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ABSTRACT

Rice and sugarcane are the two dominant crops produced in Guyana while scorn is not yet cultivated on a commercial scale, resulting in import of corn (30009tonnesannually) at a cost of $11.6 million annually. The domestic commercial production of corn has been emphasized recently by government to meet the local demand of agro industries involving in poultry feed production. Consequently, coordinated trial1 of improved corn varieties was initiated at Ebini (Savannah region)during June-September, 2013 and repeated during the 2013-2014 crop season at Mon Repos in the coastal region. A total of twenty two improved genotypes of hybrid corn along with two local check varieties were tested for their yield performance at Ebini whereas at Mon Repos, the same set with two more composite varieties were tested during October, 2013- January, 2014 cropping season. These new hybrids and composites were procured from CIMMYT, Colombia. Additionally, 22 and 14 new genotypes of hybrid corn were also tested in the Coastal region during 2013-2014 along with composite and a local variety as checks, in trials 2 and 3 respectively. The performance of new hybrid and composite varieties of corn was outstanding with average grain yields ranging from 23.16 to 37.75 q/ha at Ebini during 2013 crop season under rain fed conditions, whereas in the Coastal region the yield was further high in the range of 58.39-86.62 q/ha during 2013- 2014 in trial 1. In trials2 and 3, these ranges were 56.18-95.77 q/ha and 31.02-90.82 q/ha, respectively. These new genotypes except one (GC56) out-yielded local varieties significantly, at both regions and seasons. Based on the average yield of both seasons and regions, the genotypes, GC9,GC13 and GC1 were the most high yielding types with yields of 61.70, 59.70 and 58.60 q/ha, respectively, as compared to 26.11and 32.87 q/ha in the case of check varieties (local yellow and local red), respectively. The cost of production was G$ 82/kg or G$37/lb at Ebini and G$ 32/kg or G$14/lb in the coastal region as compared to imported corn which costs around G$46/lb(2013-2014) and locally produced corn in the near future may easily substitute import of 30000 tons of corn in Guyana. The results also indicated that improved high yielding corn genotypes can successfully be exploited for commercial cultivation in both Savannah and coastal regions in Guyana.

Keywords: Corn, *Zea mays*, Improved varieties, Cost of production, Savannah region, Coastal region, Guyana

INTRODUCTION

Corn or maize (*Zea mays* L.) is an important food, feed and industrial crop in different parts of the world. The early use and domestication of maize has been in demostration approximately 2600-2700 b.c. through association of pollen of corn with deposits of charcoal found in Aguada Petapilla, Copain Valley, Honduras (Webster et al., 2005). Corn occupied top position amongst crops as far as the production area is concerned in America. America alone produces 332 million metric tons of corn per annum (Maize - Wikipedia, 2014). In Guyana, corn is being imported mainly as an ingredient for poultry feed. In 2011, a total of 30009 tonnes of corn($11601000) was imported (FAOSTAT, 2014). The government of Guyana embarked on a programme to intensify corn cultivation using improved varieties and better crop management practices. Although efforts were made in past to test new varieties, these were restricted to one or two varieties and hybrids belonging to the private sector and therefore could not be released as varieties in Guyana. As a result corn is not yet exploited commercially at farmers' fields due to lack of sufficient seeds of improved varieties and other issues.

The grain yield of corn is affected due to different factors like varieties, weather stress, biotic stresses, soil fertility and characteristics as well as management decisions during crop growth and these directly or indirectly may lower the yields. Some of these are manageable and yields may be maximized through proper decisions related to fertility, selection of hybrids, plant population per unit area, crop rotation and tillage practices (Peters, 2014). Taking in to consideration of high prospects and demands in Guyana and in the Caribbean countries for this commodity, the systematic and coordinated efforts were made during 2013 and 2013-2014 crop seasons in Guyana to evaluate new hybrids and composite varieties obtained from CIMMYT, Colombia in the form of three yield trials.

Consequently, the studies were initiated to evaluate and select the promising varieties of corn most suitable for different agro ecological zones in terms of grain yield, quality and tolerance to biotic and abiotic stresses, and to assess the cost of production and evaluate the economics of corn production in Guyana *vis a vis* imported corn as an ingredient in poultry feed. These efforts in a coordinated manner will continue to test new varieties each year along with past year promising checks and productivity and production will be raised regularly through this 'All Guyana Coordinated Corn Improvement Programme'. Once the high yielding varieties are identified, these will be released in Guyana officially, keeping in view of non-availability of any improved corn variety in Guyana.

