

Pod quality, pod yield and disease resistance of new bush snap bean lines in Kenya

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Abstract

This study was conducted at Mwea and Embu where twenty $F_{6,7}$ lines selected from 31 bulk populations were evaluated for reaction to diseases, pod quality and pod yield in on-farm trials during the 2013 long rain and short rain seasons. Diseases were scored on a scale of 1 to 9, where scores of 1-3 were considered resistant, 4 to 6 intermediate, and 7 to 9 susceptible. Two rows per plot of each genotype were harvested three days a week and pods graded as extra-fine, fine and bobby using standard commercial criteria. Genstat Version 15 software was used for analysis of variance and mean separation. Results showed that there were significant differences among the lines for pod quality, pod yield and resistance to angular leaf spot and anthracnose. Seven new lines showed combined resistance to angular leaf spot rust and anthracnose at both sites contrasting with commercial checks which were susceptible. Angular leaf spot was more severe at Embu, where plots were irrigated with overhead sprinklers. All test lines showed resistant reactions to anthracnose at Embu but the two commercial checks were susceptible. Rust incidence was low at both locations. Pod yield over the 13 harvests varied from 6354 to 19253 kg ha⁻¹ at Mwea, and 4731 to 21175 kg ha⁻¹ at Embu, with the best lines giving a yield advantage of up to 17.7 and 29.5% over the commercial checks at Mwea and Embu, respectively. These results indicate that new bush snap bean varieties with market demanded traits, higher productivity and resistance to major diseases can be developed from these lines. Utilization of these varieties will contribute to better returns for snap bean farmers and enhanced competitiveness of local products.

Key words: Angular leaf spot, anthracnose, multiple disease resistance

Résumé

Cette étude a été menée à Mwea et à Embu, où une vingtaine de lignées de $F_{6,7}$ choisies parmi 31 populations en vrac ont été évaluées pour la réaction aux maladies, la qualité des gousses et au rendement des gousses dans les essais à la ferme au cours de la longue et courte saisons de pluies de 2013. Les maladies ont été notées sur une échelle de 1 à 9, dans laquelle les partitions de 1-3 ont été considérées comme résistantes, 4 à 6, intermédiaire, et 7 à 9, susceptible. Deux rangées par parcelle de chaque génotype ont été récoltées trois jours par semaine et les gousses classées comme extra-fine, fine et moins fine, utilisant des critères commerciaux standards. Le logiciel Genstat Version 15 a été utilisé pour l'analyse

moyenne de la variance et de la séparation. Les résultats ont montré qu'il y avait des différences significatives entre les lignées pour la qualité de gousses, le rendement en gousses et la résistance à la tache angulaire des feuilles et à l'anthracnose. Sept nouvelles lignées ont montré une résistance combinée à la tache de la rouille angulaire des feuilles et à l'anthracnose sur les deux sites contrastés avec des contrôles commerciaux qui étaient sensibles. La tache angulaire des feuilles a été plus sévère à Embu, où les parcelles ont été irriguées avec aspersion. Toutes les lignées de test ont montré de réactions résistantes à l'anthracnose à Embu, mais les deux tests commerciaux étaient sensibles. L'incidence de la rouille a été faible sur les deux sites. Le rendement de gousses au cours des 13 récoltes varie de 6354 à 19253 kg ha⁻¹ à Mwea, et de 4731 à 21175 kg ha⁻¹ à Embu. Et les meilleures lignées donnant un avantage de rendement allant jusqu'à 17,7 et 29,5% au cours des contrôles commerciaux à Mwea et à Embu, respectivement. Ces résultats indiquent que les nouvelles variétés de haricot vert, avec les traits du marché montrait que la productivité et la résistance aux principales maladies peuvent être développés à partir de ces lignées. L'utilisation de ces variétés contribuera à de meilleurs revenus pour les producteurs de haricots verts et le renforcement de la compétitivité des produits locaux.

Mots clés: tache angulaire de feuille, l'anthracnose, la résistance aux multiples maladies

Background

Production of snap bean by smallholder farmers in eastern Africa is constrained by diseases especially rust, angular leafspot and anthracnose. The intensive nature of cultivation of this crop leads to high disease and pest pressure, and consequently excessive use of pesticides. Smallholder production is further constrained by high cost of seed, reliance on susceptible varieties, stringent pesticide residue regulations and quality requirements.

Very little has been done to develop improved snap bean varieties with good pod quality and multiple disease resistance and freely available to smallholder farmers and informal seed producers in eastern Africa region. The University of Nairobi has been developing improved snap bean lines with multiple disease resistance and market demanded pod characteristics since 2006. Promising lines are currently being evaluated in multilocation on-station and on-farm trials.

Literature summary

Snap bean production is constrained by diseases such as rust, angular leaf spot and anthracnose which are the most limiting and widely distributed in Eastern Africa (Wahome, *et al.*, 2011). Most of the commercial varieties available are highly susceptible to rust, angular leaf spot and anthracnose (Kimani *et al.*, 2009). Breeding and selection for multiple resistance to such diseases therefore can reduce overdependence on fungicides and reduce postharvest losses (Otim, 2011). Overdependence on fungicides increases the risk of rejection of the farmers' produce if it exceeds the export market recommended MRLs (Odong, 2011). The objective of this study was to determine the pod quality, pod yield and reaction to diseases of new bush snap bean lines developed at the University of Nairobi.

