BIBLIOGRAPHY

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ABSTRACT

Eleven potato cultivars, two resistant check varieties and one susceptible variety were evaluated at Minac, Ballay, Kabayan, Benguet.

The study aimed to screen cultivars for resistance to late blight during dry season and to evaluate cultivars for yield and chipping qualities. Laboratory work was done at the Plant Pathology Laboratory and at the Northern Philippines Roots Crops Research and Training Center in Benguet State University (NPRCRTC-BSU).

Among the cultivars evaluated, MEVA, TPS-7 and Granola were observed to have a fair or normal crop stand while other entries had plant vigor ranging from good and vigorous to excellent and extra vigorous.

Based on the late blight infection ratings, varieties Granola and MS 35.9 were observed to be the most susceptible to potato late blight and were categorized as moderately susceptible to susceptible. Tubira, Baseko, TPS-7, Muziranzara, MEVA, Solibao, and Igorota were classified as moderately resistant varieties whereas Precodepa and Gikungo were highly resistant. The highest marketable yield was obtained from Gikungo while the highest non-marketable was obtained from Muziranzara.

The lowest dry matter content was obtained from variety Tubira while Muziranzara had the highest dry matter content.

In the sensory evaluation, chips from Solibao and Igorota varieties were liked very much because chips were crunchy, and were moderately oily to oily.

RESULTS AND DISCUSSION

Plant vigor / Crop stand

The crop stand or plant vigor was evaluated 45 days after planting. Results indicated that among the entries, Granola had a fair, normal crop stand which was not significantly different from the crop stand of TPS-7 and MEVA. The cultivars Muziranzara, Precodepa, MS 35.9 and Solibao were categorized as fair, normal to good vigor which was not significantly different from the crop stand of Baseko, (Table 1). Further, crop stand of Tubira, Igorota, and Gikungo were categorized as vigorous or good vigor to excellent or extra vigorous were not significantly different.

Table 1. Plant vigor at 45days after planting

VARIETY/CLONES	MEAN
MS 35.9	2.7^{bc}
Tubira	2^{cd}
Baseko	2.3^{bcd}
TPS-7	3^{ab}
Gikungo	1.7^{d}
MEVA	3^{ab}
Muziranzara	2.7^{bc}
Precodepa	2.7^{bc}
Igorota	2^{cd}
Solibao	2.7^{bc}
Granola	3.7^{a}
C.V. (%)	8.77%

Means with the same letter are not significantly different at 5% level of DMRT.

Vigor is affected primarily by the inherent characteristics, secondly by the environment including irrigation or moisture where the crop is grown (OSU, 1997).

Weekly Assessment of Late blight Infection

Recording of weekly late blight infection ratings was started 42 days after planting. In the first assessment, (42 DAP), all the plants were infected with late blight but with minimal spots except for MS 35.9, Precodepa and Granola which had more than ten spots per plant. At the second week of infection ratings, most of the plant had 1% infection or about 10 spots per plant. Only the variety Granola and MS 35.9 had 25% infection or 50 spots of blight.

Table 2. Mean weekly late blight infection and computed AUDPC

Days after planting	42	49	56	63	70	77	AUDPC
MS 35.9	1.00	5.00	11.00	33.33	98.33	100.00	1,387.12
Tubira	0.40	1.00	2.33	18.33	95.00	100.00	1,168.02
Baseko	0.40	1.00	1.00	18.33	98.33	100.00	1,182.02
TPS-7	0.40	1.00	1.00	43.33	98.33	100.00	1,357.02
Gikungo	0.10	0.10	0.10	5.00	75.00	100.00	911.75
MEVA	0.40	2.03	8.70	33.33	90.00	100.00	1,289.82
Muziranzara	0.40	1.00	1.00	5.00	58.33	98.33	802.87
Precodepa	1.00	1.00	2.33	5.00	66.67	100.00	878.50
Igorota	0.70	1.00	2.33	5.00	66.67	98.33	871.61
Solibao	0.70	1.00	0.70	11.67	75.00	98.33	965.20
Granola	9.17	18.33	35.00	81.67	98.33	100.00	2,015.02

At 56, 63 until 70 DAP, the infection continued to increase as shown in Figure 3-13. This was caused by the long rainy days which enhanced the multiplication of spores. Computed of the Area under the Disease Progress Curve (AUDPC) showed that Granola had the highest AUDPC at 2,015.02 and the lowest from Muziranzara (802.87), Igorota (871.61), Precodepa (878.50), Gikungo (911.75) and Solibao (965.20).The higher the AUDPC, the more susceptible the variety. In the last week of rating (77 DAP), almost all of the plants were 100% infected by blight, where all of the leaves and stems were dead.