MATERIALS AND METHODS

The experiements for evaluation of new corn genotypes were undertaken at two places, Regional Crop Research Centre, Ebini,Intermediate Savannah and NAREI Mon Repos, East Coast Demerara, (Coastal region), Guyana, during the raining seasons of June-September, 2013 and October, 2013-January, 2014, respectively. The Ebini Research Station is situated on the gently rolling intermediate Savannahs, the location being 58^0W and $51^0$2' N and is at about 60 feet above sea level. These gently undulating grass-covered plains are studded with bush Islands with forest growing along the river courses. The soil is sandy loamy with a pH around 4.2. The monthly rainfall range was 252.1-411.5mm during the June-September, 2013at Ebini with numbers of rainy days per month ranging from 22-25. The rainfall during the crop was adequate and evenly distributed (58.8-163.3 mm) from October 2013-January, 2014 at Mon Repos. The temperature ranged from 22.4-32.4 ^{0}C during the crop season at Mon Reposwhereas at Ebini it was in the range of 30-32^{0}C. The soil at Mon Repos was clay loamy type with pH about 5.5. The location of Research Farm, NAREI Mon Repos is in the coastal area at $6^0$47' 15'' N and $58^0$3' 34'' W below 7 feet of sea level.

Twenty two promising corn hybrid entries (Non-GMO) were obtained from the International Maize and Wheat Improvement Center (CIMMYT), Regional Centre, Colombia. These were tested with two local check corn varieties, Local Yellow and Local Red during 2013 at Ebini as well as during 2013-2014 crop season at NAREI, Mon Repos along with two additional composite type varieties, GC23 (Composite I) (Poineer, Belize) and GC24 (Composite II) (Sintethic13PD6#-B from CIMMYT, Colombia).

The Trial 1, representing CIMMYT trial location No. GC13A872 12ASA17HY30 was planted at Ebini on the 25th June, 2013 in a randamized complete block design (RCBD)with three replications. Each plot was having three rows of 2.75m long at a distance of 60cm from each other. The planting distance was kept at 30cm. The sowing was at the depth of 5-7 cm and seed was later covered with soil. The NPK fertilizer was applied @ 130:60:60 kg/ha to the crop. The full dose of P and K was applied at sowing along with half dose of N (Urea). The remaining N (Urea) was applied in two equal split doses at 30 and 60 days after sowing. Pre-emergence application ofRound Up weedicide @ 3 lit/ha were used to control weeds. The harvesting of ears was done once the outer cover was dried. The harvested ears were peeled and sun dried.The threshing of corn was done manually. Data were recorded on dates of sowing, germination, number of plants/plot, date of application of fertilizer, plant height, date of flowing (earing), date of maturity and harvest, ear weight, total grain weight and thousand grain weight. The yield data were analysed statistically using standard SAS softwares.

The sowing of trial 1 was done on 14th October, 2013 whereas trial 2 (CIMMYT No. GUB886 12ASA17HY44) and trial 3 (CIMMYT No. GU13B887 13ASA18HY7)were planted on 17th October, 2013 at NAREI, Mon Repos. So, during the second consecutive crop season of 2013-2014 (second rainy season), 59 non-GMO varieties of corn were tested along with three check varieties in three separate trials. The trial 1also had two local check corn varieties, (Local Yellow, Local Red) and two composite varieties, (One from Pioneer, Belize and other from CIMMYT). There were, 26, 24 and 16 numbers of entries including checks in trials 1, 2 and 3, respectively. In trials 2 and 3, only two checks, Local red and Composite 1 were used. The planting was done on ridges (15-20 cm high) using a planting distance of only 15 cmand row to row distance of60 cm. The design was randomized complete block design (RCBD) with three replications. The plot consists of two lines of 5m long. Two seeds per hole were planted at a depth of about 5cm. Irrigation was given by sprinklersto ensure proper germination and crop establishment. Five random plants were tagged per plot and recording of leaf diseases was done in 1-5 scale where one indicates only traces of leaf spots and 5 was used for more than 75% are of leaf covered due to leaf spot diseases. Likewise, shoot borer rating was done ranging from 1-5, where 1 indicates traces of infestation and 5 for high damage and death of the shoot. No disease appeared on improved corn and had low rating of shoot borer as compared to local corn varieties. The effect of drought was seen during the dry period encountered at flowering and its impact on the extent of grain filling on tagged plants. The rating of percent cob filled due to grains was done in 1-5 where 1 is for full cover of grains (100%) on ear and 5 is only 25% grains on ear.

