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Yield potential and adaptability of medium duration Pigeonpea (*Cajanus cajan* L. Millsp.) genotypes in dry parts of North Rift Valley, Kenya

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Key words: Pigeonpea, Adaptability, Food security, Underutilized, North Rift valley.

Abstract

Pigeonpea is an important crop in Semi- Arid tropical and sub- tropical areas. Although it is reported to have wide adaptability to different climates and soils, 98.7% of its production in Kenya is concentrated mainly in three counties (Machakos, Kitui and Makueni) but remains neglected and underutilized in North Rift Valley. Therefore, sixteen elite genotypes from ICRISAT were evaluated for yield performance and adaptability. Also, the study looked at association between grain yield and its yield components. Field experiment was carried out in a randomized complete block design (RCBD) replicated three times in three varied agro-ecological zones during long rain season of April-October 2014. Data was collected on grain yield, number of pods/plant, secondary branches, height at maturity, days to 50% flowering, days to physiological maturity, number of seeds/pod and 100 seed weight. The results revealed seven genotypes (ICEAPs 01147, 1147-1, 01159, 00911, 0979-1, 00850^{C} and 1154-2) recording higher yields. Site variation was significant ($P \leq 0.05$) with Koibatek recording the highest average yield of 2.5 t/ha, Marigat (0.4 t/ha) and Fluorspar (0.2 t/ha). ICEAP 1147-1 was adaptable to all sites due to its vegetative growth of high branching and podding. This variety may therefore be selected for adaptability preference. Significant ($P \leq 0.05$) positive correlation was revealed between grain yield and number of pods/plant, secondary branches, height at maturity and 100 seed weight but negatively with 50% days to flowering. The results suggested pigeonpea yield potential in the studied sites hence, can be promoted to mitigate hunger and malnutrition.

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Introduction

Pigeonpea (*Cajanus Cajan* L. Millsp.) is the third most important grain legume worldwide. It is currently cultivated on 5.5 million hectares with an annual production of 4 million metric tons and productivity of 898kg ha^{-1}(FAOSTAT, 2015). In Africa, it is grown in more than 33 countries with a production of 237.210t (Malawi), Tanzania (206.057t), Kenya (89.390t) and Uganda (84.200t) (FAOSTAT, 2015). Production in Eastern and Southern Africa (ESA) region contributes 9.3% of world production, which is very little compared to the 62.7% contribution from world's leading producer. Until 3 years ago, Kenya ranked third largest world's pigeon pea producer with over 200,000 ha cultivated annually, after India and Myanmar, and the crop is second only to field beans (*Phaseolus vulgaris*) as pulse and as a food legume in acreage and production(FAOSTAT, 2015). However, current statistics shows that Kenya is ranked the fifth (2.1%) after India 62.7%, Burma (21.3%), Malawi (6%) and Tanzania (4.9%) (FAOSTAT, 2015). In Kenya, pigeon pea production has been low for the last 13 years ranging from about 60-110 tons per annum with lowest production of 43 tons recorded in 2009 (FAOSTAT, 2015). Pigeonpea average yield of 544 $Kgha^{-1}$in farmers field have been reported in Kenya (FAOSTAT, 2015). This yield is far lower than its potential yield(1500–2500 $Kgha^{-1}$) under research conditions. The low grain yield may be attributed to biotic and abiotic stresses (Mergeai *et al.*, 2001).Several biotic, abiotic and socio-economic factors like drought, diseases, insect pests, lack of quality seeds and poor production practices are major constraints hindering improved production of pigeon pea in Kenya. Pigeonpea pest complex feeding on flowers, pods and seeds mainlypod borer (*Helicoverpa armigera*), pod sucking bugs (*Clavigralla tomentosicollis*)and pod fly (*Melanagromyza chalcosoma*) are single major biotic constraint to increasing pigeon pea production in the tropics (Minja *et al.*, 1999).

Pigeonpea is adaptable to different climates with a delayed phenology at cooler environment (Manyasa *et al.*, 2009), but each specific group has its specific area of adaptation. The crop is purely grown under rain fed conditions with varying temperature, latitude and altitude. Its phenology is affected by temperature (altitude) and day length (latitude). These factors therefore affect floral development and maturity period (Silim *et al.*, 2007).The performance of genotypes depends on soil moisture, temperature and genetic potential of the cultivar. Pigeonpea is grown mostly in semi -arid areas with unreliable rainfall, where crop failures are frequent but performs well with rainfall of 600-1000 mm. It grows in a wide range of soil types but gives optimum results in deep loam soils with a pH ranging from 5-7. It is able to fix 40kg/ha of nitrogen per season in the soil due to presence of rhizobia bacteria in the nodules(Saxena*et al.*, 2008). Pigeonpeahas the ability to withstand severe drought better than many legumes due to presence deep roots and osmotic adjustment (OA) in the leaves that assist in maintaining cell turgor through accumulation of solutes (Subbarao *et al.*, 2000).Apart from being drought tolerant, pigeon pea should find an important place among the smallholder poor farmers in Kenya and Africa due to its high nutritive value (proteins, vitamins and minerals) for supplementation of low protein cereals. This has been considered as one of the best solutions to protein-calorie malnutrition in the developing world. Pigeon pea is wonderfully abundant in protein, making it an ideal supplement to traditional cereal-, banana- or tuber-based diets of most Africans which are generally protein-deficient(Chitra *et al.*, 1996, Odeny, 2007).

