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The U.S. Government's Global Hunger & Food Security Initiative



VERS L'AMELIORATION DU RENDEMENT DU HARICOT COMMUN EN HAITI

AREA Research Conference, 10 et 11 mars, 2020, Haiti
Raphael Colbert, James Beaver, Timothy Porch y Juan Rosas



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Introduction

Le haricot commun (*Phaseolus vulgaris* L.) est un aliment de base en Haïti où il joue un rôle important dans l'alimentation quotidienne en tant que source de protéines et de minéraux bon marché.



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Rendement moyen du haricot (FAOSTAT, 2017)

Pays/Région	Rendement (kg ha ⁻¹)
Etats Unis	2000
Amérique Central	779
Caraïbes	855
Monde	861
Haïti	640

Facteurs limitants...



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Défis de la production du haricot

Haïti: doubler le rendement en grains



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Objectif

Augmenter le rendement et la productivité du haricot en Haïti



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Méthodologie

Programme d'amélioration des légumineuses (LBP) de *Feed the Future* Haiti-AREA-Univ. Of Florida en collaboration avec le *Legume Innovation Lab* Projet (S01.A4)

- Évaluation de lignées avancées
- Résistant aux maladies ayant une large adaptation



Tableau 1. Variation du climat et des caractéristiques des zones en Haïti.

Caractéristiques	Localité			
	Cabaret	Baboën	Kenscoff	Duvier
Type de sol	Inseptisol/antisol	Clay/Loamy	Basalts/Andesite	Clay/Loamy
Temperature moy. (°C)	27	30	18	23
Pluviométrie ann. (mm)	1000	700	1,800	1640
Élévation (m)	32	60	1,800	1000
pH	8.5	8.2	6.0	7.2
Salinité (ds m ⁻¹)	0.6	0.4	-	-
Saison de culture	Dec.15-Mar. 16	Dec.16- Mar.17	Mai-Aout 16	Avr-Juil 17
Irrigation	Surface	Surface	Pluviale	Pluviale



Sélection

Cabaret (213 lignées) \Rightarrow 64 lignées $\geq 1,200 \text{ kg ha}^{-1}$
Résistance à la cicadelle (*Empoasca kraemeri*)

Kenscoff (64 lignées) \Rightarrow 17 lignées

Baboen et Duvier 17 lignées \Rightarrow 5 lignées

Rendement moyen stable de $1,200 \text{ kg ha}^{-1}$

Résistance à l'oidium (*Erysiphe polygoni*)

Gènes *bgm*, *I y bc3* pour la résistance aux virus de la mosaïque





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Dispositif exp./ Analyse de données

DBCA, 2-4 reps. PROC MIXED procédure (SAS Institute, 2015)

JMP14.1 (SAS, 2018)

ACP, Biplot (Gabriel, 1971)

Variables: Rendement et composantes, maladies



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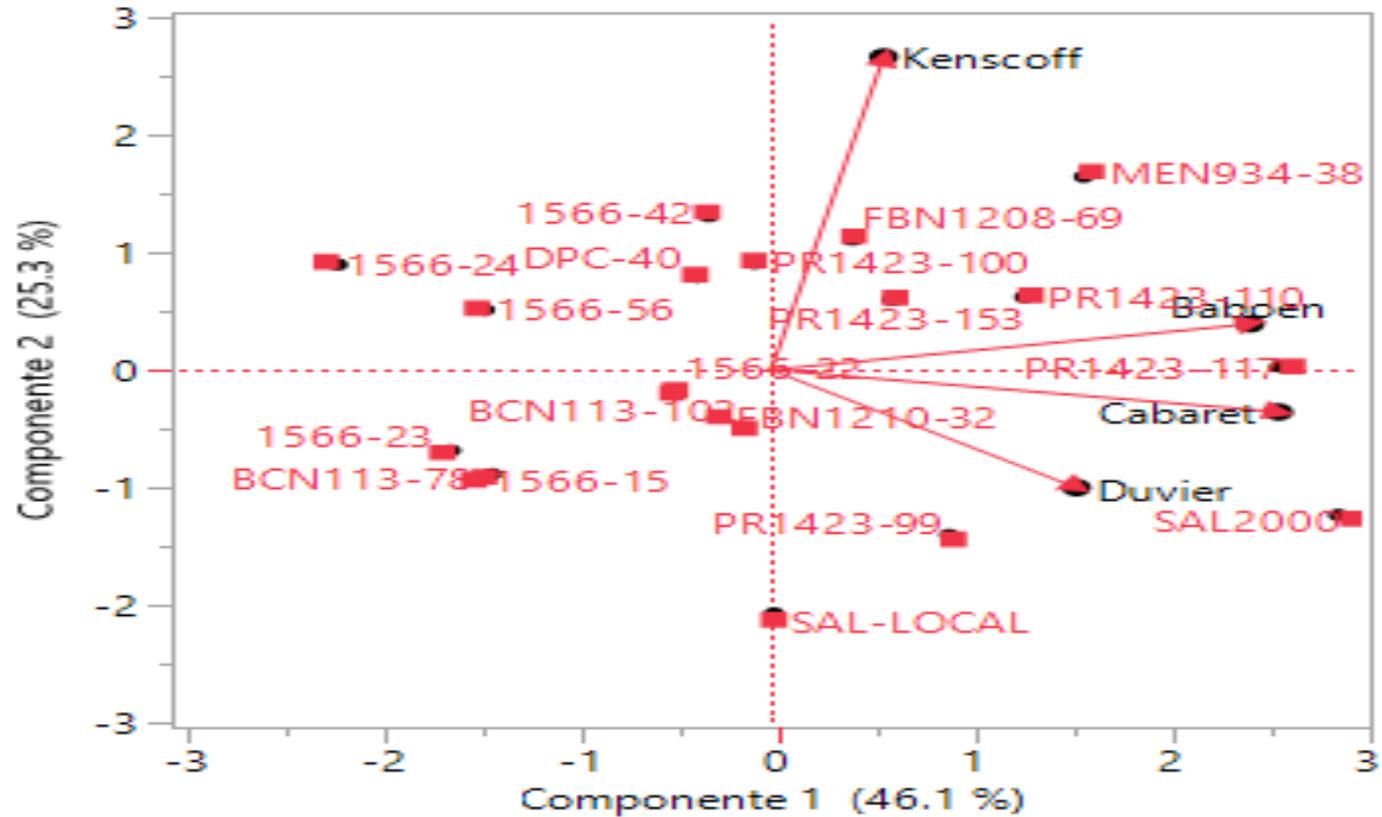
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Résultats

