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Performance and Yield Stability Analysis of Potato Genotypes in Ethiopia

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Abstract

Potato (*Solanum tuberosum* L.) is one of the most widely grown root and tuber crop in the mid and high altitude areas of Ethiopia. It has both dietary and income generating role to produces. However the yield obtained at farm levels is very low other compared with other county. One of the main reason for such low yield of potato in the country is luck of high yielding and disease resistance variety. To this effect, potato national variety trial was conducted by Adet, Holleta and Kulumsa Agricultural Research Centers with the main objective of identifying high yielder and disease tolerant potato genotypes in 2009 and 2010. In this trial 10 genotypes were tested against standard and local checks in randomized complete block design with three replications on gross plot size of 9 m^2 planted at a spacing of 75 cm × 30 cm between rows and plants, respectively. Combined analysis over locations and seasons revealed that the clone CIP-396004.337 gave the highest marketable tuber yield of 345.60 qt/ha followed by CIP-395096.2 (344.20 qt/ha) whereas the lowest tuber yield (156.40 qt/ha) was from CIP-396029.250. Moreover, the lowest percentage (4.03%) of late blight infestation was from CIP-396004.337 as compared to 21.17% from genotype CIP-396029.250. GGE biplot as well as ASV analysis identified CIP-396004.337 as high yielder and stable clone and therefore recommended for release as commercial variety. Since 2013, it is released as new potato variety in Ethiopia with local name of "Dagem".

Keywords: AMMI; ASV; GGE biplot; Stability; Yield

Introduction

Root and tubers are said to be one of the most efficient crops in converting natural resource, labor and capital into a high quality food with wide consumer acceptance [1]. Among the root and tuber crops potato is the first and the most predominant crop in Ethiopia. In Ethiopia potato cultivation extends from mid altitude areas to the extreme highland areas above 3000 m.a.s.l, where the environment preclude the choice for cultivating other crops except hardy crops such as potato and Barly. This emanates from the crop inherent nature to grow under wider agro-ecology conditions. Such quality of potato together with its short crop cycle makes it is a strategic food security crop in this areas. Hence, potato serves as both stable food and income generating crop.

However, the recent five years (2008-2012) mean national average yield is approximately 80.83 qt/ha (http://faostat3.fao.org), which are very low compared to the world average of 184.94 qt/ha (http://faostat3.fao.org). Diseases, poor crop management practices, lake of improved verities for different purpose and troubles, use of inferior quality seed tubers of unknown origin and health status and inappropriate storage structure are among the key factors contributing to this yield level. To overcome these problems research has been done for long periods. As a result reasonable number of disease tolerant varieties, improved crop management practices and postharvest handling technologies were identified. Pilot level demonstration of these technologies revealed the possibility of increasing the current yield three to four folds. However, our pervious released technologies and promotion activities as compared to the existing production constraints of the crop in the area indicates, till more research effort is required to overcome the problems.

One of the primary factor that determine the production and productivity of potato in the country is varieties under production. The local varieties are low yielder susceptible to major potato disease and narrow genetic base. Therefore, to develop high yielding, disease tolerant and stable potato varieties and increase the production and productivity of potato conducting variety development experiments in different part of the country is vital. This paper presents the result of potato national variety trials conducted for two main cropping seasons.

Materials and Methods

The trial was carried out for two years (2009 and 2010 main cropping seasons) across three agro-ecology zones of major potato growing areas (Adet, Holleta and Kulumsa). In this trial a total of 10 potato clones were tested against standard and local checks in randomized complete block design with three replications on a gross plot size of 9 m^2. A spacing of 75 cm × 30 cm between rows and plants, respectively were used for this trial. Fertilizer and crop husbandry practices were applied as per the recommendation. Finally agronomic and yield data were taken from the central two rows of 16 plants and used for analysis. The data were subjected to SAS V9 and GenStat V16 [2,3] for ANOVA and stability analysis, respectively.