The major growing areas in Kenya are Eastern provinces (mainly Machakos, Makueni, Kitui, Embu, and Mbeere) and parts of Coastal regions. Eastern regions contribute 98.7% of the total production in Kenya. However, 0.8% is contributed by Rift Valley, 0.3% Central and 0.2% Coastal regions (FAOSTAT, 2015). Farmers in drier parts of North Rift Valley predominantly grow local pigeonpea types that take up to a year to mature and are large shrubs in size.

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in collaboration with other organizations like Kenya Agricultural and Livestock Organization, Egerton University and Leldet Seed Company developed and released improved varieties of medium and short duration (Table 1). Majority of farmers in eastern Kenya have started adopting the medium duration pigeonpea varieties like ICEAPs 00554 and 00557. However, few farmers in Rift Valley have started adopting the newly released medium duration pigeonpea varieties like ICEAP 00850, Egerton Mbaazi M1 and advanced breeding lines like ICEAPs 00554 and 00557. Although these improved varieties showed high potential under research conditions, their performance in varied agro-ecological zones are poorly documented (Joshi*etal*., 2001).

Therefore, in realizing the importance of such an investigation, the present study was carried out to assess productivity and adaptability of 16 selected medium duration pigeonpea genotypes in three varied agro-ecological zones of North Rift Valley Kenya to enhance food security.

Materials and methods

Study sites

The experiment was carried out in three varied sites; (KALRO Perkerra-Marigat, ATC Koibatek in Baringo County and Fluorspar in Elgeyo Marakwet County (Fig. 1) during long rains of April- October 2014 cropping season.Kenya Agricultural and Livestock Research Organization (KALRO) Perkerra– Marigat is situated at 0°28'0" N and 36°1'0" E. It has an altitude of 1067m above sea level (A.S.L) with an average annual rainfall mean of 654mm and falls in agro ecological zone 5 (LM 5).

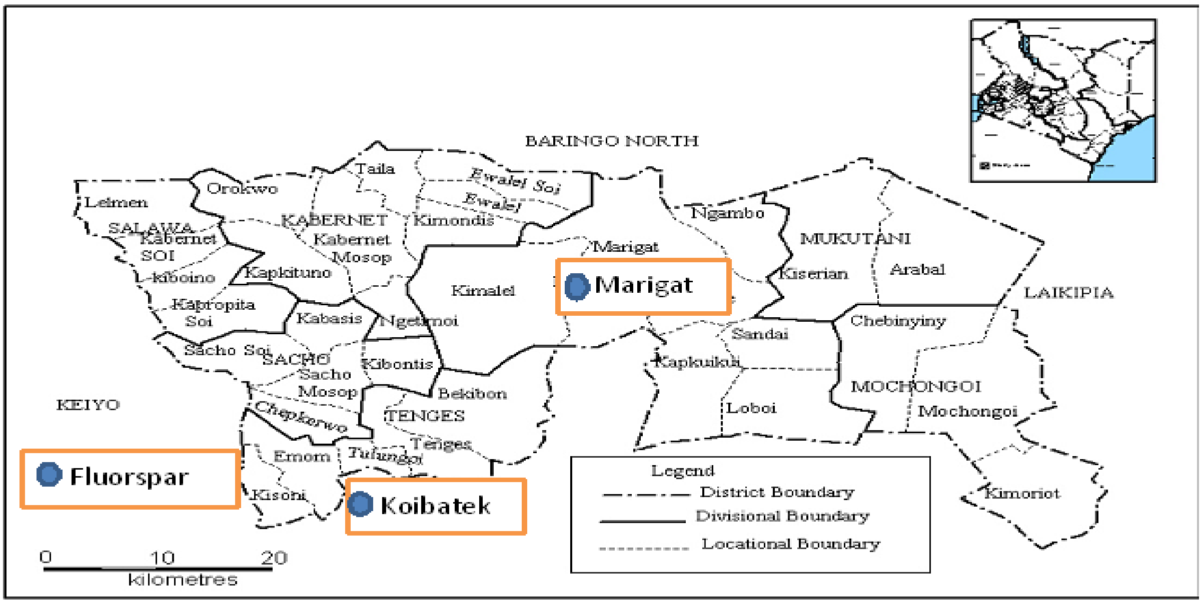

Fig. 1. Location of KALRO-Marigat, ATC Koibatek and Fluorspar (Adapted from Baringo District Development plan, 2003-2008).

