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Estimation of Genetic Variability among Potato (Solanum tuberosum L.) genotypes at Bekoji, Southeastern Ethiopia

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Abstract

The experiment was conducted at Kulumsa Agricultural Research Center, Bekoji site during 2020-21. The experiment consisting of a total thirteen potato genotypes following randomized complete block design with three replications for analysis of variance, mean performance were computed. The analysis of genetic variance revealed that the sufficient variability were present in experimental material. The analysis of variance exhibited that most of the genotypes performed significantly (P≤0.05) variable for stem height, days to flowering, days to maturity, stem number, marketable tuber yield, and total tuber yield registering the significant genetic variability among the genotypes evaluated. Genotypic and phenotypic coefficient of variations ranged from 2.59 to 63.58 and 4.49 to 75.14% respectively in first season while, in second season also range from 3.01 to 48.03 and 4.26 to 51.57% respectively. The phenotypic coefficient of variance (PCV) was slightly higher in magnitude than genetic coefficient of variance (GCV) for most of the parameters revealing that influence of seasons in expression of the traits. The heritability estimates recorded to be high for the characters viz. stem number per plant, stem height, emergence day, maturity day, marketable tuber yield and total tuber yield ha-1,while moderate to high heritability values as stem number per plant, total yield and tuber dry matter contents. The highest to moderate genetic advance was recorded for the characters as marketable tuber yield, stem number, total tuber yield, stem height and tuber dry matter content revealed that both the season and genetic variance are operating in these traits. Promising genotypes with desirable traits could be recommended to produce new variety or use as parental lines for future breeding program.

Keywords: Heritability; Genetic advance; GCV; PCV; Tuber yield

Introduction

Potato (Solanum tuberosum L.) is considered as one of the four major agronomic crops (after wheat, maize and rice) all over the world as a staple food **[1]**. In Eastern African potato is the high yield potential and plasticity to environmental regimes makes it one of the best crops for food and nutrition security **[2]**. Nowadays, potato is regarded as the major food security crop mainly because it can provide a high-volume crop produce with high nutritional products per unit input and with a short crop cycle (mostly within less than four months) **[3]**. Since potato is grown from mid altitudes to very high mountain tops, and from humid to dry areas in the country, improvements in productivity will require the development of varieties best adapted to a wide range of environments and yield advantages **[4]**. The major objective of potato breeding has been to develop potato cultivars that have maximum yield potential, adaptable to wide agro-ecologies and resistant to late blight that has been the most devastating disease throughout the dominant potato producing highlands of the country **[5]**. Knowledge on the nature of variability and association of yield with its components is of great impotence for identification of superior parents in any breeding program **[6]**. Mainly, studying the genetic variability for a given character is a basic precondition for its improvement by systematic breeding **[7,8]**. Reduction in genetic variability makes the crops increasingly vulnerable to diseases and adverse climatic changes **[9]**. Genetic variability, which is due to genetic differences among individuals within a population, is the foundation of plant breeding since proper management of diversity can produce a permanent gain in the performance of plants and can safeguard against seasonal fluctuations **[10,11]**. Moreover, estimation of genetic variability alone does not provide clear cut indication of possible advancement that can be achieved through selection and it should be coupled with heritability and genetic advance **[12]**. Although, estimates of heritability provide the basis for selection on phenotypic performance, estimates of heritability and genetic advance should be considered simultaneously because high heritability should not always associate with high genetic advance **[13]**. High heritability coupled with genetic advance is more dependable, while for others, the intensity of selection should be increased; gives an idea of the possible improvement of new populations through the selection and high heritability with low genetic advance indicates the presence of non-additive gene action **[14]**. Creating genetic variability in tetraploid potato crop through hybridization in the country is limited due to too much dependence on CIP materials **[15]**. Improving productivity of the crop through hybridization is necessary to develop varieties which are adaptable to a wide range of environments **[16]**. Hence, most of smallholder farmers are still use local tuber seed and varieties with low genetic variability are the major constraints of low yield in potato. Estimates of heritability based on growing potato genotypes at multiple locations for several years will support potato breeders to decide the breeding strategy that should be followed.