Results and Discussion

Analysis of variance

Combined ANOVA result of each location over two years indicated significant (P<0.01) genotypic differences for plant height, stem number per plant, number of tubers per square meters, late blight score, average tuber weight tuber yield (Tables 1-4).

Year/s	Source	DF	SS	MS	% (L+G+GL)
2009	Location (L)	2	418485.99	209242.99**	40.78
	Genotype (G)	11	544939.02	49539.91**	53.1
	GL	22	62772.77	2853.31**	6.12
2010	Location (L)	2	181526.59	90763.30**	17.37
	Genotype (G)	11	480404.99	43673.18**	45.97
	GL	22	383214.63	17418.85**	36.67
-	-	-	-	-	% (L+G+Y+GL +GY+GYL)
Combined	Location (L)	2	334404.25	167202.13**	15.81
	Genotype (G)	11	963291.85	87571.99**	45.54
	Year (Y)	1	44112.37	44112.37**	2.09
	GL	22	246894.61	11222.48**	11.67
	GY	11	62052.16	5641.10**	2.93
	YL	2	265608.33	132804.16**	12.56
	GLY	22	199092.8	9049.67**	9.41

Table 1: Genotype (G), environment (L and Y), genotype by environment (GE), variance terms for rainfed potato yield trials in 2009 and 2010 and combined over these years/seasons.

At Adet, the highest plant height (71.30 cm), number of tubers per square (64.13) and maximum marketable tuber yield (422.39 qt/ha) was recorded from genotype CIP-395096.2 but it didn't should statistical difference with clone CIP-39604.337 and CIP-396031.108. Whereas the largest average tuber weight (89.57 gm) and the lowest late blight score (8.58%) was obtained from clone CIP-396004.337 (Table 2). The lowest marketable tuber yield (185.46 qt/ha) was obtained from genotype CIP-395111.13. At Holleta, the maximum number of stems per plant (4.43) and number of tubers per square meters (69.01) was counted from the clone CIP-395096.2 and the highest marketable tuber yield (327.13 qt/ha) was harvested from CIP-395011.2 (Table 3). In contrast the lowest marketable tuber yield (48.05 qt/ha) was harvested from the local variety. At Kulumsa, the maximum stem number per plant (4.76) was counted from the standard check Gudenie. The highest average tuber weight (70.06 gm) and the lowest late blight score (3.51%) was recorded from genotype CIP-396004.337 whereas the maximum tuber number per square meter (63.80) was from CIP-395111.13 and marketable tuber yield of 308.77 qt/ha was obtained from CIP-395096.2 but it didn't showed statistical difference with CIP-396004.337 and CIP-395111.13 (Table 4).

Genotypes	Plant height (cm)	Main stem/plant	Late blight (%)	No of tubers/m^2	Average tuber weight (gm)	MTY (qt/ha)	TTY (qt/ha)
CIP-396033.102	67.31ab	4.36ab	16.33b	46.2d	68.71c	305.76cd	315.20b
CIP-392641.4	51.76d	2.98cd	43.66a	37.2e	68.99c	239.73efg	255.77cd
CIP-395112.36	53.30cd	2.98cd	36.66a	54.33bcd	59.03d	314.83cd	320.45b
CIP-396004.337	64.35ab	3.12cd	8.58bcd	46.80d	89.57a	398.69ab	411.55a
CIP-395096.2	71.3a	4.43ab	10.33bc	64.13a	68.50c	422.39a	434.52a
CIP-395111.13	37.85f	1.17e	10.50bc	30.93e	31.07f	185.46g	193.34e
CIP-395011.2	63.90ab	2.41d	10.08bc	46.58d	81.90ab	357.65bc	381.20a
CIP-396031.108	69.3a	3.74abc	10.91bc	52.48cd	74.65bc	374.95ab	388.58a
CIP-396029.250	43.71ef	3.32cd	42.33a	28.93e	81.07b	210.22fg	261.13ed
CIP-396004.225	70.68a	3.57bc	16.5b	61.7ab	47.66e	287.12de	300.47bc
GUDENIE	60.11bc	4.73a	15.5b	48.33d	57.33d	265.37def	273.8bcd
LOCAL	50.06de	3.08cd	12.46bc	58.13abc	47.38e	261.74def	267.56bcd
Mean	58.67	3.32	18.13	47.97	64.66	301.99	314.04
CV (%)	11.01	26.87	37.63	15.72	11.01	16.05	15.08

