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Impacts of Technology Interventions on Managing Fusarium Wilt in Sweetpotato in Bauko, Mountain Province

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Abstract

Fusarium wilt of sweetpotato caused by *Fusarium oxysporum* is considered one of the most destructive sweetpotato diseases. This disease has severely damaged sweetpotato crops, particularly in Mountain Province, Benguet, and Nueva Vizcaya causing an average of 51-100% yield reduction of sweetpotato. Of this, the NPRCRTC distributed about 76,824 pcs of quality planting materials (vine cuttings) as a quick response initiative from July 2016–June 2017 in Bauko, Mountain Province. Thus, this impact assessment was conducted to identify interventions introduced and adopted and to document and determine outcomes and economic impact of the interventions using descriptive analysis and a combination of quantitative and qualitative methods. A total of 42 respondents were interviewed through group interviews and discussions. Interventions in managing Fusarium wilt that revived the sweetpotato industry include farm demonstrations on the use of *Trichoderma harzianum*, lime, and combined chicken and hog manure; evaluation of sweetpotato entries for resistance to the disease; and conduct of training on organic fertilizer and sweetpotato processing, and tissue culture-derived plant materials of sweetpotato with different resistant varieties. Sweetpotato growers in Lagawa, Bauko, Mountain Province still lacked sufficient knowledge about the disease to implement the proper management approaches to support effective Fusarium wilt management practices. Adopting the resistant varieties, and using *Trichoderma* and organic fertilizer had at least produced a yield for home consumption. Using these interventions also reduced the infestation of Fusarium wilt on their crop, but still low due to limited access to reliable sources of planting material. The adoption of approaches to manage Fusarium wilt among sweetpotato growers has provided insight into the status of the disease in the community.

Introduction

In the Philippines, particularly in the Cordillera Region, sweetpotato has been a staple food before and as an alternative/supplement to rice, especially in the remotest, mountainous barangays. Sweetpotatoes are rich in complex carbohydrates, dietary fibre, vitamins, and minerals and offer a nutritious diet. Their

adaptability to diverse climates and ability to thrive in marginal lands make them resilient crops, contributing to food security, especially in regions prone to challenging growing conditions (Younis et al., 2024). Furthermore, Kreuze et al., (2023) also cited that sweetpotato grow in marginal conditions with relatively few inputs and simple techniques– making them ideal "climate-smart" crops. Sweetpotato is also a significant economic crop in many countries and after potato and cassava, the world's third-largest root crop. In Ethiopia, sweetpotato plays a key role in maintaining food security and household income generation. Under marginal conditions like in Ethiopia, the crop requires few inputs, grows quickly, and produces a consistent yield (Bedassa et al., 2024). Moreover, Tedesco et al., (2023) reported that sweetpotatoes can adapt to challenging environments, such as drylands and soils with low fertility.

Even though sweetpotatoes can sufficiently develop edible tuberous roots for auto-consumption and commercialization under adverse conditions, farmers may need access to high-throughput genotypes (e.g., drought-tolerant, thermotolerant, and fertilizer-efficient landraces) and the implementation of resource-efficient agronomic practices to establish cost-effective farming systems. This increase in productivity can positively impact food security and income generation for small-scale farmers (Lacaba et al., 2023a).

Fusarium oxysporum is a major wilt disease of many economically important crop plants. It is a soil borne pathogen, which can live in the soil for long periods of time due to its capacity to produce chlamydospores, which can withstand adverse conditions. It can also spread through infected dead plant material, so cleaning up at the end of the season is important. Sweetpotato Fusarium wilt is caused by *Fusarium oxysporum* f. sp. Batatas (Figure 1). This disease has severely damaged sweetpotato crops, particularly in Mountain Province, Benguet, and Nueva Vizcaya causing an average of 51-100% yield reduction (Gayao et al., 2019). Crop rotation may not be a useful control for the fact that the pathogen has a wide range of hosts. But, *Fusarium oxysporum* f. sp. batatas can be controlled by using clean seed, cleaning up infected plants, and breeding for resistance. Mphela et al. (2022) highlighted that using resistant cultivars is an effective strategy for controlling Fusarium wilt, a fungal disease. Similarly, Galian and Nagpala (2019), along with Masangcay and Galian (2018), as cited by Backian et al. (2020), reported that treating soils with *Trichoderma* and fungicide significantly delayed disease onset, prolonging the period before plant infection and reducing the soil population of Fusarium. This approach, when combined with the application of *Trichoderma* and BSU-compost along with clean planting materials, has been shown to enhance disease management. Furthermore, Lacaba et al. (2023b) noted that the application of phosphorus-