Moreover, knowledge on the degree of genetic variability present among genotypes and the association of quantitative characters with yield is vital for any crop improvement program and also to develop suitable selection strategies **[17]**. Such information is scanty owing to the limited work done by the Ethiopian potato breeding program within the existing genetic pool in the country. Therefore, the present

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study was carried to investigate and estimate the nature and extent of variability in yield and agronomic traits among eleven genotypes, one released varieties and one local cultivar.

Materials and Methods

Description of the Study Area

The field experiment was conducted at Bekoji, Southeastern Ethiopia during the rain growing season in 2020 and 2021. Bekoji is located between latitude and longitude of 070 32' 37'' N and 390 15' 21'' E coordinates. The altitude of Bekoji is 2810 meters above sea level and the annual minimum and maximum temperature of 3.8 and 20.4 0C respectively with annual rain fall 939 mm. The rainy season over the sites extends from June through October and is sufficient for crops with a maturity period of 120–150 day. The soil type of the area was Clay soil (Nitosols) with PH of 5.23 as indicated in **Tables 1 and 2.**

Experimental Design and Materials

The experiment was laid out as a Randomized Complete Block Design (RCBD) where each genotype was replicated three times. A total of 13 potato genotypes including one released variety as standard check and one local check were used for the experiment **(Table 3).** Those 11 genotypes we used for the evaluation were from crossing of Adet Agricultural Research Centre. The gross of each plot were 3 m x 3 m = 9 m2 consisting of four rows, which accommodated 10 plants per row and 40 plants per plot. The net plot size is 1.5 m x 2.4 m=3.6 m2. The spacing between plots and adjacent replications were 1.0 and 1.5 m, respectively. Medium-sized and sprouted potato tubers were planted at the spacing of 75 cm between rows and 30 cm between plants with planting depth was maintained at 5 to 10 cm. The whole recommended rate of 242 kg NPS ha-1 was applied at planting as source of phosphorous and 75 kg Nha-1 in the form of Urea in two splits, half rate after full emergence and half rate at the initiation of tubers. All agronomic practices were applied as per the recommendation made by the Research center for the area.

Data Collection

Data was recorded for phenology and growth parameters; days to 50% flowering, days to maturity, plant height (cm) and average stems number. For yield parameters; total tuber yield (t/ha), and marketable tuber yield (/ha) and tuber quality attributes: as tuber dry matter content (%) and specific gravity. Dry matter percent calculated according to **[18].**

Dry matter = (weight of sample after drying (g)) / (Initial fresh weight of sample (g))*100

Specific gravity was calculated according to formula.

Specific gravity = (weight in air)m / (weight in air - weight in water)

Data Analysis

The collected data were subjected to analysis of variance (ANOVA) using the SAS (Statistical Analysis Software) version 9.2 (SAS, 2008). Duncan Multiple Range Test (DMRT) was used to compare the mean performance of genotypes at 5% and 1% level of significant mean squares was subjected to genetic analyses.

Phenotypic and Genotypic Variability

The variability present in the population was estimated by simple measures viz., range, mean, standard error, phenotypic and genotypic variances and coefficient of variations. The phenotypic and genotypic variances and coefficient of variations were estimated according to the following methods suggested by Burton and De vane (1953). = + = Where = Phenotypic variance, = genotypic variance and = environmental variance (error mean square); = mean square of treatment and r = number of replications;

Genotypic coefficient of variation (GCV %) = (√(⟦σ2 ⟧_g))/(x ̅) *100

Phenotypic coefficient of variation (PCV %) = (√(⟦σ2 ⟧_p))/(x ̅) *100 Where, Vg = Genotypic variance, Vp = Phenotypic variance, x ̅ = Grand mean of the character. PCV and GCV were categorized as following: 0 – 10%: low, 10 - 20%: moderate, 20% and above high [19].