LSD (5%)	7.5	1.03	7.93	8.76	8.27	56.35	55.04

Table 2: Performance of potato clones combined over season at Adet.

Genotypes	Plant height (cm)	Main stem/plant	No of tubers/m^2	Average tuber weight (gm)	MTY (qt/ha)	TTY (qt/ha)
CIP-396033.102	55.33bc	3.91bcd	37.18de	71.08ab	272.01abc	275.72ab
CIP-392641.4	33.16e	2.10f	22.38f	29.87e	60.14d	65.54c
CIP-395112.36	51.66c	3.40cde	47.01bcd	59.27bcd	279.21abc	282.48ab
CIP-396004.337	50.16c	4.10c	41.11de	76.14ab	309.21abc	311.99ab
CIP-395096.2	60.66ab	4.43ab	69.01a	42.45de	274.29abc	280.35ab
CIP-395111.13	35.83de	1.78f	66.70b	53.31cd	249.65bc	259.08b
CIP-395011.2	50.00c	2.08f	43.43d	74.12a	327.13a	330.38a
CIP-396031.108	62.66a	3.18cde	45.05cd	67.64abc	305.65abc	308.80ab
CIP-396029.250	40.00d	3.15de	31.13ef	28.47e	81.97d	87.70c
CIP-396004.225	52.83c	3.91bcd	41.11de	61.55cd	246.60c	253.05b
GUDENIE	60.66ab	4.26a	56.23b	60.10bc	315.93ab	320.83ab
LOCAL	41.16D	2.71EF	54.08BC	40.99F	48.05D	62.26C
Mean	49.51	3.33	45.37	53.33	230.81	236.51
CV (%)	10.85	24.38	20.00	27.32	25.66	25.01
LSD (5%)	6.24	0.98	10.54	16.93	68.85	68.77

Table 3: performance of potato clones combined over seasons at Holleta.

Genotypes	Plant height (cm)	Main stem/plant	Late blight (%)	No of tubers/m^2	Average tuber weight (gm)	MTY (qt/ha)	TTY (qt/ha)
CIP-396033.102	60.23cd	4.22a	14.43cd	43.07f	54.55bcd	221.30d	227.87d
CIP-392641.4	43.48ef	2.55de	19.40bc	31.06g	55.30bcd	161.71e	172.43e
CIP-395112.36	56.46d	3.19bcd	18.58bc	50.03bcde	47.29ef	232.30cd	236.74cd
CIP-396004.337	59.15cd	3.51b	3.51f	44.80edf	70.06a	305.34a	313.16a
CIP-395096.2	64.83ab	4.33a	8.30ef	62.83a	50.66ed	308.77a	317.86a
CIP-395111.13	61.26bc	2.34e	11.45de	63.80a	47.85ef	292.36a	304.36a
CIP-395011.2	60.50cd	2.33e	10.38de	43.56ef	60.07b	246.40bc	259.80bc
CIP-396031.108	65.65a	3.54b	14.26cd	47.41cdef	57.70bc	262.12b	270.51b
CIP-396029.250	40.95f	3.26bc	21.23b	30.86g	52.16cde	144.59e	155.41e
CIP-396004.225	62.55abc	3.57b	12.70de	54.80b	39.81g	207.99d	217.89d
GUDENIE	60.43cd	4.76a	10.81de	51.15bcd	42.42fg	208.39d	215.05d
LOCAL	45.46e	2.83cde	31.46a	53.13bc	31.69h	157.34e	167.35e
Mean	56.75	3.37	14.71	48.04	50.80	229.05	238.20

CV (%)	6.56	16.59	31.20	11.93	11.34	9.39	9.89
LSD (5%)	4.33	0.65	5.33	6.66	6.69	25.00	27.38

Table 4: Performance of potato clones combined over seasons at kullumsa.