The improved varieties matured on 27th Jan. 2014 and were harvested manually after 105 days of sowing whereas, local varieties took 120 days to mature. The maturity was assessed by looking at the drying of outer cover of ear and grain moisture which was around 30%. The harvesting of ears was done once the outer cover was dried. The harvested ears were peeled and sun dried.Threshing of corn was done manually.

RESULTS AND DISCUSSION

In trial 1 (GC13A872 12ASA17HY30), the hybrids (GC1-22 Nos.) significantly out-yielded both local varieties. Such increase in grain yield ranged from 7.9 to 13.7 times than local check variety. The hybrid varieties took about 10 days less time to mature and plants were showing less damage due to diseases and insect pests as compared to local checks. The plant heights of hybrids vary from 120-174cm and thus were shorter in height than local check varieties. The average number of ears per plant was greater than 1.0 in the case of new hybrid varieties. Amongst hybrid varieties, GC9 had the highest grain yield (37.75 q/ha), followed by GC22 (35.55 q/ha), GC1 and GC19. These also had higher 1000 grain weights. The ear weight of GC9, GC22 and GC19 was significantly higher than other hybrid entries (Table 1). The grain filling was complete and was not affected due to rains or high heat in Guyana in the hybrid varieties. The local varieties on the other hand,had poor grain development on ears with more gaps. The grain and ear yields as well as the ear weight and grain weight ratios were higher at Mon Repos as compared to Ebini. The corn yields were greater in the Coastal region as compared to Savannah region in Guyana (Fig. 1, Table 2). It may be due to better soil and rainfall pattern in coastal region than the Savannah, besides closer planting done at Mon Repos. Amongst test varieties, GC13, GC6 and GC9 out yielded check varieties as well as hybrids and the grain yields varied from 85.65-86.62 q/ha as compared to 76.94 q/ha for Composite 1 (Pioneer, Belize) and 74.30 q/ha of Composite II of CIMMYT at Mon Repos. The 1000 grain weight of GC13 was 316.3 g whereas for GC6 and GC9 was 218.0 and 268.3g, respectively (Table1). The hybrid and composite varieties took less time (101-105 days) to mature and were showing less damage due to insect pests and diseasesat Mon Repos. The new varieties have vigourous rooting systems and were tolerant to drought under field conditions. The average number of ears per five plants ranged from 5.3-10.0 with maximum 10 ears/5 plants in GC6 whereas, GC13 had 8.3 ears/5 plants (Table 1). On an average basis for the two cropping seasons, the entry GC9 had the highest grain yield (61.70 q/ha) followed by GC13, GC1, GC6, GC2 and GC22.The yield increased from 108 to 135% in the case of improved varieties over local yellow check variety at the two locations and seasons (Table 2 and Fig. 1). The effects of genotype (G), location (L) and G × L were found to be highly significant ($P < 0{\cdot}01$) for grain yield in Ghana in corn (Boakyewaa, 2012).

Trial 2 (GUB886 12ASA17HY44) consisted of twenty four numbers of entries including two checks, Local Red and Composite 1. Amongst entries, GC33 yielded 95.77 q/ha followed by GC31 (92.65 q/ha) and were in the first significant group followed by GC41 (85.65 q/ha) and GC44 (84.70 q/ha) which were in the second significant group. The grain yield of Local Red variety was only 38.39 q/ha and that of Composite I of Pioneer (Belize) was 73.35 q/ha (Table 3). The number of ears/ five plants was 6.3 for GC33 and 7.7 for GC31, 8.7 for both GC 41 and GC44. The 1000 grain weights for GC33, GC31, GC41 and GC44 were 338.3, 339.3, 319.7 and 275.3 g respectively. The maturity period of the new hybrids 101-105 was shorter than that of Local Red check (120 days).