Figure 1

Sweetpotato Plants with Infected Fusarium Wilt (Ipomoea batatas) in Lagawa, Bauko, Mountain Province

containing fertilizer negatively affects the uniformity of sweetpotato tubers, whereas the use of muriate of potash and urea-containing fertilizer has been found to improve tuber size and weight, indicating that phosphorus may not be essential during the bulking period of sweetpotato production.

Before this assessment, there were studies on soil amendment in managing fusarium wilt and screening local cultivars for resistance to the disease conducted in Bauko, Mountain Province. This was in response to the issue of the incidence of sweetpotato fusarium wilt which was reported to devastate sweetpotato crop in the area in 2014.

From July 2016 to June 2017, about 76,824 pcs of quality planting materials (vine cuttings) were dispersed by the NPRCRTC as a quick response initiative, and from this, a simple nursery of different cultivars was sustained by the Bauko-LGU and at the same time became the community nursery in the locality established to cater to more households and other stakeholders. Thus, this impact assessment was conducted due to the remarkable impacts of studies conducted in Bauko, Mountain Province that the LGU fortunately sustained and currently the community was able to revive the sweetpotato industry and has regained the abundance of sweetpotato as their cultural commodity in the municipality.

In this study, the survey was conducted: (1) to identify interventions applied by the local government in managing Fusarium wilt that revived the sweetpotato industry in Bauko, Mountain Province; and (2) to document and determine outcomes and economic impact of the tissue culture-derived cuttings dispersed by the Center from 2016 to 2017 as to productivity, Fusarium wilt management, and livelihood in selected barangay of Bauko, Mountain Province.

Methodology

Location and Duration

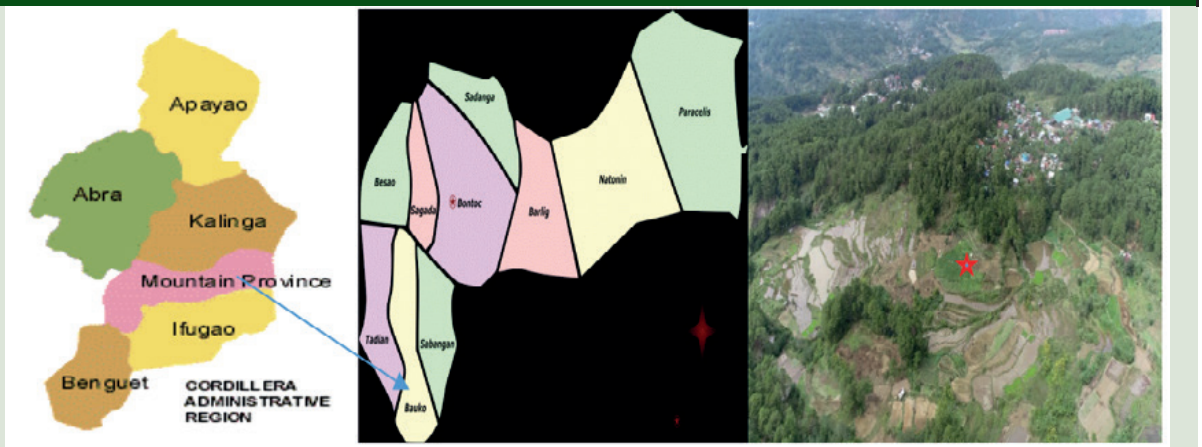
The survey for the evaluation of technology interventions in the management of sweetpotato Fusarium wilt was conducted in one of the major sweetpotato-producing barangays of Bauko from November to December 2021 (Figure 2). Lagawa is among the 22 barangays of Bauko, a fourth class municipality in the province of Mountain Province and presently engaged in the production and processing of sweetpotato thereby augmenting the family income of its members. Lagawa is situated at approximately 16.9552, 120.8878, in the island of Luzon. Elevation at these coordinates is estimated at 1,579.6 meters or 5,182.4 feet above mean sea level.