Combined analysis over location in a year as well as combined over locations and years discovered presence of significant (P<0.01) difference among marketable tuber yield of tested genotypes (Table 1). During 2009 season, the maximum mean MTY (Marketable Tuber Yield) was obtained from CIP-395096.2 (329.49 qt/ha) while the minimum was from CIP-396029.250 (123.65 qt/ha) (Table 5) but there was no statistical difference between clone CIP-396004.337, CIP-395096.2 and CIP-396031.108. During 2010 season, the maximum and significant (P<0.01) mean MTY was obtained from clone CIP-396004.337(361 qt/ha) [4]. Across locations and season, the highest marketable tuber yield (337.70 qt/ha) was obtained from genotype CIP-396004.337. In contrast the lowest marketable tuber yield (145.60 qt/ha) was harvested from CIP-396029.250 (Table 5). This manly attributed to genetic difference in yielding ability and tolerance to late blight of potato (Table 6). The highest yielding genotype gave a yield advantage of 28.30 and 116.89% over the standard checks Gudenie and local check, respectively (Table 7).

Genotype	MTY (qt/ha) during 2009 season				MTY (qt/ha) during 2010 season				Combined over loc and seasons
	E1 (Adet)	E3 (Holleta)	E5 (Kulumsa)	Combined over 2009	E2 (Adet)	E4 (Holleta)	E6 (Kulumsa)	Combined over 2010	
CIP-396033.102	318.70bc	157.04bc	241.00de	238.913c	292.82cd	386.98ab	201.41bcd	292.74d	265.82d
CIP-392641.4	209.81de	47.32d	133.60f	130.244f	269.64cd	72.95c	189.82bcde	177.47g	153.86f
CIP-395112.36	364.85b	207.59ab	268.19cd	280.210b	282.81cd	350.83ab	196.41bcde	278.65e	278.45c
CIP-396004.337	371.11ab	229.82ab	342.54ab	314.489a	426.27a	388.59ab	268.14a	361.00a	337.19a
CIP-395096.2	423.15a	213.62ab	351.71a	329.493a	421.64a	334.95ab	265.81a	340.80b	335.15a
CIP-395111.13	370.33ab	208.18ab	294.55c	291.020b	254.68cd	291.11b	290.17a	278.65e	284.84c
CIP-395011.2	328.43bc	260.29a	277.69cd	288.803b	386.88ab	393.96ab	215.10bc	331.98b	310.39b
CIP-396031.108	419.91a	222.22ab	304.23bc	315.453a	329.99bc	389.70ab	220.00b	313.23c	314.34b
CIP-396029.250	185.00e	69.49cd	116.46f	123.650f	235.44d	94.44c	172.72de	167.53gh	145.59f
CIP-396004.225	353.15ab	147.73bc	250.44d	250.440c	221.09d	345.46ab	165.55e	244.03f	247.24e
GUDENIE	224.35de	192.22ab	208.58e	208.383d	306.39bcd	439.63a	208.19bc	318.07c	263.23d
LOCAL	267.13cd	50.67d	131.50f	149.767e	256.35cd	45.43c	183.18cde	161.65h	155.71f
MEAN	318.21	162.18	243.38	243.4056	285.77	294.45	214.70	271.99	257.65
CV	13.19	33.01	9.54	6.22	18.61	22.21	9.61	4.046	5.13
LSD	72.67	93.45	39.31	18.898	90.06	110.76	34.96	13.738	11.51
Range	238.15	212.97	235.25		205.18	394.2	124.62		

Table 5: Genotype performance over 2009 and 2010 season and combined over these years.