Table 1: Performance of corn entries at Ebini Savannah during 2013 and coastal region (Research Farm of NAREI, Mon Repos) during 2013-14 in trial 1

S. No.	Entry	Pedigree	Grain weight (q/ha)			1000 grain weight (g)			Ear weight (q/ha)			Ears/5 plants	Days to 50% flowe-ring	Daysto maturity	
			Ebini sava-nnah	Coast -al region	Mean	Ebini sava-nnah	Coast-al region	Mean	Ebini sava-nnah	Coast -al region	Mean	Coas-tal region	Ebini sava-nnah	Ebini sava-nnah	Coas-tal region
1	GC1	(PobATS-B-B-B-43-)/(CL02450)	35.20	81.99	58.60	326.6	321.7	324.2	73.22	94.84	84.03	5.7	57	110	105
2	GC2	(PobATS-B-B-B-10-B)/(CL02450)	34.30	77.87	56.09	288.4	358.7	323.6	88.21	89.95	89.08	7.0	57	110	105
3	GC3	(PobATS-B-B-B-47-B)/(CL02450)	25.12	72.06	48.59	310.3	330.7	320.5	59.79	85.18	72.49	5.7	57	110	104
4	GC4	(PobBTS-B-B-B-40-B)/(CL02450)	30.29	67.10	48.70	329.6	325.7	327.7	83.73	80.13	81.93	5.7	57	110	106
5	GC5	(PobBTS-B-B-B-24-B)/(CL02450)	26.10	83.90	55.00	377.7	317.3	347.5	71.20	96.26	83.73	6.3	55	110	102
6	GC6	(PobBTS-B-B-B-20-B)/(CL02450)	26.98	85.71	56.35	310.6	218.0	264.3	82.39	96.26	89.33	10.0	56	110	101
7	GC7	([(CML172*AC8328BNC6-166-1-1-1-BBBBBB)-B]#-B-B-60-2-B-B-B)/(CL02450Q)	23.97	70.55	47.26	269.0	268.0	268.5	67.61	84.89	76.25	6.0	57	110	105
8	GC8	(CML161/CML165)/(CL0245Q)	23.16	83.18	53.17	188.6	268.3	228.5	63.68	99.66	81.67	7.0	57	110	105
9	GC9	(SRR-C4SA3HS57-1-2-1B)/(CLA18)	37.75	85.65	61.70	321.2	318.7	320.0	73.44	98.62	86.03	5.7	55	110	105
10	GC10	(SRR-C4SA3HS106-1-1-1-B)/(CLA18)	21.63	74.24	47.94	213.8	301.0	257.4	55.52	89.53	72.53	6.3	57	110	105
11	GC11	(SRR-C4SA4HS5-1-1-1-B)/(CLA42)	28.84	70.12	49.48	209.9	329.7	269.8	63.14	86.20	74.67	6.7	55	110	105
12	GC12	(SRR-C4SA4HS5-1-1-3-BB)/(CLA42)	29.29	72.65	50.97	251.9	269.0	260.5	82.61	84.74	83.68	5.7	56	110	104
13	GC13	([CML322xCML363]-B-1-1-B-B-B-B-B)/(CLRCY015)	32.78	86.62	59.70	235.4	316.3	275.9	80.60	106.52	93.56	8.3	56	110	106
14	GC14	([CML373xCML363]-B-1-1-B-B-B-B-B)/(CLRCY015)	29.82	74.10	51.96	215.8	285.3	250.6	78.36	87.20	82.78	6.7	57	110	102
15	GC15	(PobBTS-B-B-B-48-B)/(CML451)	31.16	58.87	45.02	390.4	333.3	361.9	54.18	75.09	64.64	6.0	56	110	101
16	GC16	(PobBTS-B-B-B-56-B)/(CML451)	29.27	76.32	52.80	349.8	267.0	308.4	72.99	87.89	80.44	6.7	55	110	105
17	GC17	((CLA168/CL02450)-B-B-B-5)/(CML451)	27.89	77.19	52.54	368.9	320.3	344.6	60.45	93.71	77.08	7.3	57	110	105

18	GC18	(CLA41)/(SRR-C4SA3HS106-1-1-1-B)	28.12	67.83	47.98	210.2	291.0	250.6	67.17	84.44	75.81	6.6	55	110	105
19	GC19	(CLRCY011-B-B-B-B)/([CML373xCML361]-B-B-2-B-B-B-B)	34.47	58.39	46.43	298.7	325.0	311.9	76.79	77.99	77.39	6.3	55	110	105
20	GC20	(CLRCY017-B-B-B)/([CML322xCML363]-B-1-1-B-B-B-B-B)	32.95	68.58	50.77	240.7	285.7	263.2	58.21	81.34	69.78	6.0	56	110	105
21	GC21	(CML287-B)/(CLA81)	34.18	70.64	52.41	283.4	339	311.2	61.58	93.74	77.66	7.0	55	110	105
22	GC22	(CML323-B-B)/(CML454)	35.55	73.23	54.39	241.0	301.7	271.4	80.60	91.01	85.81	5.3	56	110	105
23	GC23 Compo-site I	Pioneer (Belize)	-	76.94			345.7			83.55		7.0			105
24	GC 24 Compo-site II	Sintethic13PD6#-B	-	74.30			333.3			82.38		6.0			105
25	Local Red check	-	2.74	52.80	27.77	218.2	321.7	270.0	23.06	63.05	43.06	6.3	70	120	118
26	Local Yellow check	-	2.69	42.61	22.65	160.4	281.7	221.1	30.68	49.48	40.08	6.7	65	120	120
	LSD (p=0.05)		1.33	2.71		12.99	26.4		3.28	3.36		1.2			