Selection of Site and Respondents

There were 200 beneficiaries from the 13 barangays of Bauko on the tissue culture-derived plant materials of sweetpotato distributed

Figure 2

The Location Map of the Project Site (Lagawa, Bauko, Mountain Province)



from 2016 to 2017 (Table 1). From the list, 16 beneficiaries were from Barangay Lagawa. Barangay Lagawa is among the 22 barangays of Bauko that produces and processes root crops, particularly sweetpotato. They process sweetpotato flour, wine, and other root crop-based food products in partnership with the Lagawa Credit Cooperative. Table 2 also shows the estimated production area and volume of sweetpotato in Bauko and that the barangay Lagawa produces the highest production (12,409kg) in the year 2020 with an area of 5,150sqm using the tissue culture-derived plant materials of sweetpotato. The barangay Lagawa was able to share and sell at least 26,900 cuttings of sweetpotato either for planting materials or as feeds for swine. Accordingly, the DSWD Cash-for-Work program, i.e., food security intervention (sweetpotato production) which was implemented in coordination and collaboration with LGU-Bauko was continuous or successfully implemented only in barangay Lagawa despite of the Covid-19. Thus, barangay Lagawa was selected as the site of the case study.

Table 1

Number of Beneficiaries of Tissue Culture-Derived Plant Materials of Sweetpotato in Bauko, Mountain Province

Barangay	No. of Beneficiaries
1. Otucan Norte	19
2. Balintaugan	11
3. Otucan Sur	21
4.Mayag	13
5. Poblacion	10
6. Guinzadan Norte	9
7. Guinzadan Central	11
8. Bagnen Oriente	19
9. Leseb	25
10 Guinzadan Sur	13
11. Abatan	8
12. Bila	24
13. Lagawa	16
Total	200

Data Gathering and Procedure Methods

The study used a combination of quantitative and qualitative methods (questionnaires and group interviews). The respondents were whom the intervention was directly affected and some non-beneficiaries, with a total of 42 respondents using questionnaire as guide in the interview and discussions (Table 3). This is to determine the current level of respondents' profile, the current state of the fusarium wilt on their crop, along with the level of knowledge that sweetpotato growers had on management practices to overcome fusarium wilt. Respondents were selected based from the list and recommendation of the OMAG-Bauko staff who is assigned in the community. After the group interview and discussions, a field visits and photo documentation of the sweetpotato area was done with some respondents/farmers (Figure 3).

Profile of the Respondents

The majority of the respondents were composed mainly of women (98%). They belong to ages 30-59 years old and 79% of them were married with household size of 5-8 (52%). Educational attainment from elementary to college level were distributed, however 8 or 19% had no answer. Most regarded themselves either as farmers (48%) or housewives (41%). The rest were employed/self-employed (2-5%). Table 4 presents the profile of the respondents.

Sixty-two percent of the respondents derived their family income from farming and 29% from salary/wages. There were 36% claimed they owned the lots they were planting to sweetpotato – the lots had areas of 500 sqm and below (36%). These sweetpotato mostly grown in the rice field (69%).

About 53% of these sweetpotato growers were growing sweetpotato for 1 to 5 years and 21% for 6-10 years and 12% of them growing the crop for 21 years or more. This indicates that these group have started growing sweetpotato in their childhood or teens. The majority (33%) were not a member of any associations or organizations. However, there are at least 24% were member of the Lagawa Credit Cooperative and other organizations (21%).

