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Status of Introduced Potato Varieties in Benguet and Mountain Province, Philippines

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Abstract

Benguet and Mountain Province are recipients of several potato variety introductions since the 1970s due to its favorable climate to highland crop production. Farmers save planting materials year by year through traditional practices, which led to accumulation of diseases, degeneration, and eventually, loss of varieties. Other reasons for loss of varieties are unavailability of plant materials, susceptibility to diseases, particularly wilts and rots, vulnerability to abiotic stress, and introduction of new varieties. Out of 40 varieties introduced, only 15 varieties are presently cultivated. Only five of these cultivated varieties are most preferred by farmers, namely: Granola, Igorota, Mexican, Fina, and Cosima. However, Fina and Cosima are limited in production due to the unavailability of planting materials. These were among the eight varieties retrieved from growers and now regenerated, conserved and presently being multiplied at Benguet State University – Northern Philippines Root Crops Research and Training Center (BSU-NPRCRTC) germplasm gene bank for verification and re-introduction.

KEYWORDS

Indigenous
loss varieties
variety adoption
conservation

Introduction

The Cordillera Administrative Region (CAR) produced 99,981MT or 85.61% of the country's production of potatoes recorded at 116,783MT as of 2016 (Philippine Statistics Authority [PSA], 2017). The aforesaid is lower than previous production estimates of about 295,000MT produced from 10,964 crop hectares annually by about 30,000 farmers in Benguet and Mountain Province (A. Balanoy, personal communication, 2019) and the latest from Benguet Province at 210,613.79MT from 11,006.74 crop hectares (Office of Provincial Agriculture [OPAG], 2014).

The cultivation of potato in Luzon, Philippines, documented by Camel (1704) as cited by Potts et al. (1983), implies the introduction of potato before the year 1700 possibly from parts of Peru or Mexico because of the term `papas' similar to the Ibaloi and Kankana-ey local name for potato 'pafas' or 'patatas'. Don Blas de Baños, the second Spanish governor of Benguet was attributed with distributing a few potatoes to some Igorots who grew them so well in Benguet after 1846 (Semper, 1862 as cited by Potts, 2003). The same author explained that these introduced varieties replaced the two native potatoes known at that time: the first with tall luxurious foliage, few elongated irregular tubers, white skin, deep eyes, and sweet flavored yellow waxy flesh, and the second with tall luxurious foliage, long, maturity, and small round white-skinned and also with sweet flavored yellow waxy flesh. From these early introductions, many more successive importations of cultivars followed.

The fast turn-over of varieties as a consequence of industry demand for processed potatoes by fast food chains and snack food companies, the fast degeneration of varieties because of diseases, the lack of quality seeds and the role of potato as a principal source of cash income in vegetable farming are putting pressure on the indigenous people's food self-sufficiency and the loss of previously planted potato varieties. Thus, this research aims to update information on varieties grown (introduced and locally bred), and identify disappearing and valuable varieties that can still be saved and regenerated.

Methodology

Site Description

The major potato production areas in the Philippines are concentrated in elevations ranging from 800-2800 masl particularly in Benguet and Mountain Province with a temperature range average of 16-21ºC, a condition suitable for growth and development of potatoes. The major potato producing municipalities of Benguet Province are Atok, Bakun, Buguias, Kibungan, and Mankayan; and Bauko in Mountain Province.

Data Gathering

A structured questionnaire was prepared as guide in determining the status of the varieties introduced for the respondents. Data gathering was done through key informant interviews and focus group discussions. Key informants are individuals who are potato farmers with a particular knowledge on farming in Benguet and Mountain Province. Other individual farmers interviewed were walk-in visitors of the BSU-NPRCRTC coming to request or avail of the quality plant materials produced or seek technical consultation. Focus group discussions were pre-arranged and simultaneously done during trainings and meetings conducted under the potato seed production project of the BSU-NPRCRTC. Secondary data were taken from the review of literatures and data gathered from the different DA-LGU offices.

Respondents

From the 155 respondents (88 males and 67 females), majority were from Benguet and Mountain Province because these are the major provinces that produce potato in CAR and in the country as a whole. These respondents are composed of Indigenous Peoples Kankana-ey and Ibalois of Benguet, and Applais of Mountain Province. The age-group were divided into seven categories (Table 1). The youngest participant is 15 and the oldest is 77 years old. Seventy-eight percent of the respondents have ages ranging from 33 to 59. Moreover, they belong to legitimate associations that had undergone participatory training on potato seed production in BSU.

Forty-one percent of the respondents are high school graduates, 39% are college graduates and 20% are elementary graduates (Table 2).

Thirty-eight and 28% of them had 11 to 20 and 1 to 10 years of farming experience while 15% had 31 or more years of farming experience (Table 3).