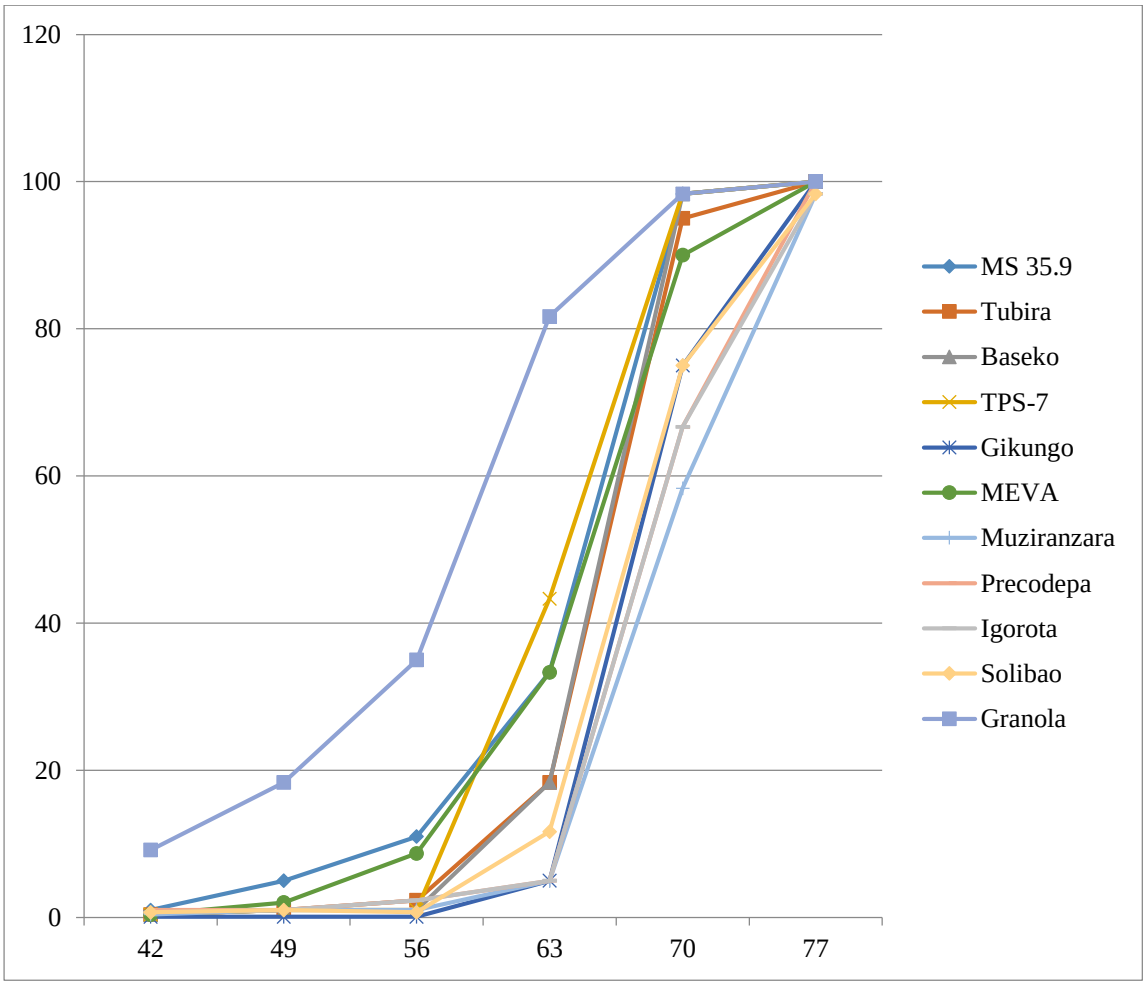

Figure 2. Weekly assessment of Late blight Infection

Varietal Reaction

At 30 DAP, most of the varieties were observed to be moderately resistant except for the Gikungo and Precodepa which were rated as highly resistant. However, Granola was observed to be moderately susceptible and MS 35.9 was susceptible, (Table 3).