Genotypes	Plant height (cm)	Main stem/ plant	Late blight (%)	No of tubers/ m^2	Average tuber weight (gm)	TTY (qt/ha)
CIP-396033.102	60.99cd	4.17bc	10.25c	42.13e	64.78b	272.9b
CIP-392641.4	42.80fg	2.54fg	21.02a	30.18f	51.39c	164.6c
CIP-395112.36	53.80e	3.19ed	19.41a	50.46bc	55.20c	279.9b
CIP-396004.337	57.88d	3.58d	4.03e	44.24de	78.59a	345.6a
CIP-395096.2	65.60ab	4.39b	6.21de	65.32a	53.87c	344.2a

CIP-395111.13	44.98fg	1.76h	4.16e	50.47bc	44.08d	252.6b
CIP-395011.2	58.13d	2.27g	6.82de	44.52de	73.70a	323.8a
CIP-396031.108	65.87a	3.49d	8.39cd	48.31cd	66.66b	322.6a
CIP-396029.250	41.55g	3.42de	21.17a	30.31f	53.91c	156.4c
CIP-396004.225	62.02bc	3.68cd	6.48de	52.53bc	49.67cd	257.1b
GUDENIE	60.53cd	4.92a	8.77cd	51.90bc	53.28c	269.9b
LOCAL	45.56f	2.87ef	14.64b	55.11b	30.02e	165.7c
Mean	54.98	3.34	10.95	47.12	56.26	262.9
CV (%)	10.01	22.90	43.16	15.98	17.50	17.60
LSD (5%)	3.62	0.50	3.11	4.96	6.48	30.5

Table 6: Yield, agronomic and disease reaction of potato clones combined over locations and seasons.

Genotypes	MTY (qt/ha)	Advantage over the standard check	Advantage from the local check
CIP-396033.102	264.6	0.53	69.94
CIP-392641.4	153.9		
CIP-395112.36	275.4	4.63	76.88
CIP-396004.337	337.7	28.30	116.89
CIP-395096.2	335.5	27.17	115.48
CIP-395111.13	242.5		55.75
CIP-395011.2	310.4	17.93	99.36
CIP-396031.108	314.2	19.37	101.79
CIP-396029.250	145.6		
CIP-396004.225	247.2		
GUDENIE	263.2		
LOCAL	155.7		

Table 7: Mean marketable tuber yield and yield advantage of potato clones across locations.

The two genotypes CIP-396004.337 and CIP-395062.2 were the two superior genotypes that produced the highest tuber yield as well as the lowest late blight percentage. There for, these clones are selected as a candidate for variety verification trial of 2012 year for release to maximize potato yield in the country. At appropriate stage we invited technical committee to see the field performance of candidate clones across Adet, Holleta and Kulumsa location. During this trial stage, the maximum mean on-station as well as on-farm tuber yield was obtained from clone CIP-396004.337 (Table 8). The mean on-station and on-farm of tuber yield (qt/ha) of clone CIP-396004.337 were ranged from 332.80 (Holleta) to 472.50 (Kulumsa) and 243.90 (Holleta) to 460 (Kulumsa), respectively. This clone, also showed minimum late blight score (Table 8). It also had better mineral and starch content (Table 8). This result assures that clone CIP-396004.337 is one of the potential variety to bust production in the country.

Genotype	Total tuber yield (tons/ha)						Late blight score (%)		Dry matter content (%)	Starch yield (t/ha)*	Mineral content (mg/kg)*	
	Adet		Holleta		Kulumsa							
	On-station	Means across on-farms	On-station	Means across on farms	On-station	Means across on farms	Adet	Kulumsa	FE	ZN		
CIP-396004.337	337.5	308.0	332.8	243.9	472.5	460.0	6	8.5	24.22	5.63	79.96	8.10
CIP-395096.2	292.5	281.0	321.0	223.1	267.9	266.2	17	10	22.50	4.21	32.98	10.8
Gudenie	270.0	213.5	314.8	226.9	274.7	255.3	24	32	23.30	6.91	24.63	7.07
Belete	295.0	281.0	323.0	239.6	430.0	432.2	4	6	22.58	4.25		

Table 8: mean total tuber yield, late blight score and quality parameters of candidates and standard checks during VVT during 2012 main season. *adapted from: Tesfaye et al. [5].