Table 2. Grain yield (q/ha) of top entries in trial 1 in Coastal region and Ebini during 2013-2014 crop seasons

Varieties	Grain yield (q/ha		
	2013-14 at Mon Repos	2013 at Ebini Savannah	Increase over check (L .Yellow) on an av.(%)
GC9	85.65	37.75	135
GC13	86.62	32.78	129
GC1	81.99	35.20	124
GC6	85.71	26.98	116
GC2	77.87	34.30	115
GC22	73.23	35.55	108
Local Yellow Check	49.48	2.74	-
Local Red Check	63.05	2.69	

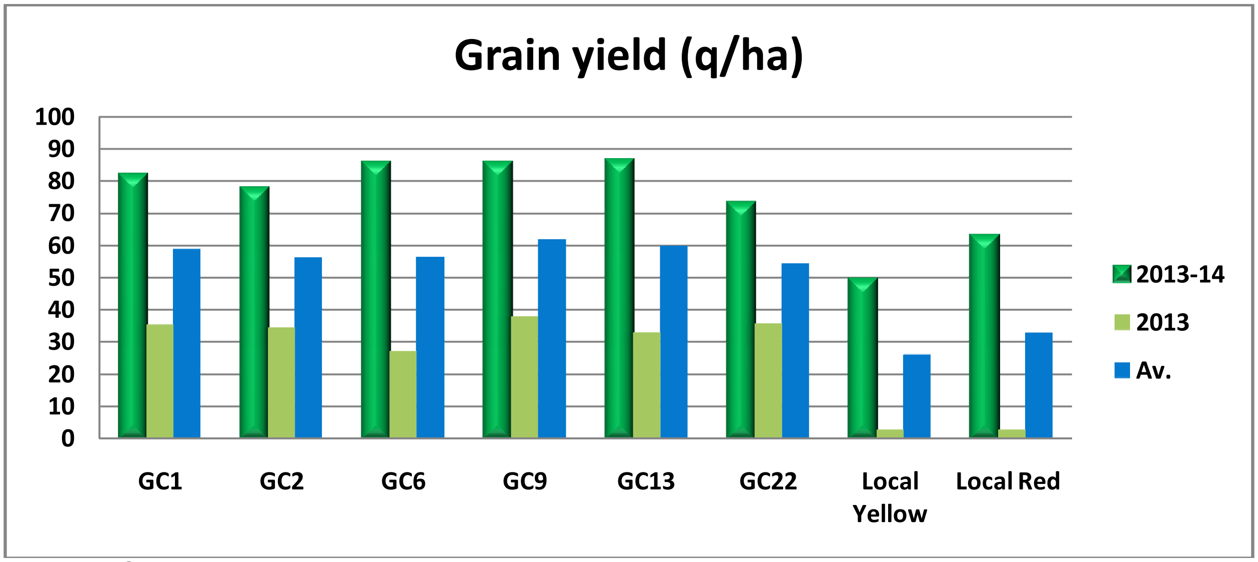

Fig. 1. Grain yield (q/ha) of top varieties in trial 1 at NAREI, Mon Repos during 2013-2014 and at Ebini during June-Sep. 2013

Table 3: Evaluation of corn entries at Research Farm of NAREI, during 2013-14 in trial 2 for yield and other agronomic parameters