Heritability in the Broad Sense:

In total, 201.71 quintals of EGS of tef were produced from the

Table 1: Physicochemical properties of soils of Bekoji experimental sites.

Altitude	Soil physical and chemical properties						
Above sea level(m)	Soil pH	Total N (%)	Available P (ppm)	Available K ($Cmol^{+}$. kg^{-1})	CEC (Meq per100 g)	Organic matter (%)	Texture
2810	5.23	0.21	9.72	0.83	23.72	1.89	Nitosols

Data analyzed by the Kulumsa Soil laboratory Research Department center

Table 2: Mean temperature, rainfall, and relative humidity of two seasons at Bekoji experimental site.

Cropping season	Cropping season months	Mean monthly Rainfall (mm)	Mean air temperature (°C)		Relative humidity (%)
			Minimum	maximum	
2020	May	83.9	6.3	20.6	54
	June	155.2	3.8	20.1	70
	July	296.3	3.9	18.9	79
	August	190.9	4.0	18.7	80
	September	109.0	4.2	19.0	72
	October	87.2	2.3	20.0	66
2021	May	74.2	3.5	21.0	72
	June	82.6	3.1	23.3	78
	July	213.0	3.1	23.2	81
	August	193.3	3.5	20.8	82
	September	100.1	3.2	19.4	77
	October	57.5	3.1	20.3	78

Source: Kulumsa Agricultural Research Meteorology Bekoji station.

2016/17-2021/22 cropping season **(Table 2).** The highest share of 32.82 quintals of seed was produced from the variety Areka-1 pre-basic in 2018/19, followed by 21 quintals of the variety Cr-37 pre-basic seed in 2019/20. The lowest share of 1.2 quintals of seed was produced from the varieties Cr-37 pre-basic and Boset basic in 2017/18 **(Table 2).**

Genetic advance

The Genetic Advance (broad sense) expected under selection assuming the selection intensity of 5% was calculated by the formula suggested by [**20, 21**]: Gs= (K) (δA) (H) Where, Gs = expected genetic advance, and K = the selection differential (K=2.06 at 5% selection intensity), δA= phenotypic standard deviation, H = heritability. Genetic advance as part of the mean (GA) for each trait was computed as GA = (k) (σp)* (H^2)

Genetic advance as percent of means (GAM):

Genetic advance as percent of mean was estimated as follows: GAM = GA/($\bar{x}$)*100 Where, GA = Genetic advance, $\bar{X}$ = Grand mean; Genetic advance as percent of mean was categorized as 0-10% = Low, 10-20% = Moderate, >20% = High as suggested by [**19**].

Results and Discussion

Analysis of Variance

A homogeneity test was conducted since the experiment was multi-seasonal that needs to be analyzed with combined ANOVA. Homogeneity of error variances assured that the data of both seasons were homogenies; so that separate data analysis were preferred rather than combined analysis over years. The analysis of variance (ANOVA) showed that there was significant difference in potato tuber yield during both cropping seasons. Thus, the mean squares from analysis of variance for all traits of 13 potato genotypes are presented in **(Table 4).** Total tuber yield was highly significantly ($P<0.05$) affected by genotypes in both cropping seasons, The results revealed that the presence of significant differences among potato genotypes for all traits except for days to flower and specific gravity, dry matter content for 2020 and 2021 respectively. As a result most of the genotypes performed significantly ($P\leq0.05$) variable for stem height, days to flowering, days to maturity, stem number, marketable tuber yield, and total tuber yield ha^{-1} registering the significant genetic variability among the genotypes evaluated. The yield difference between the cropping seasons may be the seasonal environment effect on the genotypes that gave maximum mean values of total tuber yield, marketable tuber yield, stem height, stem number per hill in 2020 and total tuber yield, marketable tuber yield, stem height and days to maturity, this suggesting the presence of genetic variability among the genotypes for the characters studied which shows an ample scope for selection of promising genotype from the present gene pool for increasing tuber yield; while the lowest mean value of these traits was recorded from the local check in second season 2021 **(Table 4).** The presence of large amount of variability might be due to diverse source of material taken as well as seasonal influence affecting the phenotypes. Many authors also reported the existence of significant variation among potato genotypes for different traits as: [**22,23**].