Stability analysis

GGE Biplot: The partitioning of GGE through GGE biplot analysis showed that PC1 and PC2 accounted 78.50% and 12.13% of GGE sum of squares, respectively explaining a total of 90.63% variation (Figure 1). This result revealed that there was a differential yield performance among potato genotypes across testing environments due to the presence of GEI. Genotypes that had PC1 scores>0 were identified as

higher yielding and those that had PC1 scores<0 were identified as lower yielding [6]. Thus, of the tested genotypes G4, G5, G7 and G8 identified as high yielder genotypes (PC1 score>0) while G2, G9 and G12 as low yielder genotypes (PC1 score<0 (Figure 1). Unlike the PC1, PC2 was related to genotypic stability/instability. The minimum the absolute PC2 value is the more stable than the other. Thus, G7and G8 were the most stable genotypes. Similarly, among high yielder genotypes G4 also had better stability.

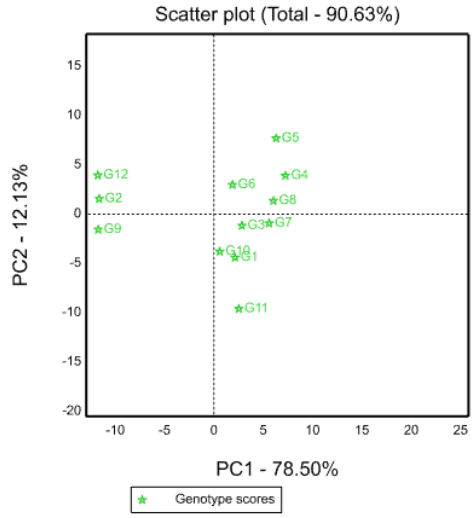

Figure 1: GGE-biplot based on genotype focused scaling for the trait MTY (qt/ha), 2009 and 2010. Where G1-CIP-396033.102; G2-CIP-392641.4; G3-CIP-395120.36; G4-CIP-396004.337; G5-CIP-395096.2; G6-CIP-395111.13; G7-CIP-395011.2; G8-CIP-396031.108; G9-CIP-396029.250; G10-CIP-396004.225, G11-Gudenie and G12-Local variety.

Mean performance and stability of potato genotypes: Figure 2 shows the AEC view of the GGE biplot. The average tester coordinate (ATC) ordinate separates genotypes with above average mean from below average means. Therefore, genotypes with above average means were from G3 to G4 on the figure, while G9, G2 and G12 were genotypes which had below average mean performance. Whereas G1, G11 and G10 were had near to average mean yield. The shorter the genotype vector is more stable than others. Thus, among tested genotypes G4 identified as maximum yielder genotype as well as better stability while G11 identified as poorly stable (long vector length) and mean yielder genotypes. Among the tested genotypes G5 identified as high yielder genotype but less stable genotype.

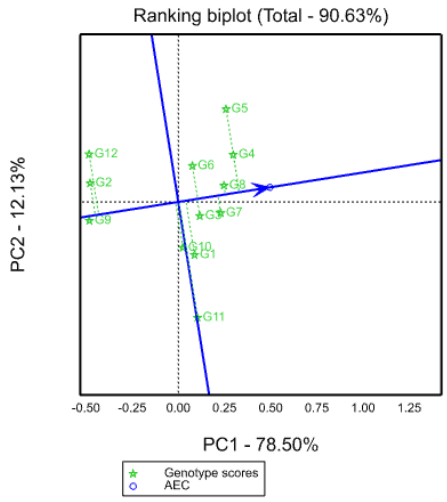

Figure 2: GGE ranking biplot shows the mean marketable tuber yield and stability performance.