S. No.	Entry	Pedigree	Grain weight (q/ha)	1000 grain weight (g)	Ear weight (q/ha)	Ears/5 plants	Days to maturity
1	GC25	(PobATS-B-B-B-43-B)/(CL02450)	66.19	406.3	77.74	6.0	105
2	GC26	(PobATS-B-B-B-10-B)/(CL02450)	63.61	307.7	73.44	5.7	105
3	GC27	(PobATS-B-B-B-47-B)/(CL02450)	56.18	282.7	77.30	5.3	104
4	GC28	(PobBTS-B-B-B-40-B)/(CL02450)	72.60	264.3	90.31	6.7	106
5	GC29	(PobBTS-B-B-B-24-B)/(CL02450)	73.25	279.3	86.11	5.7	102
6	GC30	(PobBTS-B-B-B-20-B)/(CL02450)	77.51	289.7	84.52	7.3	101
7	GC31	([(CML172*AC8328BNC6-166-1-1-1-BBBBBB)-B]#-B-B-60-2-B-B-B)/(CL02450Q)	92.65	339.3	105.57	7.7	105
8	GC32	(CML161/CML165)/(CL02450Q)	82.83	342.3	97.26	7.0	105
9	GC33	(SRR-C4SA3HS57-1-2-1-B)/ (CLA18)	95.77	338.3	111.98	6.3	105
10	GC34	(SRR-C4SA3HS106-1-1-1-B)/ (CLA18)	82.53	322.7	60.75	5.7	105
11	GC35	(SRR-C4SA4HS5-1-1-1-B)/ (CLA42)	73.67	348.0	80.06	6.0	105
12	GC36	(SRR-C4SA4HS5-1-1-3-B-B)/ (CLA42)	74.56	353.0	83.76	6.3	104
13	GC37	([CML322xCML363]-B-1-1-B-B-B-B-B)/(CLRCY015)	78.61	321.0	92.18	7.3	106
14	GC38	([CML373xCML363]-B-1-1-B-B-B-B-B)/(CLRCY015)	73.94	288.0	85.83	6.7	102
15	GC39	(PobBTS-B-B-B-48-)/(CML451)	80.40	311.7	97.16	5.3	101
16	GC40	(PobBTS-B-B-B-56)/(CML451)	71.67	322.3	83.80	5.3	105
17	GC41	((CLA168/CL02450)-B-B-B-5)/CML451)	85.65	319.7	104.02	8.7	105
18	GC42	(CLA41)/(SRR-C4SA3HS106-1-1-1-B)	74.23	314.0	87.64	6.7	104
19	GC43	(CLRCY011-B-B-B-B)/([CML373x CML361]-B-B-2-B-B-B-B)	58.29	297.3	66.77	6.0	106
20	GC44	(CLRCY017-B-B-B)/([CML322x CML363]-B-1-1-B-B-B-B-B)	84.70	275.3	103.42	8.7	102
21	GC45	(CML287-B)/(CLA81)	65.67	264.3	79.26	6.3	101
22	GC46	(CML323-B-B)/(CML454)	77.01	305.7	89.28	7.3	105
23	GC23 Composite I	Pioneer (Belize)	73.35	341.7	83.41	5.7	105
24	Local Red Check	-	38.39	342.0	50.08	7.0	120
	LSD (p=0.05)		3.20	27.1	5.24	2.0	

In trial 3 (GU13B887 13ASA18HY7) there were fourteen test hybrids with two checks. The performance data of these are shown in Table 4. Amongst entries, the grain yield of GC55 was significantly higher (90.82 q/ha), followed by GC60 (90.65 q/ha). The second significant group of entries was GC48 (83.15 q/ha) and GC57 (82.23q/ha). The number of ears/five plants was 6.7, 9.3, 6.7 and 7.3, respectively whereas, 1000 grain weight was 262.0, 302.3, 286.3 and 283.0 g, respectively for GC55, GC60, GC48 and GC57 (Table 4).

Table 4: Performance of corn entries at Research Farm of NAREI, during 2013-2014 in trial 3