Study description

Field evaluation of new bush snap bean lines was conducted in 2013. Trials were carried out at Mwea (1159 masl) and Embu (1350masl) during the 2013 long rain (March-May) and short rain (October-December) seasons. Study materials were 20 lines selected for disease resistance and pod yield from bulk populations developed by the University of Nairobi Bean Research Program (Wahome *et al.*, 2011). Two commercial varieties were used as checks in both locations.

The trials were laid out in randomized complete block design (RCBD) with two replications in both sites. The plot sizes were 3 m x 2 m. Spacing was 50 cm x 10 cm respectively with four rows per plot. During planting, di-ammonium phosphate (DAP: 18:46:0) fertilizer was applied at the rate of 225kg ha⁻¹. Supplementary irrigation was provided as by furrow irrigation at Mwea and sprinklers at Embu. Test lines were evaluated for pod yield, pod quality traits and disease resistance following procedures describe by Wahome *et al.* (2011). Genstat Version 15 software was used for analysis of variance and mean separation.

Table 1. Mean disease severity scores and pod length of new bush snap bean lines grown at Mwea and Embu during the 2103 long and short rain seasons.

Genotype	Disease scores						Pod lengths (cm)	
	Rust		Angular leafspot		Anthracnose		Mwea	Embu
	Mwea	Embu	Mwea	Embu	Mwea	Embu		
KSB08-3-4M	4	1	3	2.5	7	1	9.54	12.77
KSB22-3-1T	1	1	3	1.5	3	1	13.28	12.43
KSB33-1-2M	4	1	1	5.5	4	1	9.27	12.9
KSB33-3-1M	6	1	3	4.5	3	1	12.04	11.06
KSB36-1-5M	2	1	2	1.5	1	1	9.6	13.78
KSB39-1-1M	2	1	2	1.5	1	1	11.04	12.49
KSB39-1-4M	3	1	1	4	1	1	11.28	11.1
KSB39-2-4M	3	1	3	1.5	1	1	11.24	11.37
KSB39-3M	2	1	1	2.5	1	1	20.92	11.37
KSB43-2M	2	1	3	2	2	1	13.56	11.9
KSB46-2M	1	1	1	4.5	1	1	9.35	11.46
KSB47-2-2M	2	1	2	2	3	1	10.3	10.31
KSB47-2M	2	1	4	2.5	2	1	11.14	12.33
SAMANTHA	3	1	6	7	4	3.5	8.13	11.61
TERESA	2	1	5	4.5	5	1	12.29	11.83
Grand mean	2.98	0	2.66	3.29	2.9	1.36	11.1	11.79
LSD	3.224	0	3.684	4.619	4.064	2.116	5.889	2.35

LSD: Least significant Difference; CV: Coefficient of Variation.

Table 2. Pod yield and grade distribution of new bush snap bean lines grown at Mwea and Embu during the 2013 short and long rain seasons.

Genotype	Grade distribution (%)						Yield (kg/ha)	
	Extra fine		Fine		Bobby			
	Mwea	Embu	Mwea	Embu	Mwea	Embu	Mwea	Embu
KSB08-3-4M	18.58	28.59	63.45	37.74	17.96	33.67	16027	14921
KSB22-3-1T	28.96	41.29	62.59	43.96	8.45	14.75	15319	17296
KSB33-1-2M	3.95	27.32	70.79	45.12	25.26	27.56	16126	12450
KSB33-3-1M	9.87	26.76	79.61	50.27	10.52	22.97	16531	14362
KSB36-1-5M	12.01	22.98	80.96	51.72	7.03	25.3	15739	14154
KSB39-1-1M	12.42	26.41	83.21	47.47	4.37	26.11	18174	12555
KSB39-1-4M	8.41	28.45	70.72	42.65	20.86	28.9	16750	17600
KSB39-2-4M	5.43	28.03	81.24	43.95	13.33	28.02	17554	15285
KSB39-3M	10.93	24.53	73.26	44.85	15.81	30.62	14559	14802
KSB43-2M	7.21	32.56	83.22	53.5	9.57	13.93	18904	18413
KSB46-2M	22.25	62.25	65.02	31.59	12.73	6.16	18514	21175
KSB47-2-2M	3.02	28.95	86.33	53.99	10.65	17.06	17916	19859
KSB47-2M	22.63	48.6	66.39	41.28	10.98	10.12	19253	10882
SAMANTHA	4.13	18.87	57.73	53.12	38.15	28.01	16474	12841
TERESA	8.5	29.83	54.44	49.14	37.06	21.03	16214	17007
Trial mean	13.1	30.0	70.7	47.3	16.1	22.7	15498	14673
LSD	19.0	20.6	28.3	20.5	26.33	18.6	3531.2	1071.9

LSD: Least significant Difference; CV: Coefficient of Variation.

Research application

Disease reaction of the best thirteen lines and their pod characteristics are presented in Tables 1 and 2. The average pod length in both sites ranged from 10.3 to 16.1cm. The average percentage of the market preferred grades (extra fine and fine) in all the test lines was 83.2% as compared to 68.9% in the checks. KSB39-1-1M, KSB43-2M and KSB47-2-2M had a combination of good pod quality, combined disease resistance to rust, anthracnose and angular leafspot and high pod yield in both Mwea and Embu sites. Disease severity was high for rust and anthracnose in Mwea while angular leafspot was severe in Embu due to overhead sprinkler irrigation. Other significant variations were due to environmental effects.

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