Figure 1. ACP du rendement





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Tableau 2. Jour à la maturité

Lignée	Localité				
	Cabaret ^x	Kenscoff ^y	Baboen ^y	Duvier ^z	Moy.
	DAP				
PR1423-99	69	93	76	76	79
PR1423-100	66	93	75	74	77
PR1423-110	67	93	71	77	77
PR1423-117	67	93	73	76	77
PR1423-153	67	93	72	76	77
Moy. gén.	71	94	77	76	77
LSD(0.05)	NS	NS	NS	1.33	
Année: x: 2015; y: 2016; z: 2017	CV%	4.58	1.39	5.08	1.23



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Lignée

Localité

Cabaret^x Kenscoff^y Baboen^y Duvier^z Moy.

kg ha⁻¹

Tableau 3.

Rendement de la sélection

Lignée	Cabaret ^x	Kenscoff ^y	Baboen ^y	Duvier ^z	Moy.
PR1423-99	1521	634	1089	1551	1199
PR1423-100	1060	1262	1022	1806	1287
PR1423-110	1100	977	1385	1519	1245
PR1423-117	1839	1004	1422	1759	1506
PR1423-153	1270	974	1178	1435	1214
Moy. gén.	1358	970	1219	1614	1290
PPDS (0.05)	1040.2	674.7	589.8	438.9	
CV%	42.3	34.0	40.2	18.8	