Data Analysis

Descriptive analysis was used to assess the

Table 2

Sweetpotato Produciton and Areas, and Volume in Bauko, Mountain Province

Barangay	Production Area (ha)			Production Volume (mt)		
	2018	2019	2020	2018	2019	2020
1. Abatan	0	1,365	1,365	0	495	495
2. Balintaugan	0	2,940	2,940	0	1,976	1,976
3. Bagnen Oriente	2,200	5,100	5,100	680	3,443	9,443
4.Banao	2,600	0	0	257	0	0
5. Bila	5,000	6,280	6,280	1,519	1,968	1,968
6. Guinzadan Central	1,045	1,940	1,940	895	820	820
7. Guinzadan Norte	1,445	1,875	1,875	1,010	10,675	10,675
8. Guinzadan Sur	1,300	3,340	3,340	1.070	4,331	4,331
9. Mayag	3,500	1,366	1,366	875	460	460
10 Lagawa	**2,360**	**5,150**	**5,150**	**1,359**	**2,409**	**12,409**
11. Leseb	9,600	1,365	1,365	2,125	1,871	1,871
12. Otucan Norte	2,400	1,850	1,850	752	1,104	1,104
13. Otucan Sur	2,600	4,200	4,200	608	3,233	3,233
14. Poblacion	2,400	1,220	1,220	447	1,474	1,474
15. Sadsadan	1,420	0	0	0	0	0
Total	**3,787**	**3,799**	**3,799**	**11,657**	**34,260**	**50,259**

Table 3

Number of Respondents by Sitio of Barangay Lagawa

Barangay/Sitio	Number	Percentage
Proper Lagawa	24	57
Lao-ingan	7	17
Adadugan	4	9
Coputan	2	5
Pamungayan	2	5
Atey	2	5
Central	2	2
Total	42	100

economic impacts of the interventions applied by the local government in managing Fusarium wilt. A structured interview schedule was used as a tool for data collection. The data collected were summarized using Excel Software and the descriptive statistics comprised the use of frequency distribution tables, and percentages. In addition, this study was also to follow-up project and to evaluate the activities over a 4 year-period (2016-2020). Three categories of impacts were evaluated (1) interventions applied by the local government in managing Fusarium wilt that revived the sweetpotato industry in Bauko, Mountain Province; (2) Adoption and impact of the technologies developed; and (3) Impact of the Fusarium wilt on farmers' knowledge, skills, production practices, and social relations in the community.

Results and Discussion

Impact of Technology Interventions

The LGU-Bauko, Mountain Province has prioritized bringing back the glamour of sweetpotato crop in the area. This persistent

Table 4

Profile of the Respondents of Clean Sweetpotato Planting Materials in Lagawa, Bauko, Mountain Province

Socio-Economic Characteristics	n=42 f	%
Age		
Below 30 years old	4	9
30-59 years old	24	57
60 and above	12	29
No answer	2	5
Gender		
Male	1	2
Female	41	98
Civil Status		
Married	33	79
Single	1	2
Widow/Widower	1	2
No answer	7	17
Educational Attainment		
Elementary level/graduate	4	9
High school level/ graduate	20	48
College level/graduate	10	24
No answer	8	19
Household Size		
4 and below	11	26
5-8	22	52
Greater than 8	3	7
No answer	6	14
Occupation*		
Farmer	20	48
Housewife	17	41
Business woman/man	1	2
Employed	1	2
Self-employed	2	5
Others	1	
Farm size		
500sqm and below	27	64
500-1000 sqm	2	5
1000 sqm-0.5 ha	6	14
0.5-1 ha	2	5
No answer	5	12
Ownership		
Own	15	36
Lease	9	21
No answer	18	43
Years in SP Farming		
1 to 5	22	53
6 to 10	9	21
16 to 20	1	2
21 and above	5	12
No answer	5	12
Household livelihood Source		
Salary/wages	12	29
Farming	26	62
Business	1	2
Others	1	2
No answer	2	5
Area Planted to SP*		
Backyard	3	7
Rice field	29	69
Garden	6	14
Kaingin	4	10
Family engaged in SP*		
Spouse	9	21
Children (male/female)	20	48
None	13	31
Membership in Organization*		
Lagawa Credit Cooperative	10	24
Sweetpotato production organization	4	10
Other organization (specify)	9	21
None	14	33
No answer	5	12