Estimation of Phenotypic and Genotypic Coefficient of Variation

The phenotypic and genotypic coefficient of variations for first season were ranged between 4.49 to 75.14% and 2.59 to 63.58%, respectively. In the second season the phenotypic and genotypic coefficient of variations were ranged between 4.26 to 51.57 and 3.01 to 48.03%, respectively. Both highest phenotypic and genotypic coefficient of variations were computed for marketable tuber yield and total tubers yield t ha-1 respectively, while the lowest phenotypic and

Table 3: List of experimental materials included in the study.

No.	Genotype	Pedigree	No.	Genotype	Pedigree
1	AD515606.16	Belete x Aterababa	**8**	AD515578.102	Jalene x Aterababa
2	AD515606.44	Belete x Aterababa	**9**	AD515606.15	Belete x Aterababa
3	AD515578.77	Jalene x Aterababa	**10**	AD515578.187	Jalene x Aterababa
4	AD515578.49	Jalene x Aterababa	**11**	AD51645.9	Belete x CIP-396034.263
5	AD515270.96	Gera x Shenkola	**12**	Belete	Standard check
6	AD515606.213	Belete x Aterababa	**13**	Local check	Farmer's cultivar
7	AD515606.164	Belete x Aterababa			

Source of all genotypes except the local cultivar and Belete was Adet Agricultural research center

Table 4: Mean squares from analysis of variance for agronomic and yield traits of 13 potato genotypes tested for two years at Bekoji.

Source of variation	Year 2020									
	DF	DE	DF	DM	STN	STH	MY	TY	SG	DM
Replications	2	1.64	37.33	4.18	0.28	1.46	1.87	4.66	0.02	0.41
Genotypes	12	15.91**	23.08ns	45.61**	2.50**	252.08**	198.92**	206.21**	0.002**	8.85**
Error	24	1.73	20.97	7.01	0.59	36.85	38.75	44.58	0.002	4.12
Mean		18.89	70.64	116.28	2.93	60.69	27.45	31.37	1.22	25.13
CV %		6.95	6.48	2.28	26.3	10.00	29.02	21.28	3.99	8.07
R^2		0.83	0.42	0.77	0.68	0.78	0.72	0.69	0.33	0.52
Year 2021										
	DF	DE	DF	DM	STN	STH	MY	TY	SG	DM
Replications	2	16.23	0.54	3.00	3.48	75.00	49.84	107.01	0.001	44.81
Genotypes	12	33.03**	50.31**	59.75**	7.30**	617.06**	445.55**	537.42**	0.001ns	16.86ns
Error	24	3.93	5.37	10.89	1.58	42.5	64.72	76.58	0.001	11.81
Mean		19.15	67.54	120.31	6.49	82.07	42.98	47.9	1.05	19.82
CV %		10.34	3.43	2.75	19.37	7.94	18.63	18.27	1.13	17.34
R^2		0.82	0.84	0.74	0.72	0.88	0.78	0.78	0.37	0.51