Table 3. Varietal reaction of potato cultivars against late blight (*Phytophthora infestans*)

TREATMENT	DESCRIPTION	% INFECTION	SCALE
MS 35.9	Susceptible	41-60%	3
Tubira	Moderately Resistant	20-40%	2
Baseko	Moderately Resistant	20-40%	2
TPS-7	Moderately Resistant	20-40%	2
Gikungo	Highly Resistant	1-20%	1
MEVA	Moderately Resistant	20-40%	2
Muziranzara	Moderately Resistant	20-40%	2
Precodepa	Highly Resistant	1-20%	1
Igorota	Moderately Resistant	20-40%	2
Solibao	Moderately Resistant	20-40%	2
Granola	Moderately Susceptible	61-80%	4

Figure 3. Symptoms of late blight infection on clone MS 35.9 (56, 63, 70 DAP)

Figure 4. Symptoms of leaf blight infection on clone Tubira (56, 63, 70 DAP)

Figure 5. Symptoms of leaf blight infection on clone Baseko (56, 63, 70 DAP)

Figure 6. Symptoms of leaf blight infection on clone TPS-7 (56, 63, 70 DAP)

Figure 7. Symptoms of leaf blight infection on clone Gikungo (56 DAP)

Figure 8. Symptoms of leaf blight infection on clone MEVA (56, 63, 70 DAP)

Figure 9. Symptoms of late blight infection on clone Muziranzara (56, 63, 70 DAP)

Figure 10. Symptoms of leaf blight infection on clone Precodepa (56, 63, 70 DAP)

Figure 11. Symptoms of leaf blight infection on clone Igorota (56, 63, 70 DAP)

Figure 12. Symptoms of leaf blight infection on clone Solibao (56, 63, 70 DAP)

Figure 13. Symptoms of leaf blight infection on clone Granola (56, 63, 70 DAP)

Yield Parameters of Marketable
According to Size, Non-marketable

There were significant differences on the weight of the marketable and non-marketable tubers. The data revealed that there were more non-marketable tubers than the marketable tubers, (Table 4& 5).The low marketable yield was due to the high mortality at an early stage (77 DAP) which was due to early the infection of late blight which appeared at the early tuber bulking stage affecting the size of harvested tubers. In addition, tubers were infected by soilborne diseases like bacterial wilt and scab. In the extra large and small size weight, only few of the potato had produced it. However, in terms of big size weight almost all of the entries had produced it except for the Granola primarily because it was the first one which was infected by the blight and it has the highest rating of blight. Late blight remains a serious threat to potato production causing significant yield and economic losses to farmers (Lungaho et. al, 1998). Gikungo and Igorota had the heaviest weight followed by Precodepa, Solibao, Tubira, Baseko, TPS-7, MS 35.9 Muziranzara, MEVA and Granola

which had no yield. Moreover, in the non-marketable yield, the Muziranzara and Baseko had the heaviest weight following Gikungo, MEVA, Igorota, Precodepa, Tubira MS 35.9, Solibao, and TPS-7.

Table 4.Marketable yield tons per hectare

TREATMENT	MARKETABLE YIELD			tons/ha
	Extra large	Big	Small	
MS 35.9	0.00[b]	266.70[c]	53.33[a]	0.57[cd]
Tubira	0.00[b]	808.33[bc]	0.00[a]	1.50[cd]
Baseko	0.00[b]	700.00[bc]	26.70[a]	1.30[cd]
TPS-7	66.67[b]	350.00[c]	53.33[a]	0.84[cd]
Gikungo	133.33[b]	1,983.33[a]	120.00[a]	3.99[a]
MEVA	0.00[b]	156.70[c]	0.00[a]	0.27[d]
Muziranzara	0.00[b]	116.70[c]	150.00[a]	0.48[cd]
Precodepa	116.67[b]	950.00[bc]	170.00[a]	2.20[bc]
Igorota	353.33[a]	1,566.70[ab]	175.00[a]	3.74[ab]
Solibao	66.67[b]	416.70[c]	326.70[a]	1.43[cd]
Granola	0.00[b]	0.00[c]	0.00[a]	0.00[d]
CV (%)	8.53	10.99	97.73	17.42

Means with the same letter are not significantly different at 5% level of DMRT.