Table 4 *Continuation...*

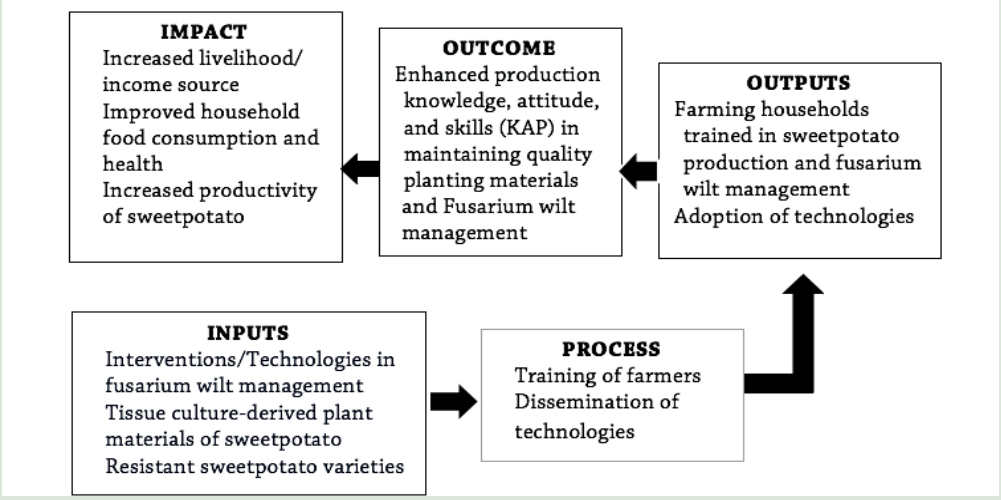
*multiple responses

Figure 3

Group Interview/Discussion and Field Visit in Lagawa, Bauko, Mt. Province

Figure 4

Conceptual Framework of the Study



attitude draws regular follow-ups by the municipal agricultural technicians to conduct the management experiment as a quick solution to address the problem. The interventions introduced and adopted/applied by the local government in managing the Fusarium wilt that revived the sweetpotato industry in Bauko, Mountain Province are discussed below.

Soil Application of Amendments and Bio-Pesticide

A participatory field trial using soil amendments and bio-pesticides like Trichoderma harzianum and organic fertilizer (lime + chicken/hog manure) to manage the fusarium wilt disease in sweetpotato was conducted in a farmer's field in barangay Otucan, Bila, Bauko. This barangay was known as infested with the disease, mainly due to its being identified as a major sweetpotato growing barangay. It was reported that the mean number of marketable storage root yields gave significant differences among treatments used, i.e., combined manures of chicken and hog recorded the highest yield. Both the use of lime and compost + Trichoderma showed comparable results. Plants not applied with any amendments gave the lowest number of marketable yields and the majority were non-marketable. Therefore, the soil nutrient elements made available in the application of

chicken manure in combination with hog manure may have likewise enhanced productivity. Likewise, Mustacisa-Lacaba (2023) cited that applying low-phosphorus fertilizer combined with organic fertilizer can increase sweetpotato yield by promoting tuber growth and improving soil fertility.

Evaluation of 10 Sweetpotato Entries for Resistance to the Disease, and Provision of Tissue Culture-Derived Plant Materials of Sweetpotato with Different Resistant Varieties

The NPRCRTC through LGU-Bauko distributed tissue culture-derived plant materials of sweetpotato with different varieties as initial planting materials of the community. Some of these quality planting materials were also planted in the demo farm as an alternative source of clean planting materials for the community

Disease resistance is always the most effective method of disease control. A resistant cultivar can change Fusarium wilt from being the most serious disease of sweetpotato to a disease of little economic significance. This scenario happened in Japan since the resistant cultivar USDA P.I. No. 153909 was selected (Centre for Agriculture and Biosciences International [CABI], 2017).

The 10 most preferred cultivars in the region were screened for resistance in infected farmer's field in Bila, Bauko, Mountain Province. Cuttings (tissue culture-derived) were planted in a single row and the incidence of Fusarium wilt was assessed at 4 months after planting and at harvest. Storage root yield was similarly monitored at 4 months old to determine whether the cultivar was short or late maturing.