Table 1

Age Group and Gender of Respondents

Age Group	Male	Female	Total no. of Respondents	% (n=155)
69-77	2	0	2	1
60-68	6	5	11	7
51-59	17	23	40	26
42-50	28	21	49	32
33-41	18	13	31	20
24-32	15	3	18	12
15-23	2	2	4	3
Total	**88**	**67**	**155**	**101**

Table 2

Highest Educational Attainment

Levels	no. of respondents	% (n=155)
Elementary	31	20
High school	63	41
College	61	39

Table 3

Farming Experience

Years of Farming	no. of respondents	% (n=155)
1 to 10	44	28
11 to 20	59	38
21 to 30	28	18
31 or more	24	15

Data Analysis

Data gathered were encoded using Microsoft Excel to facilitate the calculation of descriptive statistics, such as means, frequency and percentage distribution, and minimum and maximum values. Preferred traits and variety preferred were cross-tabulated. The qualitative data were analyzed through categorization and content analysis and presented in tables and graphs accordingly.

Results

Unknown and Known Potato Varieties

There were 40 potato varieties listed that were introduced in Benguet and Mountain Province. Four varieties; Native, Japanese White, Japanese Pink, and Columbus, that were cultivated and introduced in the 1700 to 1950s are totally not known by the farmers' today. Twenty-four of the varieties introduced from 1960's to 2015 are not known by 61 to 96 % of the respondents. The eight varieties known by majority 55% to 88% of the respondents (Table 4) include the Red Pontiac, Solibao, Raniag, Greta, Ganza, Connect, Montañosa, and Mexican. The all known variety is Granola, while 97% of the respondents know the variety Igorota.

Varieties Presently Grown and Extent of Production

There are 15 varieties presently grown in Benguet and Mountain Province. The top varieties grown by farmer-respondents were Granola (91% of farmers), Igorota or PO3 (88%), Mexican (53%), Raniag (33%), PO4 or Solibao (16%), Fina (16%), Greta (15%), Montanosa (11%), and Ganza (13%) as shown in Table 5.

On the extent of production, the >500 m^2 is considered a wide area while <500 m^2 cultivated is considered narrow in cultivation. Igorota and Granola are grown on wide areas by 60 to 65% of the farmer-respondents. Only 26 to 28% of the total respondents grew these varieties in small farm areas. Mexican variety is grown in wide areas by 37% respondents. There were more farmers who grow the varieties of Raniag, Greta, Fina, and Ganza in smaller areas. For the varieties Conchita, Baraka, Connect, Bengueta, and Red Pontiac, only one to three percent of the respondents grew in large areas. (Table 5).

Reasons for Not Keeping the Varieties

There were 13 reasons enumerated by the respondents for not conserving the variety or loss of the variety. Table 6 shows that the five main reasons of not keeping the potato varieties were: quality degradation of the plant materials, no available source of plant materials, susceptible to diseases especially bacterial wilt, all marketed in the trading post due to high price, easily rots, bad weather condition and introduction of new varieties. Other reasons for losing the varieties were short dormancy, shifted to other crops, not marketable, not adopted/suited to the area, and not good for all seasons.

Preferred Traits and Variety Preferred

Cross-tabulation was done to verify results between the traits preferred and varieties preferred by the respondents (Table 7). The varieties preferred were Granola, Igorota, Mexican, Cosima, and Fina while the traits preferred were round to oval tubers with yellowish/cream skin color, early maturing (70-80 DAP), medium growth, tolerance to abiotic stress, pest resistance, and high yielding. Granola, Fina, and Cosima were early maturing

Table 4

Unknown and Known Potato Varieties Introduced but Not Grown by Farmers in Benguet and Mountain Province

	Year Introduced	Potato Varietes	% of Farmers (n=55)	
			Unknown	Known but not Grown
1	1700-1900	Native varieties	100	0
2	1950's	Japanese white	100	0
3		Japanese pink	100	0
4		Columbus	100	0
5	1960's	Conchita	68	11
6		Greta	27	28
7	1970's	Cosima	61	15
8		Red Pontiac	37	30
9	1980's	Alpha	94	5
10		Isola	86	6
11		Fina	45	13
12		Granola	12	18
13		Mexican	0	10
14	1989	Agria	91	6
15		Dalisay	90	5
16		Kennebec	88	6
17		Univita	84	7
18		Sante/Smite	82	9
19		Baraka	79	6
20		Berolina	75	16
21		Montañosa	63	17
22	1996	Solibao/PO	31	23
23		Igorota/PO3	3	7
24	2000's	Farmer	96	3
25		Ceasar	95	4
26		Dejima	95	3
27		Recolta	95	4
28		Remarka	95	4
29		Signal	95	3
30		Franzi	94	4
31		Idaho	92	3
32		Gineke	81	7
33		Raniag	28	30
34	2004	Ganza	25	21
35	2007	Gloria	79	15
36		Bengueta	36	16

Table 4 continuation ...