The highest computed yield in tons per hectare was obtained from Gikungo (3.99) which was not significantly different from Igorota (3.74), and Precodepa (2.20). Whereas, the lowest computed yield in tons per hectare was obtained from Tubira (1.50), Baseko (1.30), Solibao (1.43), MS 35.9 (0.57), TPS-7 (0.84), MEVA (0.27), Muziranzara (0.48) and Granola (0.00) which is significantly different.

Table 5. Non-marketable yield

VARIETY/CLONES	MEAN
MS 35.9	1,343.30[bcd]
Tubira	1,608.30[bc]
Baseko	2,281.70[b]
TPS-7	800.00[cd]
Gikungo	2,200.00[b]
MEVA	1,666.70[bc]
Muziranzara	3,683.30[a]
Precodepa	1,633.30[bc]
Igorota	1,666.70[bc]
Solibao	1,183.30[bcd]
Granola	436.670[d]
CV (%)	5.11

Means with the same letter are not significantly different at 5% level of DMRT

Figure 14.Marketable and non-marketable yield MS 35.9

Figure 15.Marketable and non-marketable yield of Tubira

Figure 16.Marketable and non-marketable yield of Baseko

Figure 17. Marketable and non-marketable yield of TPS-7

Figure 18. Marketable and non-marketable yield of Gikungo

Figure 19. Marketable and non-marketable yield of MEVA

Figure 20.Marketable and non-marketable yield of Muziranzara

Figure 21. Marketable and non-marketable yield of Precodepa

Figure 22. Marketable and non-marketable yield of Igorota

Figure 23. Marketable and non-marketable yield of Solibao

Figure 24. Marketable and non-marketable yield of Granola

Dry Matter Content

Tubira, Baseko and TPS-7 tubers had the lowest dry matter content at 14.67, 14.83, and 15.83 respectively. This was comparable to Gikungo (16.17), MS 35.9 (17.17), Igorota (17.17), MEVA (17.67) and Precodepa (17.83) while Solibao and Muziranzara had the highest dry matter content at 20.00 and 18.50 which were significantly higher compared to all the entries. This was followed by MEVA, Precodepa, and Solibao at 17.67 and 17.83, (Table 6).

Table 6. Dry matter content of potato tubers

VARIETY/CLONES	MEAN
MS 35.9	17.17^{cd}
Tubira	14.67^{f}
Baseko	14.83^{f}
TPS-7	15.83^{f}
Gikungo	16.17^{de}
MEVA	17.67^{bc}
Muziranzara	20.00^{a}
Precodepa	17.83^{bc}
Igorota	17.17^{cd}
Solibao	18.50^{b}
Granola	0.00^{g}
CV (%)	0.79%

Means with the same letter are not significantly different at 5% level of DMRT

The low dry matter content is caused by excess of water during the growth of the plants which results to low dry matter content, (Kellock, 1995). It is also affected by genetic characteristics but probably influenced by water uptake, photoperiod, diseases and other factors, (Rastovski, 2003). Further, Feltran (2004) found the same result that dry matter content is influenced by the conditions in the site. The typical dry matter content for potato chips is 21.7 to 25.1% (Fernando, 2010). The variety Igorota which was earlier reported to the dry matter ranging from 20-21% had registered to very low dry matter content at 17.17% in this trial.

Chipping Quality

Table 7 shows the results of the sensory evaluation of the potato chips from the different entries. In terms of color, the chips fromMS 35.9, Baseko, Gikungo, MEVA, Muziranzara, Igorota, and Solibao were liked very much. Chips from TPS-7 were liked moderately and the chips from Tubira were liked slightly. Chips from Tubira were similar to cooked chips which are infected with bacterial wilt. Color is the most important factor in the evaluation for chipping. Hence, the yellow chips were the most preferred. Other skin color may be selected as long as it will pass certain requirements of the processors (Sabiano, 2006).When it comes to crunchiness or crispiness, all of the varieties were rated as crunchy except for the TPS-7 which was moderately crunchy. MS 35.9, Tubira, TPS-7, Gikungo, MEVA, Precodepa, and Igorota were rated as oily while Baseko, Miziranzara, and Solibao were moderately oily. As to flavor, MS 35.9 and Igorota were liked very much while Tubira, Baseko, TPS-7, Gikungo, Muziranzara, Precodepa, and Solibao were liked moderately by the panelists whereas MEVA was liked slightly. Moreover, MS35.9, Tubira, Baseko, TPS-7, Gikungo, MEVA, Muziranzara and Precodepa were rated as acceptable while Igorota and Solibao were rated as highly acceptable.