genotypic coefficient of variations were recorded for specific gravity in both season **(Table 5).** In agreement with this result, **[23]** reported that highest PCV and GCV was observed for marketable tuber yield t ha^{-1} (34.84 and 32.59%), total tuber yield t ha^{-1} (32.26 and 30.40%), while the lowest PCV and GCV were observed in specific gravity. As a result, higher genotypic and phenotypic coefficient of variation were recorded for total tuber yield, marketable tuber yield, stem number per hill, plant height and days to emergence for both season. Similarly, **[15,24]** also reported high PVC and GCV for marketable yield t ha^{-1} and total tuber yield t ha^{-1}. The traits which exhibited high estimates of genotypic and phenotypic coefficient of variation have high probability of improvement through selection while the improvement of traits is difficult or virtually impractical through selection which exhibited low estimates for both variability components due to the masking effect of environment on the genotypic effect **[25].** Moderate genotypic and phenotypic coefficient of variation value were recorded for tuber dry matter content (10.88% & 13.55%) and days to flowering (10.31% & 10.87%) for first and second production season respectively. This revealed the existence of substantial variability and selection of genotypes would be effective based on this traits for further improvements. However days to flowering (5.68% & 8.62%) during first cropping season, days to maturity (5.66% & 6.10%) and specific gravity (2.59% & 4.49%) had the lowest GCV and PCV values respectively, which revealed low variability. This indicated the presence of seasonal influence on these characters was considerably low for the expression of the traits. The results of the phenotypic variance were in general higher than the genotypic variance for all characters studied. Thus it suggests the substantial influence of environment (season) besides the genetic variation for expression of these traits. The difference between phenotypic and genotypic coefficient of variation was the most pronounced for the traits stem number, average tuber number, average tuber weight, number of leaves per plant, tuber yield. Therefore, we speculated that these traits are substantially influenced by the growing environments.

Estimates of Heritability and Genetic Advance

The estimated values of heritability and genetic advance as percent of mean for first growing season were ranged from 33.00% (specific gravity) to 89.87% (days to emergence) and 3.08% (specific gravity) to 93.11% (tuber marketable yield), respectively. While, during second (2021) cropping season the moderate to highest genetic advance for tested genotypes expressed as percentage of the mean (GAM) showed for all traits ranging from 4.39 to 92.16% except for specific gravity of tubers **(Table 5).** Most of the traits had high heritability values as days to emergence, days to maturity, stem height, marketable tuber yield and moderate to high heritability values as stem number per plant, total yield and dry matter contents respectively. A similar result reported by **[15,21]** reported for plant height, average stem number, total tuber yield and marketable tuber yield both high heritability (> 60%) and genetic advance (> 20%) as a percent of the mean. Traits which showed high values of genetic advance might be due to additive gene action. Mishra et al., 2006 noticed that high heritability associated with high genetic advance would be used as a clue in most selection programs and these characters were predominantly governed by additive gene action and can be improved through simple selection **[25].** But high heritability followed by low genetic advance indicates that the high heritability is expressed probably due to the favorable influence of environment rather than genotype and selection for such traits may not be rewarding. However, **[19]** suggested that heritability estimates along with genetic advance would be more useful in predicting yield under phenotypic selection than heritability estimate alone. As a result days to flowering and specific gravity was recorded medium to low heritability value respectively. Similarly, specific gravity and dry matter content percentage coupled with low heritability and low to medium genetic advance was reported by **[23].**

Mean Performance of Genotypes

Thirteen potato genotypes exhibited a wide range of mean values

Table 5: Estimate of variability components for 13 potato genotypes evaluated at Bekoji for two years.