It was reported that during the first three months, symptoms of the fusarium disease were observed only in two varieties, Immitlog and Bukagan. After 4 months, however, six of the 10 varieties were already diseased and only four varieties namely, 'Atok', 'Pakak', 'Gislayan', and 'Haponita' remained uninfected. However, after 6 months, all plants regardless of variety dried up due to Fusarium wilt with characterized symptoms as yellowing and wilting of leaves and blackening of the main stem and extending to all its laterals. The disease was aggravated by flood due to poor drainage in the area and the heavy rains that occurred during the 5th to 6th month period.

The 10 sweetpotato entries screened for tolerance to Fusarium wilt are the most preferred varieties grown by farmers in Cordillera. Variety Immitlog became popular elsewhere being an early-maturing variety, 'Swerte' (smooth and red skin, yellow flesh) was a favorite among households and staple in Kayapa, Nueva Vizcaya (Figure 5). Varieties 'Violet' and 'Pakak' are liked by most children because of the purple color and herbage are best for making sweetpotato juice drink. 'Haponita' variety is used in wine and sweets processing or as natural food colorant. Others became popular because of their diverse color and mealy boiled flesh and high marketability as well as nutritional value.

Farmers' Trainings on Organic Fertilizer and Sweetpotato Food Processing

There were various types of trainings were conducted and sponsored by BSU-NPRCRTC and other government units, specifically using sunflower with pig manure, Bio-pesticide preparation for the household, and farmers' training on processing and fermentation such as sweetpotato flour and wine making (Figure 6).

Figure 5

Sweetpotato Varieties

Based on the number of recipients-respondents who attended sweetpotato Fusarium wilt (SPFW)/ other training related to sweetpotato Fusarium wilt, the reach of the training is 75% (12/16) and tried and adopted the introduced interventions-Trichoderma 62% (26/42), training on organic fertilizer 29% (12/42), tissue-cultured derived planting materials 160% (67/42), and other intervention like through demo farm 2% (1/42). This means that the impact of the training dissemination is 169% (27/16) of the respondents (Table 5). This implies that the farmers are interested in improving their sweetpotato production and are willing to invest their time and effort to attend trainings that can serve to strengthen their farming system.

Figure 6

Trainings Attended by the Farmers

Technology Adoption

Majority of the respondents tried and adopted the Trichoderma (62%) and using organic fertilizer (29%) to manage the Fusarium wilt in their sweetpotato crop (Table 6). Tissue culture-derived plant materials and resistant cultivars of sweetpotato such as 'Swerte' (69%), 'Miracle' (52), and the local variety in the community which is the 'Tinapay' (24%) were the most adopted varieties that are resistant to Fusarium wilt. This indicates that these strategies to reduce the Fusarium wilt from infecting plants are shown to be effective. These management practices also reduce disease intensity and enhance sweetpotato productivity. Therefore, using tissue

Table 5

Number of Trainee-Respondents who Attended Fusarium Wilt Trainngs, Tried and Adopted Interventions

Sitio	Attended SP Fusarium wilt training	Tried and adopted Technology/ Interventions*			
		Trichoderma	*Organic Fert./ Trainings*	*Tissue cultured derived PM*	*Others (thru demo farm)*
Propee Lagawa	6	19	8	42	1
Lao-ingan	1	3		10	
Adadunga	1	-	-	-	-
Coputa	-	-	4	1	-
Pamungayan	2	2	-	6	-
Atey	2	2	-	6	-
Central	-	-	-	2	-
Total	12 (75%)	26 (62%)	12 (29%)	67 (160%)	1 (2%)
				106/4=27 (169%)	

culture-derived plant materials and resistant varieties has great potential for the management of diseases and pests in sweetpotato production.