Table 7.Sensory evaluation of potato for chipping quality

TREATMENT	SENSORY CHARACTERISTICS				
	COLOR	CRUNCHINESS	OILINESS	FLAVOR	GENERAL ACCEPTABILITY
MS 35.9	Like very much	Crunchy	Oily	Like very much	Acceptable
Tubira	Like Slightly	Crunchy	Oily	Like moderately	Acceptable
Baseko	Like very much	Crunchy	Moderately oily	Like moderately	Acceptable
TPS-7	Like moderately	Moderately crunchy	Oily	Like moderately	Acceptable
Gikungo	Like very much	Crunchy	Oily	Like moderately	Acceptable
MEVA	Like very much	Crunchy	Oily	Like moderately	Acceptable
Muziranzara	Like very much	Crunchy	Moderately oily	Like slightly	Acceptable
Precodepa	Like slightly	Crunchy	Oily	Like moderately	Acceptable
Igorota	Like very much	Crunchy	Oily	Like very much	Highly acceptable
Solibao	Like very much	Crunchy	Moderately oily	Like moderately	Highly acceptable

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The field trial was conducted at Minac, Ballay, Kabayan, Benguet, and the laboratory works was done at the Plant Pathology Laboratory and Northern Philippines Roots Crops Research and Training Center Benguet-State University (NPRCRT- BSU) Area at La Trinidad, Benguet from December 2012 to April 2013. The study aimed to screen germplasm materials for resistance to late blight during the dry season and to evaluate materials for yield and chipping qualities.

As to crop stand, Granola was observed to be fair or normal compared to the other cultivar. Based on the late blight infection ratings, Granola and MS 35.9 were observed to be the most susceptible to potato late blight as compared to Tubira, Baseko, TPS-7, MEVA, Muziranzara, Solibao, Igorota, Solibao,Precodepa and Gikungo.Area under the Disease Progress Curve (AUDPC) confirms the result because Granola and MS 35.9 has the highest value at 2,015.02 and 1,387.12 compared to Muziranzara (802.87), Igorota (871.61), Precodepa (878.50), and Gikungo (911.75) which had the lowest AUDPC. The higher the value of AUDPC, the more susceptible the variety.

Granola and MS 35.9 were categorized as moderately susceptible and susceptible to late blight. Tubira, Baseko, TPS-7, Muziranzara, MEVA, Solibao, and Igorota were classified as moderately resistant whereas Precodepa and Gikungo were highly resistant. As to marketable yield, the highest marketable computed yield in tons per hectare was obtained from Gikungo and Igorota (3.99 and 3.74) while the highest non-marketable yield was obtained from Muziranzara (3,683.3).

The lowest dry matter content was obtained from Tubira (14.67) while Muziranzara tubers gave the highest dry matter content at 20.00.

In the sensory evaluation, chips from Solibao and Igorota were liked very much because chips were crunchy, moderately oily to oily.

Conclusion

Among the cultivars evaluated, Gikungo exhibited the least late blight infection which was descriptively resistant whereas the resistant checks Solibao and Igorota were rated as moderately resistant. Computed Area under the Disease Progress Curve (AUDPC) value was almost the same (Gikungo 911.75, Solibao 965.20, Igorota 871.61). Granola had the highest infection rating which was described as moderately susceptible. In terms of yield, dry matter and chip qualities, Gikungo, Muziranzara, Igorota and Solibao are the best.

Recommendation

Among the cultivars evaluated, Gikungo is recommended for dry season planting. However, because of the low performance of the entries in this site compared to the good perform in the other sites where the same entries were tested, it is further recommended that the trial be repeated in the same municipality at the same planting season to validate the results.

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