Comparison of genotypes with ideal genotypes: An ideal genotype should have both high mean yield performance and high stability across environments. It is a genotype to be on average environmental coordinate (AEC) on positive direction and has vector length equal to the longest vector of the genotype on the positive side of AEC with longest vector length of high yielding genotypes and indicated by an arrow pointed to it [4,6]. Thus, Figure 3 shows that G4 nearest to the ideal genotypes (the center of concentric circles) so it is more desirable than other tested genotypes.

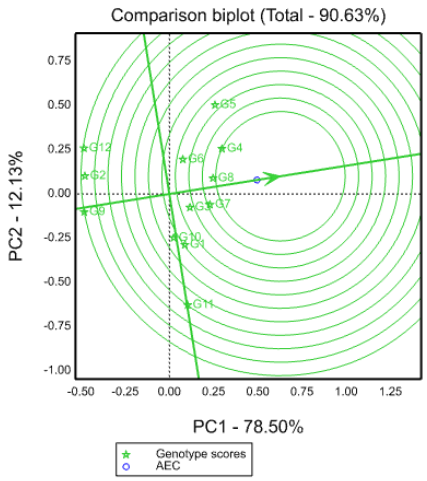

Figure 3: Comparison biplot views of marketable tuber yield of genotypes with the ideal genotype.

Suitability of genotypes for particular environment using the "Which-Won-Where" function of a GGE biplot: Figure 4 shows the which-won- Where view of this study. The vertex genotypes in this figure were G4, G5, G7, G9, G11 and G12. Four rays divide the biplot in to four sectors. Out these test environments fall in three of them. The vertex genotype for sector which encompasses E1, E2, E5 and E6 was G4 and sector content E3 was G7, for E4 was G11, these implying that these genotypes were the winning genotypes for respected environments. However, Which-won-where views of the GGE biplot of each year was repeated across years (Figure 5). In this case GE can be exploited by recommending specific genotype to specific locations [7]. Thus, G4 can be recommended to Adet and Kulumsa and G7/11 for location Holleta.

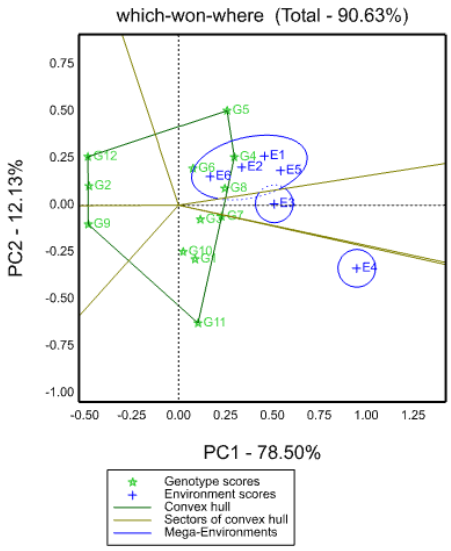

Figure 4:. Where E1 and E2; E3 and E4, E5 and E6 were 2009 and 2010 rain fed season in Adet, Holleta and Kulumesa, respectively.

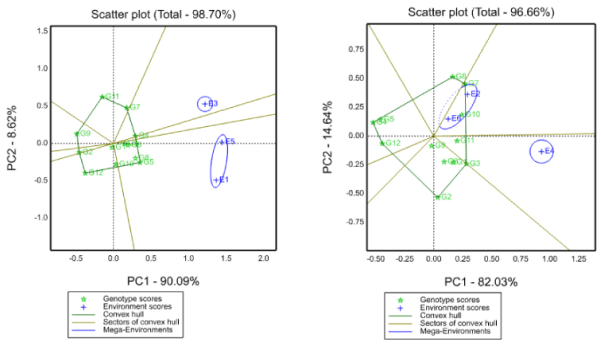

Figure 5: Which won where view of GGE biplot of 12 genotypes over three locations during 2009 (left) and 2010 (right).

