empowered through the knowledge and awareness about the availability of tolerant varieties, improved cultural practices, how to diagnose late blight, how and when to apply fungicide, how to produce and maintain disease free seed, and how to store potato seed. Moreover, participants indicated the advantage of having improved resistant varieties which can grow during the main rain season, and which can be harvested during October-December when there is serious demand of food i.e. potato will fill the food gap in the area during that period. In this regard all the seven schools were constructed diffuse light stores DLS and of the evaluated clones under their environment 3 to 4 clones /varieties were stored in DLS for multiplication. Currently all the seven schools reevaluated at the same time multiplied the selected varieties/clones for seed.

Lessons Learned

- ***Expectation of participants due to misconception of the FF***: During the FFS organization, farmers were expecting to get fertilizers, fungicide and improved potato varieties for free, which was not in line with the objective of the FFS approach. Therefore, a through understanding by the farmers group about the working modalities of the FFS is required. Hence, prior to organizing the members repeated introductory sessions is required.
- ***Similarity of FFS with Previous Development Approaches***: Even after the sensitization workshop with farmers on FFS objectives and working modalities, most of the farmers were suspicious and were not convinced that FFS approach is a new approach but similar to the previous farmer organization, which was functional in the previous regime. Therefore a continuous and exhaustive discussion should be facilitated until farmers understood what FFS is planning to do with them.
- ***Organizational***: Participants were selected based on their interest, no other criteria like ability to read and write were considered, majority of the school members were

not able to read/ write and this forced to merely depend on their memory to remember new learning. Therefore selection of FFS members shall include some criteria like ability to read and write.

- ***Problem Encountered***: Low attendance for the participants due to unexpected social conditions, 3-4 market days, other commitments, seasonal workload and overlapping of main season & off-season school were also additional constraints encountered.

Before the initiation started the facilitators and researchers were discussed about the FFS with the district MoA bureau and reached an agreement to start the initiation. Similarly brief discussion was made with peasant association (PA) leader and some individual farmers. During implementation of the sessions all members were not able to come according the schedule or they came very late and it was disappointing for facilitators and researchers who are committed to gate the job done. This was happened because of the overlap of the schedule of either the development agents or PA leader and social group leaders. Therefore prior to organizing the FFS and initiate sessions, close collaboration and development of the work plan with the involvement of development agents assigned in the community, other social group leaders such as "IDER", "MAHBER" and PA leader help to conduct the activities smoothly. Moreover, studying the agricultural calendar with in the year and identifying saint and market days are necessary.

Duration of field sessions, 4-5 hr, which was happened due to lack of experience from the facilitators or the volume of the session. Generally most of the constraints were solved through the development and adoption of by-laws.

Low Participation of women and school children: in the FFS all members of the community who potentially take part in potato production related activities is very important. Women and children, in Galessa, provide a vital labor contribution during planting, weeding, hilling and harvesting of potato. Therefore, their participation in the FFS and their involvement in the control of late blight is very crucial.

Conclusion

A continuation of the implementation of FFS activity is presumably possible. The limited experience showed that the approach helps to solve farmers' problems by directly involving them in the process and ensures the generation of demand driven technologies. It is encouraging in terms of the involvement of different stakeholders. Though it is too early to conclude that the approach is best over previous extension approaches, it can help shift away from dependency on long term external support for late blight control technologies dissemination and adoption because the approach is based on learning by doing. However for successful implementation of FFS activities the following points need to be considered. Identifying gaps in knowledge during base line and KAP survey, i.e. difference in understanding between members and the knowledge they have in relation to the content of the curriculum; Aid farmers in the discovery process through on-farm experimentation and testing during the school session relevant to the activity.

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