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Research Application Summary

Agronomic performance of potato population B_3C_2 genotypes in southwestern Uganda

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Abstract

Thirteen potato genotypes known as population B_3C_2 were evaluated for yield and resistance to late blight. Assessment of late blight severity started at the onset of the disease symptoms; disease severity rating was based on visual symptoms, using a 1-9 CIP scale and percentage leaf area affected. Two genotypes (391046.14 and 396031.119) showed higher levels of susceptibility to late blight than Victoria, while two others (396026.103 and 393280.82) showed higher resistance than Cruza. Four genotypes, i.e., 396026.103 (38.6 t ha^{-1}), 396031.108 (38.5 t ha^{-1}), 396029.250 (34.5 t ha^{-1}), 396038.107 (31.3 t ha^{-1}) yielded higher than Victoria (61.5t ha^{-1}), the main commercial cultivar in Uganda.

Key words: Cruza, genotypes, late blight, *Solanum tuberosum*, Victoria

Résumé

Treize génotypes de pomme de terre connus sous le nom de population B_3C_2 étaient évalués sur place pour le rendement et la résistance à la rouille retardée. L'évaluation de la sévérité de la rouille retardée a commencé au début des symptômes de la maladie ; l'estimation de sévérité de la maladie a été basée sur des symptômes visuels, en utilisant une balance 1-9 CIP et la région de la feuille la plus affectée. Deux génotypes (391046.14 et 396031.119) ont montré des niveaux plus élevés de sensibilité à la rouille retardée que Victoria, alors que deux autres (396026.103 et 393280.82) montraient une résistance plus élevée que Cruza, la reférence de résistance. Quatre génotypes, c.-à-d. 396031.108 (83.4 t ha^{-1}), 396026.103 (80.1 t ha^{-1}), 396029.250 (75.5 t ha^{-1}) et 396038.107 (75.1 t ha^{-1}) ont eu un plus grand rendement que Victoria (61.5t ha^{-1}), le cultivar commercial principal en Ouganda.

Mots cles: Cruza, génotypes, rouille retardée, *Solanum tuberosum*, Victoria

Background

Potato *(Solanum tuberosum)*suffers various production constraints, among them, late blight caused by the fungus *Phytophtora infestans*. Without chemical control, epidemics of *P. infestans* can lead to complete yield loss. In Uganda, approximately 200,000 to 300,000 farmers are involved in potato production in the high land areas of Western (Kabale, Kisoro, Mbarara, Kasese), Eastern (Mbale, Kapchorwa) and north western Uganda (Nebbi, Arua) (IITA-FOODNET, 2001). However, yields per unit area are still disappointing by low potato yields in Uganda averaging only 7.0 t/ha as compared to the continents' average of 10.8t/ha (FAOSTAT, 2007). The production constraints include poor agronomic practices, pests and diseases especially late blight. This study assesed the level of late blight resistance and the yield of the recently introduced population B3 cycle 2 breed for quantitative resistance to late blight under Ugandan conditions. Elite parents were subsequently used in a half diallel cross of resistant progenies.

Literature Summary

The program for the improvement of potato populations by increasing gene frequencies for quantitative (horizontal) resistance to late blight was initiated by the International Potato Center (CIP) from 1990 (Landeo *et al.*, 1999). This program also had the objective of upgrading and maintaining desirable characteristics of economic importance, such as tuber yield, dry matter content, early tuberization and bulking (Landeo, 1999). As an output, a potato population (Population B) with high level of partial resistance to *P. infestans*, free from any of the R genes (R1-R11) was selected (Landeo *et al.*, 1997). Population B3, the most advanced source of horizontal resistance to late blight currently available at CIP was selected from population A. B3 contains mostly the *S.demissum*-derived progenies with horizontal resistance improved mainly in an *S.tuberosum* germplasm background, and to date, has undergone three cycles of recombination and carries only quantitative resistance to late blight (Landeo *et al.*, 1997).

Study Description

The experimental site was Karengyere research station (2450 meters above sea level (m.a.s.l.) in southwestern Uganda representing one of the major potato growing areas of the country. Thirteen potato genotypes known as population B_3C_2 (population B three, cycle two of selection) were evaluated in this study. Three local checks were included in the trial, namely Victoria (local commercial variety, but susceptible to late blight), Cruza (resistant check) and Nakpot 5 (a most recently released cultivar considered high yielding and resistant to late blight).