AMMI's stability value (ASV): AMMI's stability value (ASV) was calculated using the following formula, as suggested by Purchase [8].

$$ASV = \sqrt{\left[\frac{IPCA1SS(IPCSA1\ score)}{IPCA2SS}\right]^2 + (IPCA2\ score)^2}$$

Where, ASV=AMMI's stability value, SS=Sum of Squares, IPCA1=Interaction of Principal Component Analysis one, IPCA2=Interaction of Principal Component Analysis two IPCASS1 and IPCASS2 are engine values Sum of squares of PCA 1 and PCA2 respectively.

The AMMI stability value (ASV) [8] based on the AMMI model's IPCA1 and IPCA2 scores for each genotype was also computed. The

larger the IPCA scores, either negative or positive, the more specifically adapted a genotype is to a certain environments; the smaller the IPCA scores, the more stable the genotype is over all environments studied. Stability in performance of genotypes across locations and seasons (2009 and 2010 rainfed seasons) using ASV for MTY was performed (Table 9). During 2009 season, clone CIP-395112.36 identified as stable while Gudenie was identified as the most unstable variety. Whereas during 2010 season as well as combined over seasons and locations analysis identified, CIP-396004.337 and clone Local variety as stable and unstable clones, respectively.

Genotype	2009 season					2010 season					Combined over locations				
	Genotype mean	IPCA1	IPCA2	ASV	RANK	Genotype mean	IPCA1	IPCA2	ASV	RANK	Genotype mean	IPCA1	IPCA2	ASV	Rank
1	238.9	0.57	-0.32	3.26	2	292.7	4.80	0.49	32.37	7	265.8	-4.79	0.18	16.08	7
2	130.2	0.62	-0.53	3.59	4	177.5	-8.53	-0.28	57.52	11	153.9	8.28	2.90	27.95	11
3	280.2	0.26	1.98	2.46	1	276.7	3.43	0.82	23.16	5	278.4	-3.11	-3.28	10.96	4
4	314.5	-0.60	-4.63	5.76	5	361	0.54	-4.04	5.42	1	337.7	-0.75	2.63	3.64	1
5	329.5	3.56	-3.49	20.61	9	340.8	-1.71	-4.18	12.23	3	335.1	2.08	-1.21	7.08	3
6	291	0.60	-0.56	3.48	3	278.7	-1.06	7.88	10.63	2	284.8	1.39	-4.95	6.81	2
7	288.8	-5.19	1.59	29.69	11	332	2.88	-4.60	19.94	4	310.4	-3.44	4.11	12.25	6
8	315.5	2.73	1.96	15.72	7	313.2	3.66	-0.63	24.68	6	314.3	-3.10	-4.04	11.18	5
9	123.7	-2.28	1.07	13.08	6	167.5	-6.48	1.05	43.72	9	145.6	6.02	3.22	20.49	9
10	250.4	3.24	0.14	18.49	8	244	5.16	2.97	34.94	8	247.2	-4.49	-5.86	16.17	8
11	208.4	-7.36	-0.36	42.03	12	318.1	6.64	0.48	44.76	10	263.2	-7.71	7.31	26.92	10
12	149.8	3.86	3.16	22.25	10	161.7	-9.33	0.04	62.93	12	155.7	9.62	-1.01	32.35	12

Table 9: AMMI stability value (ASV) with the IPCA 1 and IPCA 2 scores, mean marketable tuber yield and ranks of 12 clones during 2009, 2010 and combined over all environments.

Conclusion

During variety releasing committee meeting, the technical committee report was in line with our submitted data. However, both candidate clones have similar merits variety releasing committee accept the release of CIP-366004.337 clone as a new variety with local name of 'Dagem' during April, 2013 meeting at Addis Ababa.

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