S. No.	Entry	Pedigree	Grain weight (q/ha)	Ear weight (q/ha)	1000 grain weight (g)	Ears/5 plants	Days to maturity
1	GC47	((CLA18/CLA17)-B-B-B-3-B)/(CL02450)	64.78	73.83	338.3	5.7	104
2	GC48	((CLA18/CML161)-B-B-B-1-B)/(CL02450)	83.15	92.70	286.3	6.7	106
3	GC49	((CLA41/CLA16)-B-B-B-4-B)/(CL02450)	78.78	87.51	298.3	6.0	102
4	GC50	((CLA37/CLA81)-B-B-B-5-B)/(CL02450)	76.82	92.02	282.7	6.0	101
5	GC51	((CLA44/CLA81)-B-B-B-5-B)/(CL02450)	71.63	83.62	292.7	6.0	105
6	GC52	((CLA42/CML451)-B-B-B-7-B)/(CL02450)	58.09	65.25	264.7	6.7	105
7	GC53	((CLA168/CL02450)-B-B-B-5-B)/(CML451)	36.92	43.34	276.6	5.3	104
8	GC54	((CLA41/CML451)-B-B-B-2-B)/(CL02450)	31.02	39.17	232.3	5.7	106
9	GC55	((CLA93/CML451)-B-B-B-2-B)/(CL02450)	90.82	109.24	262.0	6.7	102
10	GC56	((CLA7/CLA81)-B-B-B-4-B)/(CLRCY015)	40.86	52.38	273.0	5.7	101
11	GC57	((CLA42/CML451)-B-B-B-2-B)/(CLRCY015)	82.23	101.77	283.0	7.3	105
12	GC58	((CLA93/CLA161)-B-B-B-3-B)/(CML451)	72.12	82.08	324.0	8.3	105
13	GC59	((CLA37/CL02450)-B-B-B-5-B)/(CML451)	62.06	81.86	295.0	5.7	104
14	GC60	((CLA105/CL02450)-B-B-B-6-B)/(CML451)	90.65	108.46	302.3	9.3	103
15	GC23 Composite 1	Pioneer (Belize)	75.62	83.71	307.7	7.0	104
16	Local Red check	-	39.71	48.90	276.3	6.3	118
	LSD (p=0.05)		3.06	3.61	5.8	1.5	

The diseases were absent on test entries and local varieties which may be due to growing of corn only on experimental basis in Guyana. The shoot borer rating was 3 as compared to traces or no infestation on improved varieties. The effect of drought on fertilization thus leading to grain setting and filling was negligible on improved varieties whereas local yellow and red varieties suffered up to 75%. The grain filling in improved varieties was excellent compared to local varieties. Further characterization of new varieties may be done by repeating the trials, front line demonstrations at farmers' fields and recording of DUS characters using standard descriptors (BPGR and CIMMYT, 1991). Vanessa et al. (2012) summarized the CIMMYT maize hybrid testing programme over a number of years in Africa and used yield data for 448 maize hybrids and evaluated in 513 trials across 17 countries from 2001 to 2009. The trials were grouped according to five subdivision systems into climate, altitude, geographic, country, and yield-level sub regions. For the first four subdivision systems, genotype x sub-region interaction was low, suggesting broad adaptation of maize hybrids across eastern and southern Africa. In contrast, genotype x yield level interactions and moderate genotypic correlations between low- and high-yielding sub-regions were observed. Therefore, hybrid means should be estimated by stratifying the TPE considering the yield-level effect as fixed and appropriately weighting information from both sub regions. This strategy was at least 10% better in terms of predicted gains than direct selection using only data from the low or high-yielding sub-region and should facilitate the identification of hybrids that perform well in both sub regions.

Cost of cultivation: The cost of production is shown (G$) in Table 6. If the most high yielding hybrid of corn (GC9) is used, one may easily get an average yield of 37.75 q/ha with the cost of production of $ 310439/ha in the Savannah region inclusive of transport costs. On the coasts, the cost of production was $ 274188/ha in the Coastal region. If a farmer uses the most high yielding hybrid of corn (GC13), one may easily get an average grain yield of 86.62 q/ha. Thus, the cost of corn will be around $14/lb as compared to $37 for the Savannah (Tables 5 and 6). Another advantage in the Coastal region is that it is possible to have two crops per year with the two rainy seasons per year in these areas of Guyana. A net profit of $604399/ha or $244696/acre is possible by growing corn in only one crop season in the coastal region (Table 5). The cost of production would be further low in case corn is cultivated in an organized manner using mechanized operations. The cultivation of corn will boost the poultry industry; generate rural and urban employment, income and cheaper food production. The crop production and protection technologies need to be refined further and front line demonstrations conducted at strategic locations to disseminate new varieties and technologies faster amongst farmers. Collaborations need to be made with poultry researchers, feed manufacturers and policy planners to reduce the import of corn in Guyana in a phased manner. The seed companies and farmers need to be trained on seed production technology and technology made available for exploitation through private-public partnerships. The four main producers of corn in CARICOM are Haiti, Belize, Jamaica, and Guyana. During 2008, the corn production was 210000 metric tons in Haiti, 65274 metric tons in Belize, 1891 metric tons in Jamaica and 1025 metric tons in Guyana. Corn is second most important consumed cereal after rice in Haiti whereas.in Belize the main use of corn is for poultry feed, (both broilers and layers). The corn production is considered a vital means for improving food security in the Caribbean region and role of Guyana is important in it keeping in view of good available land and high yield potentials (Caribbean Agribusiness-Maize/corn, 2014). Morris et al. (1999) conducted studies on adoption of new maize technology in Ghana. Three sets of factors, characteristics of the technology, farming environment and kind of farmer influence the adoption of improved production technology in a great extent. The survey conducted also revealed that adoption of new production technology is indirectly is affected by other factors which may be out of control of researchers including the extension services used in agriculture, distribution system of inputs and environment of economic policies. The above findings may be taken in to account while promoting new corn hybrids and composites for an early adoption and commercial cultivation of crop in Guyana.