Traits	Range		Mean	s_g^2	s_p^2	s_e^2	PCV (%)	GCV (%)	H^2 (%)	GA	GAM (%)
	Max	Min									
Year 2020											
Days to emergence	22.67	16.00	18.89	15.34	17.07	1.73	21.87	20.73	89.87	7.65	40.49
Days to 50% flowering	74.00	64.33	70.64	16.09	37.06	20.97	8.62	5.68	43.42	5.44	7.71
Days to maturity	121.0	107.7	116.28	43.27	50.28	7.01	6.10	5.66	86.06	12.57	10.81
Stem number per hill	5.13	1.73	2.93	2.03	2.62	0.59	55.24	48.63	77.48	2.58	88.17
Steam height (cm)	71.00	42.00	60.69	239.79	276.64	36.85	27.41	25.52	86.68	29.70	48.94
Marketable tuber yield (t/ha)	38.01	11.94	27.45	186.01	224.76	38.75	54.62	49.69	83.76	25.56	93.11
Total tuber yield (t/ha)	48.69	21.63	31.37	191.35	272.31	80.96	52.60	44.10	70.27	23.89	76.15
Specific gravity of tubers (g/cm3)	1.26	1.18	1.22	0.00	0.00	0.002	4.49	2.59	33.00	0.04	3.08
Dry matter content (%)	27.67	22.17	25.13	7.48	11.60	4.12	13.55	10.88	64.48	4.52	18.00
Year 2021											
Days to Emergence	27.67	15.00	19.15	32.32	36.25	3.93	31.44	29.69	89.16	11.06	57.75
Days to 50% flowering	73.33	58.67	67.54	48.52	53.89	5.37	10.87	10.31	90.04	13.62	20.16
Days to maturity	126.33	114.0	120.31	56.12	67.01	10.89	6.80	6.23	83.75	14.12	11.74
Stem number per hill	8.73	3.27	6.49	6.8	8.38	1.58	44.60	40.18	81.15	4.84	74.56
Steam height (cm)	104.33	47.67	82.07	602.9	645.4	42.5	30.95	29.92	93.41	48.89	59.57
Marketable tuber yield (t/ha)	65.93	22.59	42.87	423.98	488.7	64.72	51.57	48.03	86.76	39.51	92.16
Total tuber yield (t/ha)	73.78	25.93	47.9	511.89	588.47	76.58	50.64	47.23	86.99	43.47	90.75
Specific gravity of tubers (g/cm^3)	1.06	1.04	1.05	0.001	0.002	0.001	4.26	3.01	50.00	0.05	4.39
Dry matter content (%)	23.40	16.17	19.82	12.92	24.73	11.81	25.09	18.14	52.24	5.35	27.00

Where: $\delta^2 p$ =Phenotypic variance, $\delta^2 g$ =Genotypic variance, PCV = phenotypic coefficient of variance, GCV = Genotypic coefficient of variation, H^2 (%) = Heritability in broad sense, GA (5%) = genetic advance at 5% selection intensity, GAM (%) = genetic advance as percent mean.

for all traits with both season. The first season 2020 the genotypes of total tuber yield and marketable tuber yield were ranged from 21.63 to 48.69 and 11.94 to 38.01 t ha^{-1} with the overall mean total tuber yield of 31.37 t ha^{-1}, whereas the second year 2021 the total tuber yields and marketable yields were ranged from 25.93 to 73.78 and 22.59 to 65.93 t ha^{-1}, respectively **(Table 6).** Total tuber yield was significantly ($P<0.05$) affected by genotypes in both cropping seasons. Since there were no interaction effect between genotypes and year, tuber yield was put in the form of one way table. Tuber yield (t ha^{-1}) was significantly ($P < 0.05$) affected by cropping season.

Relatively, higher yield was recorded during 2021 cropping season compared to 2020 cropping season because of may be the heavy rainfall and relative humidity condition during 2020 cause favorable environment to high pressure of late blight severity. In 2020 cropping season, significantly the highest total tuber yield (48.69 t ha^{-1}) was recorded from genotype AD51645.9 followed by AD515606.164 genotype (44.49 t ha^{-1}) and Belete variety (37.48 t ha^{-1}) which was statistically similar, while the lowest total tuber yield (21.63 t ha^{-1}) was recorded from genotype AD515578.77 followed by 22.53 and 24.74 t ha^{-1} were recorded from the genotypes of AD515578.102 and AD515578.187 respectively. In 2021 cropping season significantly, the highest total tuber yield (73.78 t ha^{-1}) was recorded from standard check Belete variety followed by AD515606.164 genotype (60.00 t ha^{-1}) were recorded, while the lowest total tuber yield (25.93 t ha^{-1}) was recorded from the local check followed by 28.74 and 34.96 t ha^{-1} were recorded from the genotypes of AD515606.44 and AD515578.102 respectively (Table 6). In a similar kind of study, [**26**] state that potato genotypes (offsprings) produced from Belete cross with Ater Ababa manifested highest mean for marketable tuber yield and total tuber yield. This may be due to over dominance of maternal effect which Belete (female parent) is high yielder variety in the country. Tuber yield variation results were reported on potato genotypes by different scholars in Ethiopia In addition to the genetic makeup of the genotype, differences in other factors could have contributed to the observed yield variations among varieties and environments [**27**]**.** Generally, the genotype AD51645.9 and AD515606.164 recorded maximum mean performance among the genotypes for number of characters but, no significant with standard check variety in season [**28,29**]**.**

Conclusion and Recommendations

The present study revealed that there exists an adequate amount of variability in the genotypes studied in almost all traits. The estimates

Table 6: Mean performances of 13 potato genotypes for tuber yield and other traits evaluated at Bekoji for two seasons 2020 & 2021.