The respondents also claimed that the reasons for trying the technology were that the vine cuttings planted and the varieties adopted were able to survive from fusarium wilt compared to their local varieties which are prone or susceptible to diseases. Using these interventions also produces a good yield of their sweetpotato crop. Accordingly, root yield is the final basis and herbage does not matter as long as the root yield is good. Lacaba et al., (2023) found that adopting new sweetpotato varieties and improved farming techniques has significantly increased yield per hectare. In addition, Tegen and Mohammed (2016) reported that sweetpotato farmers in Zimbabwe were able to achieved high economic returns per hectare base using tissue culture-derived planting material which is replaced every 3 years whereas growers using unimproved planting material made a loss. Another study by Esan et al. (2021) reported that application of compost and biofertilizer increase the weight of sweetpotato tuber and starch content of sweetpotato tubers because the application of compost mixture and biofertilizer supplied the essential nutrients to plants during the growth and development stages.

Table 6

Interventions or Technologies Dissemination and Adopted by the Respondents (n=42)

Technologies/ Interventions Adopted	Number	%
Trichoderma	26	62
Organic fertilizer (using sunflower with pig manure)	12	29
SP Varieties		
Miracle	22	52
Swerte	29	69
Tinapay	10	24
Taiwan	2	5
Salinganga	1	2
Kalbo-oy	2	5
Haponita	1	2
None	3	7

**Multiple response*

Changes in Knowledge/Experience in Management of Sweetpotato Fusarium Wilt

Changes in knowledge mostly refer to Fusarium wilt management, i.e. using tissue-culture-derived or clean planting materials (55%) and Trichoderma (29%) (Table 7). Using clean planting materials compared to farmers' planting materials was assessed by the respondents into four categories: which include, growing or yield performance, tolerance, and resistance from pests and diseases, storability, and marketability of root yield. Regarding to growth and yield performance, the respondents claimed to be productive or good yield especially if these were planted in good soil with good management. This could also be attributed to the high adaptability of the varieties introduced, good quality and age of cuttings planted. Tolerance and resistance to Fusarium wilt was also considered and this may be one of the reasons why the respondents adopted the technology or innovations introduced. In terms of the storability of the root yield, it was susceptible to dry rot (*mabiyo sipay madonot/mabko*) and cannot be stored for longer days. However, respondents claimed to have high marketable roots with good color and skin. It was a general observation that planting quality plant materials in infected fields was able to produce good yield but the infected vines were no longer suited for the following cropping. In a comparative study done on the effect of sweetpotato variety with the kind of plant material by Langoyan and Kiswa (2014) revealed that among the local varieties, 'Bengueta' produced the longest vine and heaviest herbage, while 'Immitlog', 'Bengueta' and 'Beniazuma' had the greatest number of storage roots. 'Immitlog' and 'Bengueta' gave the heaviest yield. Further, plants grown from tissue culture-derived stem cuttings consistently produced longer vines, heavier herbage, with numerous storage roots, heavier total and computed root yield, and highest return on cash expenses.

Changes in attitude and practices refer to increased or enhanced sweetpotato production (38%), and improved practices, i.e. crop rotation or practice the intercropping with other leafy vegetables and legumes, and transferring planting materials to other locations to avoid the occurrence of Fusarium wilt or another pest incidence (31%). Doing these practices may

Table 7

Changes in Knowledge, Attitude, Practices Toward Management of SPFW, Tissue-culture Derived Planting Materials and Resistant Varieties

Changes in KASP	Number	%
Using clean planting materials/ Change old variety to a new or resistant variety	23	55
Fusarium Wilt management-using Trichoderma	12	29
Learned to Sacrifice	2	5
Increased/Enhanced the SP production to increase income	16	38
Improved practice on crop rotation, transferring planting materials to other locations to avoid the occurence of Fusarium wilt, etc.	13	31
No answer	4	9
None	3	7

lead to minimize the fusarium wilt infestation. The added attitude of the respondent claimed that they learned to sacrifice in all aspects of sweetpotato cultivation practices especially in the management of Fusarium wilt.