The field plots were laid out in a randomized complete block design (RCBD) of a split- plot arrangement, with two replications. The spray regimes (Sprayed vs No spray) were the main plots, while the potato genotypes were the subplots. Each sub-plot consisted of one row 4 m long each with 10 plants due to limited seed quantity. Spacing was 80 cm by 40 cm. Two plantings were done. The first and second planting dates were done at 30 days interval.

Assessment of late blight severity started at the onset of the disease symptoms (approximately 21 days after planting). Disease severity rating was based on visual symptoms, using a 1-9 CIP scale where 1 is equivalent to no infection and 9 is 100% infection (Henfling, 1987). Late blight scores were used to calculate areas under disease progress curves (AUDPC) which were subsequently standardized to give relative AUDPC (Campbell and Madden, 1990). At harvest, data were collected on tuber number and fresh weights, which were used to calculate the overall yield per hectare (kg/ha).

Table 1. Relative areas under disease progress curves (rAUDPC) for late blight on 13 genotypes and three local cultivars at Kalengyere, 2009B season.

Genotypes	Planting date 1			Planting date 2		
	No spray	Sprayed	Mean	No spray	Sprayed	Mean
391046.1	155.9	23.1	89.5	118.5	91	104.7
393280.8	39.7	1.7	20.7	47.9	2.6	25.2
395011.2	103.2	5.7	54.5	51.8	15.9	33.9
395111.1	135.2	20.3	77.8	123	50.4	86.7
395112.2	58	12.4	35.2	123.5	47.6	85.5
396004.3	112.8	19.3	66.1	48.2	22	35.1
396026.1	39	1.6	20.3	16.9	3.6	10.3
396029.3	134.9	7.9	71.4	74.7	42.5	58.6
396031.1	110.4	4.8	57.6	44.6	15.1	29.8
396031.1	136.6	32.1	84.3	106.7	78.2	92.4
396038.1	111.3	11	61.2	61.9	14.3	38.1
396241.4	74.8	23.8	49.3	NE	NE	NE
396244.1	83.1	5	44.1	75.4	14.8	45.1
Cruza^{LC}	41.1	4	22.6	30.6	8.2	19.4
Nakpot 5^{LC}	131	31.2	81.1	76.9	21.3	49.1
Victoria^{LC}	128.2	27.8	78	118.1	74.6	96.3
Mean	99.7	14.5	57.1	71.4	29.4	50.4
$LSD_{0.05}$		4.2			1.9	
CV		27.5%			11.9%	

Key: $LSD_{0.05}$ = Least significance difference at 5%, CV= Coefficient of variation, NE= Not evaluated, LC= Local cultivar.

Research Application

Relative AUDPCs ranged from 1.6 (396026.103) to 27.8 (Victoria) in the sprayed plots and from 39 (396026.103) to 155.9 (391046.14) in the "no sprayed" plots. The genotypes 391046.14, 396031.119 and Victoria (the local susceptible) had the highest disease severity both in the sprayed and "no sprayed" plots. Two genotypes namely 396026.103 (39.0) and 393280.82 (39.7) had lower rAUDPCs than the resistant cultivar Cruza (41.1) both in the sprayed and "no sprayed" plots. At planting date 2, relative AUDPCs varied from 3.6 (396026.103) to 91 (391046.14) in the sprayed plots and from 16.9 (396026.103) to 123.5 (395112.19) in the "no sprayed" plots. The genotypes 395111.13 (123.0) and 395112.19 (123.5) had the highest disease severity in the no sprayed plots, while the same genotypes namely 396026.103(3.6) and 393280.82 (2.6) had the lowest rAUDPCs. Five genotypes, i.e., 395112.19 (73.1 t ha^{-1}), 396026.103 (80.1 t ha^{-1}), 396029.250 (75.5 t ha^{-1}), 396031.108 (83.4 t ha^{-1}) and 396038.107 (75.1 t ha^{-1}) yielded higher than Victoria (61.5 t ha^{-1}) across both planting dates. Victoria yielded higher (61.5t ha^{-1}) than Nakpot5 (45.3 t ha^{-1}) and Cruza (25.0 t ha^{-1}). However, the yield of Cruza may have been affected by the fact that it was planted on mini-tubers from the green house. In general the planting date 2 had lower yields than the planting date 1 despite the decrease in disease severity (mean rAUDPCs=50.4 vs 57.1).

Recommendation

It is recommended to evaluate potato population B_3C_2 genotypes for at least two seasons so as to establish the stability of resistance to late blight and yield as well as a to check on the other useful traits such as dry-matter content, early tuberization and bulking, good quality for potato fries and chips. Subsequently, those progenies that perform well should be grown in multi-location trials.

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