Table 5. Economics of corn production in Guyana at Ebini during 2013

S. No.	Inputs and operations per ha	Total expenses (G$)/ ha	Total income (G$)/ha
1.	Hired machine/tractor use (Ploughing, sowing, threshing etc.)	50000	
2.	Hired labor @$1,500/day (100 days), all field manual operations	150000	
3.	Basal dressing (NPK) 200 kg	34000	
4.	Top dressing (Urea) 152 kg	20064	
5.	Transportation cost Fertilizer @ $500/ bag	3500	
6.	Transportation cost of corn to bring to market	37750	
8.	Herbicide cost (Round-up @3 lit/ha)	6000	
9.	Insecticide cost (2 sprayings)	6000	
10.	Seed cost @ 25 kg/ha	2125	
11.	Total expenses (labour and assets)	309439	
12.	Land annual lease	1000	
13.	Total cost inclusive land cost	310439	
14.	Total grain yield obtained, using improved hybrid variety 'GC22' @ 37.75 q/ha calculated @ $10143/q or $46/lb		$382898/ha
15.	Net profit/ha	$ 72459/ha or $ 32861/acre	
16.	Cost of production per quintal in Savannah of Guyana	$8223/q ($ 82/kg or $37/lb.)	

Labour was used for harvesting, drying and husking 6 persons for 2 days at $1,500.00/day, Cost of NPK (15:15:15) per bag (50kg)=$ 8500, Urea per bag (46% N)= $ 6600, Cost of round up weedicide=$2000 /lit. Seed cost @ $ 8500 per q, Production of corn (GC9) @37.75 q/ha

Table 6. Economics of corn production in Guyana during 2013-2014 in coastal region (Mon Repos, ECD)

S. No.	Inputs and operations per ha	Total expenses (G$)/ha	Total income (G$)/ha
1.	Hired machine/tractor use (Ploughing, sowing, threshing etc.)	50000	
2.	Sprinkler irrigation (Two)	5000	
3.	Hired labor @$1,500/day (100 days), all field manual operations 9Sowing, irrigation spraying, weeding, harvesting, drying, threshing etc.)	150000	
4.	Basal dressing (NPK) 200 kg	34000	
5.	Top dressing (Urea) 152 kg	20064	
6.	Herbicide cost (Round-up @3 lit/ha)	6000	
7.	Insecticide cost (2 sprayings)	6000	
8.	Seed cost @ 25 kg/ha	2125	
9.	Total expenses (labour and assets)	273188	
10.	Land annual lease	1000	
11.	Total cost inclusive land cost	$274188	
12.	Total grain yield obtained, using improved hybrid Variety ‘Guyana Corn (GC 13)’ @86.62 q/ha calculated @ $10143/q or $46/lb		$878587/ha or $355703/acre
13.	Net profit/ha	$604399/ha or $244696/acre	
15.	Cost of production per quintal in Coastal region of Guyana	$/3165q ($ 32/kg or $14/lb.)	

Labour was used for harvesting, drying and husking 6 persons for 2 days at $1,500.00/day, Cost of NPK (15:15:15) per bag (50kg)=$ 8500, Urea per bag (46% N)= $ 6600, Cost of round up weedicide=$2000 /lit. Seed cost @ $ 8500 per q, Production of corn (GC13 variety) was @86.62q/ha

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COMPETING INTEREST

I have no competing interests.

AUTHOR’S CONTRIBUTION

D. P. Singh: 50%, (Planning of trials, dispatch of seeds, data books, conduct of trial at Mon Repos location, Data analysis, paper writing.)
O. Homenauth: 20% (Being CEO of the institute he took part in arranging facilities and planning of experimentation)
N. Cumberbatch: 15% (He planned and conducted experiment at Ebini centre)
V. Persaud: 10% (He helped in conduct of the trials at Mon Repos, arranged threshing and weighing of produce).
F. Benjamin: 5% (He helped in conduct of the trial at Ebini).

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