	Year Introduced	Potato Varietes	% of Farmers (n=55)	
			Unknown	Known but not Grown
37	2015	Calwhite	96	4
38		Canestoga	95	5
39		Cherokee	95	5
40		Connect	72	17

Table 5

Extent of Production of Presently Grown Potato Varieties in Benguet and Mountain Province

Varieties	Extent of Production (%) (n=155)		
	>500 m²	<500 m²	Total
Granola	65	26	91
Igorota/ P03	60	28	88
Mexican	37	16	53
Raniag	10	23	33
Fina	6	10	16
Solibao/P04	6	10	16
Greta	5	10	15
Ganza	3	10	13
Montañosa	3	8	11
Cosima	4	4	8
Baraka	1	6	7
Bengueta	3	2	5
Connect	3	1	4
Red Pontiac	1	3	4
Conchita	1	1	2

Table 6

Respondents Reasons for Not Keeping the Variety/ies

Reasons for not keeping the varieties	% (n =155)
Degradation of the quality of plant materials/decreases in yield	49
No available quality seed tuber	45
Susceptible to diseases	42
It was all sold to the market during high buying price	41
Due to introduction of new varieties	23
Easily rots during storage	23
Lost planting materials due to typhoons/ bad weather conditions	23
Low yielding	21
Difficulty to dispose in the market due to undiserable shapes	16
Low shelf life/ sprouts easily/short dormancy	15
Shifted to other crops	15
Not suitable in the area	6
Not good for all season	3

varieties, medium growth varieties and resistant to scab and virus, while Igorota and Mexican are tall, long maturing but resistant to late blight, leaf miner and root-knot nematode and also more tolerant to abiotic stresses such as drought, frost, and typhoon. Moreover, all the preferred varieties had round to oval tubers with yellowish/cream skin color and high yielding. This analysis shows that each variety does not meet all preferred traits, which is why farmers prefer more than one variety.

Collection, Regeneration, and Conservation of Varieties Preferred by Farmers

Two (Cosima and Fina) of the five varieties are now collected as the others were already in the BSU-NPRCRTC germplasm gene bank. It was cleaned, regenerated, and conserved in the tissue culture laboratory, and is multiplied in the greenhouse for characterization, field verification, and evaluation before making it available to the farmer.

Table 7

Cross Tabulate Between Preferred Traits and Variety Preferred

Preferred traits for potato varieties	Preferred Potato varieties				
	Granola	Igorota	Mexican	Cosima	Fina
Round to oval tubers	√	√	√	√	√
Yellowish/cream skin color	yellow	cream	yellow	yellow	yellow
Early Maturing (70-80 DAP)	70-80	100-120	100-120	70-80	70-80
Medium growth	√	X	X	√	√
Environmental Advantage	Not sensitive to long days	Drought, frost, typhoon tolerant	Drought, frost tolerant	-	Not sensitive to long days
Pest Resistance	Virus, Common scab	LB, Leafminer, RKN	LB, Scab, Virus	Scab, Virus	Scab, virus
High Yielding (≥ 18 tons per/ha ave.)	21-30	25-35	25-35	25-30	25-30

Discussion

Potato industry is booming in the Philippines and the demand for potatoes is high, thus, the need for continuous introduction of new varieties. Updating information on varieties grown is needed to identify potential varieties, which are disappearing and valuable but can still be saved and regenerated.

Based on the results, most of the respondents don't know the introduced varieties, or they know, but didn't grow them. This result could be because most of the respondents were young and high school or college graduates who may have shorter farming experiences, especially growing potatoes. Although some respondents mentioned that their parents grew some of the past varieties, they somehow lost them for reasons discussed later in this paper.

Only 15 varieties are presently grown in Benguet and Mountain Province, and three out of these (Granola, Igorota, and Mexican) are widely grown. In 1980, Fina, Cosima, and Greta were the varieties grown by farmers (Potts et al., 1983). In 1996, Granola was the variety grown by 95% of farmers in Atok and Buguias, followed by BSU PO3, also known as LBR1-5, then renamed Igorota (33%), Sante or Smite (11%), Dalisay (10%), and Solibao (5%) and very few of Agria, Univita, Dalisay, Atlantic, and Famosa. With a follow-up survey in 2004 in Benguet and Mountain Province (Gayao et al., 2006), Igorota (78%) and Granola (72%) were the predominantly grown varieties, followed by Solibao (25%) and Raniag (19%). Other varieties mentioned were Montañosa, Hermes, Sante, Agria, and Kennebec. Igorota, Solibao, and Raniag resulted from the local selection of CIP clones and approved by NSIC in 1997 and 2000. Furthermore, in 2010 it was reported that the most widely appreciated potato variety in the Philippines is Granola. A seed potato import that was date back in 1983 and the degeneration rate is very low. On the other hand, Igorota, a variety bred by the Benguet State University, has a high dry matter content rendering it suitable for processing placed on the National list (Wustman et al., 2010). Gonzales et al. (2016) also confirmed that the main potato varieties grown in the Philippines are Granola for table and Igorota for processing. Granola is well known for being not easily degenerated and short maturing, while Igorota is planted by many farmers because of high yield and resistance to late blight and tolerant to leaf miners.