Année: x: 2015; y: 2016; z: 2017



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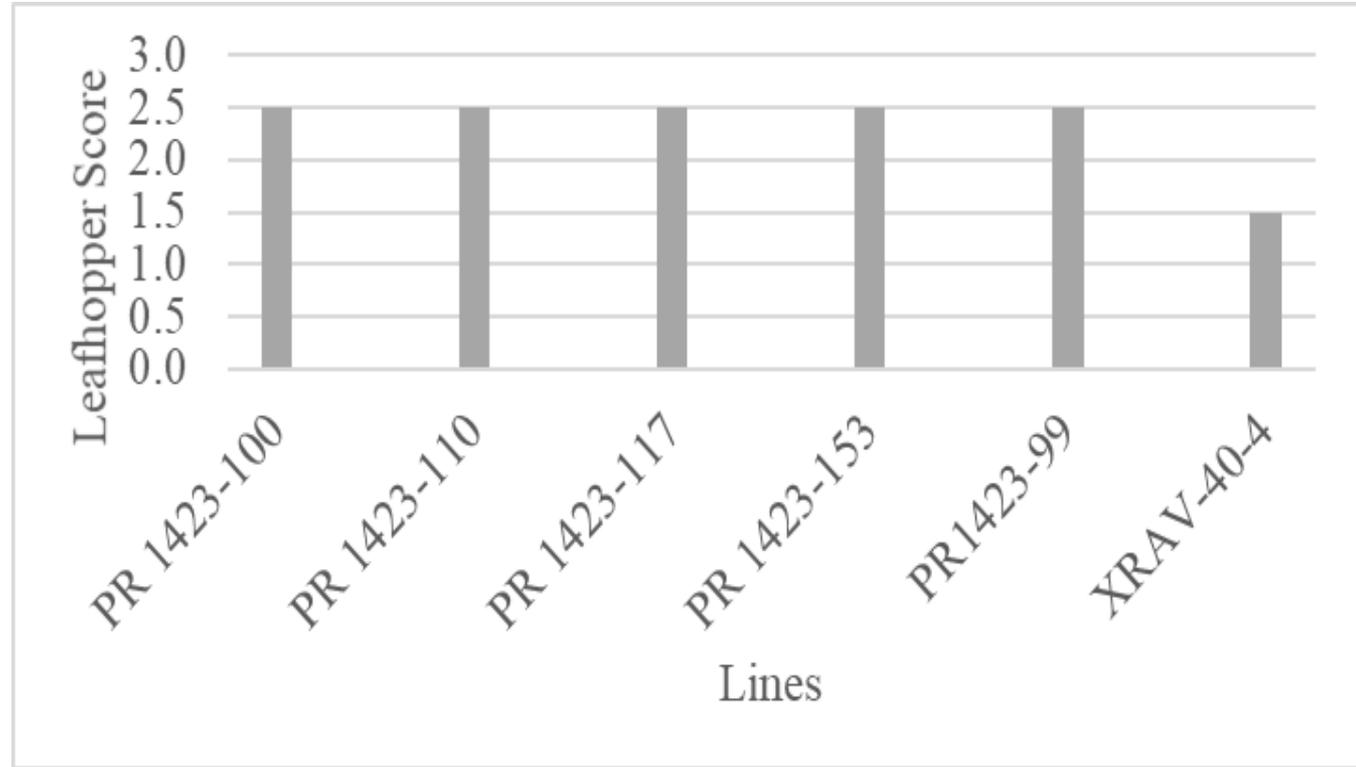
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Figure 2.
Cicadelle score†
à Cabaret



†Scale 0-5, where 0 = no visible damage and 5 = severe damage.
LSD (0.05) =1.64



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Table 3. 5 Location and description of named QTL identified in multiple environments from 75 inbred backcross lines developed from a cross Matterhorn*/EMP507 and evaluated in Michigan and Puerto Rico in 2009-2011.

Assigned QTL†	Trait	LG	Flanking Markers	LOD‡	R ² §	Add¶
LH2.1 ^{ME}	Nymph counts - <i>E. fabae</i>	Pv02	PVBR78-PT045	14.4	61.2	-1.14
LH2.2 ^{ME}	Leaf Burn - <i>E. fabae</i>	Pv02	PT079-Drought1	4.6	22.3	-0.29
LH3.1 ^{BE,ME}	Leaf Curl - <i>E. kraemeri</i>	Pv03	PT050-PT072	5.5	18.8	-0.26
LH3.2 ^{ME}	Leaf Curl - <i>E. fabae</i>	Pv03	PVM148-PT148	5.9	19.9	0.3
LH3.3 ^{ME}	Leaf Burn - No-Choice	Pv03	PVBR23-BM159	4.8	22.8	0.38
LH3.4 ^{ME}	Leaf Burn - No-Choice	Pv03	FJ18-PVBR255	4.2	30.6	-0.91
LH6.1 ^{ME}	Leaf Burn - <i>E. kraemeri</i>	Pv06	FJ16-149M2.200	7	24.5	0.3
LH6.2 ^{ME}	Leaf Burn - <i>E. kraemeri</i>	Pv06	BM170-PT145	4.4	17.2	0.26
LH6.3 ^{ME}	Leaf Curl - <i>E. kraemeri</i>	Pv06	PVM21-BM3	3.9	17.1	0.25
LH7.1 ^{BE,ME}	Leaf Burn - <i>E. kraemeri</i>	Pv07	PT001-149M2.120	3.7	20.4	0.32
	Leaf Curl - <i>E. fabae</i>	Pv07	PT001-149M2.120	7.2	36.3	0.39
	Leaf Curl - <i>E. kraemeri</i>	Pv07	PT001-149M2.120	4.7	25.5	0.36
	Leaf Curl - No-choice	Pv07	PT082-PT001	5.9	33.1	0.38
LH8.1 ^{ME}	Leaf Curl - <i>E. kraemeri</i>	Pv08	PT019-PT146	3.8	14.5	-0.26
LH9.1 ^{ME}	Leaf Curl - <i>E. fabae</i>	Pv09	BM141-PVBR131	2.8	10	-0.18

†LH: Leafhopper, § R²: Proportion of phenotypic variance explained by QTL at peak LOD; ¶ Additivity: Effect of substituting a single allele from one parent for another. Positive values indicate allele originates from Matterhorn. Negative values indicate allele originates from EMP507