Genotypes	Year 2020								
	DE	DF	DM	STN	STH	MY	TY	SG	DMC
AD515606.16	19.33^{cd}	73.00	120.67^{ab}	2.33^{cde}	50.67^{ef}	21.56^{cd}	30.58^{cd}	1.23	25.00
AD515606.44	22.67^{a}	74.00	114.67^{cde}	2.00^{de}	42.00^{f}	17.78^{cd}	29.47^{cd}	1.26	26.67
AD515578.77	17.67^{de}	69.67	114.00^{de}	2.93^{bcde}	57.67^{bcde}	11.94^{d}	21.63^{d}	1.22	23.00
AD515578.49	16.67^{e}	74.00	118.67^{abc}	3.27^{bcd}	67.33^{ab}	25.69^{bc}	36.05^{bc}	1.22	26.50
AD515270.96	17.67^{de}	72.67	112.67^{e}	2.93^{bcde}	69.33^{a}	17.78^{cd}	27.47^{cd}	1.24	22.17
AD515606.213	17.67^{de}	71.33	116.33^{bcde}	2.60^{bcde}	53.00^{de}	14.31^{d}	23.99^{d}	1.26	24.50
AD515606.164	19.00^{cd}	68.33	121.00^{a}	3.47^{bc}	71.00^{a}	34.76^{ab}	44.49^{ab}	1.18	26.17
AD515578.102	21.67^{ab}	72.00	118.67^{abc}	2.00^{de}	53.67^{cde}	12.84^{d}	22.53^{d}	1.20	25.50
AD515606.15	18.00^{de}	69.33	112.00^{ef}	2.53^{bcde}	63.67^{abc}	21.48^{cd}	31.17^{cd}	1.22	24.67
AD515578.187	16.33^{e}	64.33	107.67^{f}	3.80^{b}	61.33^{abcd}	15.05^{d}	24.74^{d}	1.18	22.67
AD51645.9	16.00^{e}	70.33	119.33^{ab}	5.13^{a}	70.33^{a}	38.01^{a}	48.69^{a}	1.19	25.17
Belete (St. Check)	22.67^{a}	67.67	118.67^{abc}	1.73^{e}	71.00^{a}	27.79^{abc}	37.48^{abc}	1.20	27.67
Local (check)	20.33^{bc}	71.67	117.33^{abcd}	3.40^{bc}	58.00^{bcde}	19.84^{cd}	29.53^{cd}	1.22	27.00
Mean	18.89	70.64	116.28	2.93	60.69	21.45	31.37	1.22	25.13
LSD (5%)	2.213	Ns	4.4626	1.3001	10.23	10.491	11.252	ns	ns
CV (5%)	6.95	6.48	2.27	26.31	10.001	29.02	21.28	3.99	8.07
Year 2021									
AD515606.16	15.67^{de}	71.00^{a}	125.00^{a}	5.8^{cd}	78.33^{de}	50.15^{bcd}	53.85^{bcde}	1.04	19.78
AD515606.44	27.67^{a}	73.33^{a}	121.67^{ab}	3.27^{e}	47.67^{f}	24.15^{fg}	28.74^{gh}	1.05	20.73
AD515578.77	18.00^{cde}	58.67^{e}	117.67^{bcd}	6.07^{cd}	87.67^{bcd}	46.52^{bcde}	51.33^{bcde}	1.04	18.40
AD515578.49	20.67^{bc}	71.67^{a}	126.33^{a}	6.33^{bcd}	80.33^{cde}	52.74^{abc}	57.85^{bc}	1.05	22.53
AD515270.96	20.33^{bc}	64.0^{d}	117.67^{bcd}	8.73^{a}	91.00^{bc}	43.04^{cde}	50.67^{bcde}	1.05	17.27
AD515606.213	18.00^{cde}	66.67^{bcd}	117.00^{bcd}	6.27^{bcd}	80.33^{cde}	37.48^{def}	44.67^{cdef}	1.05	18.70
AD515606.164	16.67^{de}	64.33^{d}	125.33^{a}	6.33^{bcd}	87.67^{bcd}	57.63^{ab}	60.00^{ab}	1.05	23.40
AD515578.102	21.67^{b}	71.33^{a}	121.00^{abc}	5.00^{de}	72.33^{e}	33.48^{efg}	34.96^{fgh}	1.06	19.83
AD515606.15	16.67^{de}	69.67^{abc}	114.33^{d}	8.33^{ab}	77.33^{de}	40.89^{cde}	41.71^{efg}	1.04	16.17
AD515578.187	21.33^{bc}	66.00^{cd}	115.67^{cd}	7.87^{abc}	92.67^{b}	37.26^{def}	42.29^{defg}	1.04	17.43
AD51645.9	18.67^{bcd}	70.00^{ab}	123.33^{a}	7.07^{abcd}	97.67^{ab}	45.56^{bcde}	56.96^{bcd}	1.04	21.78
Belete (St. Check)	15.00^{e}	66.67^{bcd}	125.00^{a}	5.07^{de}	104.33^{a}	65.93^{a}	73.78^{a}	1.04	23.25
Local (check)	18.67^{bcd}	64.67^{d}	114.00^{d}	8.27^{ab}	69.67^{e}	22.59^{g}	25.93^{h}	1.04	18.42
Mean	3.3387	3.9057	5.5608	2.1195	10.986	42.877	14.747	ns	ns
LSD (5%)	19.15	67.54	120.31	6.49	32.07	13.459	47.9.3	1.05	19.82
CV (5%)	10.34	3.43	2.74	19.37	7.94	18.63	18.27	1.13	17.34