Regarding the loss of other varieties, many reasons were mentioned by the respondents ranking degeneration as the main, followed by the unavailability of clean planting

materials and susceptibility to diseases. Most farmers keep their seed for two to five or more seasons without replacement and this continual use of potato seed from informal sources promotes the spread of seed-borne diseases mainly bacterial wilt (Kinyua et al., 2001) and viruses (Kakuhenzire et al., 2000) as cited by Namugga et al. (2017). The unavailability of clean plant materials may be attributed to limited production since only BSU-NPRCRTC is producing clean potato plant materials in CAR; therefore, the Center cannot supply the bulk demand of farmers for clean seeds. Although some trained farmers adopted Rapid Multiplication Technique and were multiplying tissue-cultured planting materials acquired from the Center, they are just producing enough for their own farms.

Sixty percent of the respondents rank tolerance to biotic stress as the most preferred trait. Ranks 2 to 5 were agronomic traits such as early maturing (70 to 80 days), high yielding, rounded shape, and yellowish-cream skin color. Respondents cited that these preferred traits would help lessen their production costs. Tolerance to biotic stress (pest) and early maturing varieties would reduce their frequency for applying chemicals and the amount of chemicals applied. Moreover, in the local fresh potato market, farmers repetitively mentioned that yellowish, cream, or whitish skin color and roundish and round to oval-shaped potatoes are the consumer's preference. These attributes resemble all the five potato varieties preferred by the farmers. These fresh market's aforementioned qualities also influence the preference of the farmers to prefer or kept a variety. This suggests that more research is needed to what varieties to introduce or develop varieties. Hence, consumer's variety preference should also be surveyed as reference in introducing/developing a variety. This result corresponds to the findings of Namugga et al. (2017) in South Africa wherein high yield, resistance to late blight, early maturity and marketability were the most preferred attributes in new varieties. In addition, further screening of new potato varieties is recommended based on the following traits: - bacterial wilt (BW) tolerance - high yield - yellow-flesh color/yellow skin color/ shallow eyes - a high dry matter concentration (> 22 %) (requirement of chips industry) - good frying quality/low reducing sugar content (requirement of chips industry). For the fresh potato market, only the first three traits mentioned above are relevant. For the chips industry, the color of the skin and flesh are less important. Dual-purpose varieties (being suitable for both the fresh market and the chips industry) may be preferred, as it gives farmers the flexibility to market the same potatoes through different channels. It was mentioned that variety screening should be done not only at common research sites, but also under typical farmer conditions at higher altitudes (Wustman et al., 2010).

With these mentioned character traits preferred, five potato varieties were enumerated as most preferred, namely: Granola, Igorota, Mexican, Cosima, and Fina. However, Cosima, and Fina are limited in production due to unavailability of plant materials. It was also found out that Granola and Mexican were mostly grown in the lower and mid-elevation, while Igorota was most likely grown in mid and higher elevation like Atok, Bauko, and Kibungan. The farmers claimed that Igorota were susceptible to scab in lower elevations while Granola was also susceptible to late blight in higher elevation, where it was usually foggy and cloudy. Nevertheless, these five varieties resemble all the traits preferred by the farmers in Benguet and Mt. Province. Most farmers choose more than one variety as one variety rarely meets all needs. This result confirms the findings of Mulatu and Zelleke (2002) and Kolech et al. (2015a), as cited by Kolech et al. (2017), that it is impossible to find one variety that fulfills all of the characteristics farmers want; therefore, availability of varieties with different suites of traits allows them to satisfy their multiple needs.

Due to these findings, the researchers collected samples from farmers who have remaining planting materials of being lost preferred varieties like Fina and Cosima, and regenerated them in the tissue culture laboratory for conservation and multiplication. However, although the BSU-NPRCRTC is already multiplying these varieties, they need to be evaluated and characterized in the field to determine if these are true-to-type to those varieties before making it available to the farmer.

The introduction of newly developed varieties for a specific agroecological zone is good. Still, it is much better to improve, regenerate, and save potato varieties already widely adopted to the region. Using clean planting materials from tissue culture is not only one way to improve potato production but it also helps to prevent the loss of potential varieties.

Conclusions

Based on the results, the conservation of true-to-type varieties through germplasm genebank in the tissue culture laboratory should be actively supported to safely conserve the preferred varieties that are threatened. In addition, the use of clean planting materials need to be promoted to increase productivity and income.

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