Brisco et al. 2014



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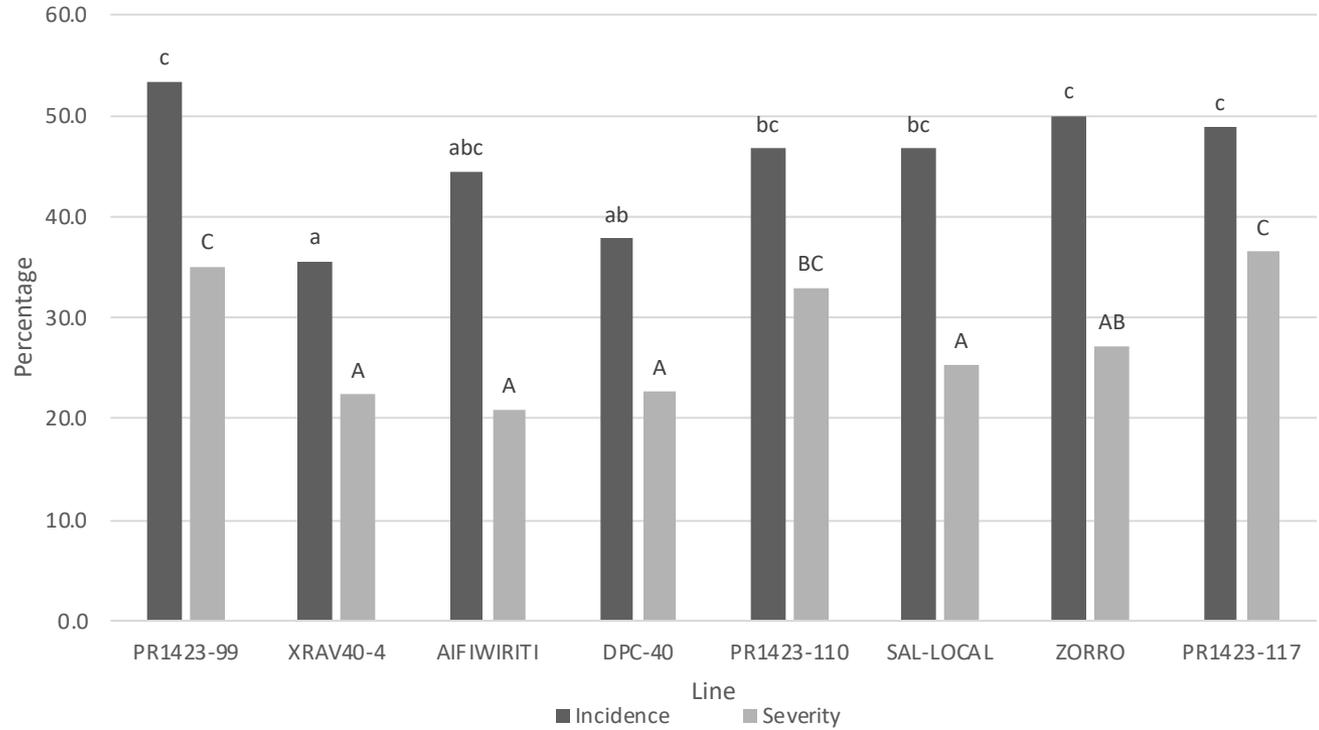


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Figure 3. Incidence y séverité † de l'oidium à Duvier

† Escala CIAT 1-9 (0-100%)



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Table 3 - QTLs to angular leaf spot and powdery mildew resistance mapped in the AND 277 x SEA5 RIL common bean population using 80 SSRs and 251 SNPs.

Disease	LG	QTL	Interval (cM)	Marker	LOD	Additive Effect	R ² (%)
ALS	Pv05	ALS5 ^{AS}	79.2-104.3	IAC159	3.26	0.38	15.3
ALS	Pv06	ALS6 ^{AS}	67.6-98.5	BAR3800	3.86	-0.36	14.4
ALS	Pv10	ALS10 ^{AS}	21-40	BAR5771	3.87	-0.35	13.7
ALS	Pv11	ALS11 ^{AS}	78.6-107.7	BAR5054	4.39	-2.45	26.5
PWM	Pv02	PWM2 ^{AS}	136-149.5	PVBR149	3.88	-0.47	7.3
PWM	Pv11	PWM11 ^{AS}	79.3-107.7	BAR5054	29.6	1.53	66.5

LG = Linkage group ALS = Angular leaf Spot PWM = Powdery Mildew

Bassi et al. 2017



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Conclusions et Recommandations

Large adaptation des lignes ++

Résistance multiple ++ ... Confirmation moléculaire (marqueurs?)

Double rendement $\geq 1200 \text{ kg ha}^{-1}$ ++

Validation ++

Test sensoriel

Diffusion aux agriculteurs?

Contribution à la sécurité alimentaire d'Haïti +++



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