Contributions of Tissue-Culture Derived Plant Materials

Tissue-culture-derived plant materials and resistant varieties contribute to households' food consumption and food supply (55%) and 48% of respondents claimed that cash income was used to pay for electric bills, cellphone load, and basic needs of the households. The respondents also claimed that using Tissue-culture-derived plant materials and resistant varieties contributed much to their health (38%) because they did not need to buy commercial bread, as well as a good alternative source of flour (Table 8). These interventions can potentially increase food security and income for farmers. Mutandwa (2008) reported that use of tissue-cultured planting materials lowered production costs by US$500-700 per hectare, specifically on labor, especially during weeding and sowing, accounted for the greatest proportion of cost. Moreover, tissue-cultured varieties met smallholder farmers' expectations, but these sweetpotatoes remained susceptible to nematode attack and the sweetpotato viral disease (SPVD). In addition, production costs per hectare were higher for tissue-cultured sweetpotatoes due to the higher number of days required to harvest and transport the crop to the market.

Tissue-cultured sweet potatoes were found to be profitable in Peru. According to Zuger (2003) as cited by Mutandwa (2008), sweet potato productivity in the country had been negatively affected by the incidence of diseases, which prompted research into new varieties. Use of tissue-cultured planting materials lowered production costs by US$500-700 per ha. Labor, especially during weeding and sowing, accounted for the greatest proportion of cost. Tissue-cultured varieties met smallholder farmers' expectations, but these sweet potatoes remained susceptible to nematode attack and the sweet potato viral disease (SPVD). In this study, production costs per hectare were higher for tissue-cultured sweet potatoes due to the higher number of days required to harvest and transport the Use of tissue-cultured sweet potato varieties in smallholder agriculture enhanced crop yields when compared to unimproved sweet potato varieties.

Table 8

Contributions of Tissue-Culture-Derived Planting Materials and Resistant Varieties to Household Needs of the Respondents

Household Needs	Number	%
Reduction in output cost of labor	15	36
Increase in input cost of labor	14	33
Cash income	20	48
Food consumption and food supply	23	55
Health	16	38
Others (less buying of commercial bread, source of flour, good market price of tubers)	12	29

Higher yields per hectare for tissue-cultured sweet potatoes contributed to the attainment of higher economic returns for farmers Use of tissue-cultured sweet potato varieties in smallholder agriculture enhanced crop yields when compared to unimproved sweetpotato varieties. Higher yields per hectare for tissue-cultured sweetpotatoes contributed to the attainment of higher economic returns for farmers Use of tissue-cultured sweet potato varieties in smallholder agriculture enhanced crop yields when compared to unimproved sweet potato varieties. Higher yields per hectare for tissue-cultured sweet potatoes contributed to the attainment of higher economic returns for farmer.

Conclusions

Sweetpotato growers in Lagawa, Bauko, Mountain Province still lacked sufficient knowledge about the disease and its management approaches, and limited access to disease-free planting materials to consistently support effective Fusarium wilt management practices. However, practical solutions applied with assistance from their Local Government Unit enabled them to sustain the crop productivity and eventually became a source of food security and part of their livelihood during the Pandemic.

The adoption and implementation of practices to reduce the incidence of Fusarium wilt on sweetpotato farming, such as the use of clean planting materials or resistant varieties, and organic fertilizer have been shown to increase productivity despite the presence of the disease. Therefore, the adoption of approaches to manage Fusarium wilt among sweetpotato growers has alleviated the Fusarium wilt in Lagawa, Bauko. Using these interventions also reduced the infection of Fusarium wilt on their crop, however, limited access to a reliable source of planting material to replenish succeeding cropping is still a challenge.

Recommendations

For sustainability, reliable sources of planting material and community-based nurseries in their locality needs to be established. However, soil analysis for soil borne Fusarium population must be assessed prior to establishment of new nurseries as well as sustain productive herbage production using local compost products and the Rapid Multiplication Technique (RMT).

Concurrent to this, the sweetpotato growers will undergo training/technical assistance to strengthen their capability in maintaining the quality of the plants as well as assistance in managing Fusarium wilt and other major pests of sweetpotato.

Thus, a follow-up proposal was conceptualized to answer issues raised in previous collaborative projects. This project proposal aims to enhance the role of sweetpotato and other root and tuber crops as a key food and cash crop for livelihood in farming communities through the adopt-a barangay project in Lagawa, Bauko, Mountain Province.

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