Means with similar letter(s) in a column are not significantly different, LSD (5%), least significant difference, ns= non-significant difference, CV (5%) = coefficient of variation in percent, DE=Days to emergence, DF= Days to flower, DM=Days to maturity, STN=steam number per plant, STH=Plant height (cm), MY(t ha^{-1}) = marketable tuber yield, TY(t ha^{-1}) = total tuber yield tons per hectare, SG= specific gravity DM (%) = tuber dry matter content of phenotypic coefficients of variation was slightly higher than the estimates of genotypic coefficients of variation for all traits under study implying that besides genetic factors some seasonal factors are having their role in expression of characters. The genetic parameters revealed that moderate to high GCV, PCV coupled with high heritability and high genetic advance as percent of mean were observed for all traits expect specific gravity and days to 50% flowering in first season. These results indicate the operation of additive gene action in the inheritance of these traits and improvement of these traits are possible through simple selection. In second season all traits shows high to moderate GCV, PCV and genetic advance as percent of mean, while specific gravity and days to maturity shows low. In the present investigation, the genotype AD51645.9 and AD515606.164 recorded maximum mean performance among the genotypes for more number of characters i.e. days to emergence, days to maturity, stem number per hill, stem height, marketable tubers and total tuber yield which also exhibiting high PCV to moderate GCV along with high heritability with high genetic advance. Further the genotypes, AD51645.9, AD515606.164, AD515578.49, AD515606.16 and AD515578.77 are identified as promising varieties for utilization in hybridization programme aimed at developing varieties with high yield and quality traits of potato to the area. Average tuber number, average tuber weight, specific gravity of tubers, dry matter content and total starch content, are major traits used during selection for tuber yield and quality attributes. Generally, the present findings revealed adequate existence of variability for most of the traits in the studied genotypes which need to be exploited in future potato breeding programs for the study area.

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