The average temperature of the area range 16-34ºC. Their soils are fluvisols of sandy/silt clay loam texture, slightly acid to slightly alkaline, highly fertile with adequate, P, K, Ca, Mg but low N and C .National Youth Service (Chepsirei), Fluorspar falls in the agro-ecological zone 6 (LM6) with sandy loam soils, temperature range 16 -30 ºC, altitude 900-1500 m above sea level and receiving rainfall ranging from 400 to 800 mm per annum but the rainfall is usually erratic and unreliable ATC Koibatek is located 1°35'S, 36 °66'E at an elevation of 1890 meters A.S.L in agro-ecological zone UM4, with low agricultural ppotential. Average annual rainfall is767mm and mean temperature ranges between 18.2-24.3°C. Mean minimum and maximum temperatures are 10.9 °C and 28.8°C respectively. Soils are Vitric andosols with moderate to high soil fertility, well drained deep to sandy loam soils(Jaetzold and Schmidt, 1983).

Plant germplasm

Sixteen selected yield elite pigeonpea lines of medium duration sourced from ICRISAT were evaluated during this study during the long rains of April-November 2014 cropping season. One (ICEAP 00850) among the 16 genotypes is acommercial variety and was used as a local check (Table 2).

Field layout and experimental designs

The field study involved evaluation of 16 genotypes of pigeon pea genotypes for one season in each siteunder rain fed conditions. Planting was done at the onset of the rains. The test entries were evaluated in a randomized complete block design (RCBD), in three replications. Each plot consisted of 5 rows measuring 5 m in length, spaced 75 cm between the rows (inter-row) and 25 cm between the plants (intra-row).

Data collection and analysis

Data was collected on eight quantitative traits at each site according to descriptors of pigeonpea (ICRISAT and IBPGR ,1993). Five plants from middle rows of each plot were tagged randomly for evaluation on, number of secondary branches, number of pods/plant and height at maturity. Data on days to 50% flowering, days to physiological maturity, 100 seed weight and grain yield was recorded on plot basis while number of seeds per pod was taken from 10 pods selected randomly from five plants in middle rows. Data was subjected to analysis of variance using SAS version 9.1. Treatment means were separated using LSD (P ≤ 0.05) and Simple correlation coefficient (r) was carried out using Pearson's correlation.

Results

Yield performance and adaptability

The sites received different amount of rainfall and temperature during the study period. Koibatek recorded higher amount of rainfall (245 mm), Marigat (128.3) while Fluorspar recorded the lowest (115.9 mm) (Table 3).

Significant (P ≤ 0.05) variations was observed amongthe 16 genotypes in days to 50% flowering, days to physiological maturity, height at maturity, 100 seed weight,Number of secondary branches/plant, number of pods/plant and grain yield (Table 5).

Table 1. List of improved pigeonpea varieties released by various organizations.

Variety name	Official Release Name	Year of release in Kenya	Owner	Altitude range (M a.s.l)	Duration to maturity (months)	Grain yield (t/ha)	Special attributes
Kat 777	Kat 777	1981	KARLO	600-1500	5 - 6	1.5-2.2t/ha	Tolerant to Fusarium wilt
Kat81/3/3	Kat81/3/3	1981	KARLO	900-1800	5.5 - 6	2.0-2.5	Tolerant to Fusarium wilt
ICEAP00040	Mbaazi 2	1995	KARLO	900-1800	4 - 6	2.0-2.5	Tolerant to insect pest, wilt.
Mbaazi - 1	Mbaazi - 1	1998	KARLO	600-900	3 - 4	1.8-2.2	Short duration
Katumani 60/8	Katumani 60/8	1998	KARLO	1000-1800	4 - 5	2.0-2.5	Short duration
Kat/Mbaazi 3	Kat/Mbaazi 3	ND	KARLO	1000- 1500	3-3.5	1.5-2.0	Extra early Short
ICEA P00068	ICEA P00068	ND	KARLO	1000-1500	4-6	2-2.5	Medium maturity
ICEAP00850	Peacock	2011	LELDET	800-1500	4	1.5	Drought tolerant
ICEAP00936	Karai	2011	LELDET	1000-1800	6	2	Drought tolerant, N_2 fixer
EUMDPV00104-902	Egerton Mbaazi 1	2012	Egerton University	800-1500	4-5	1.4-2.8	Drought tolerant, Tolerant to Fusarium wilt

The interaction between genotype and environment (Genotype * site) significantly (P≤0.05) influenced yield performance among the genotypes. Sites varied significantly (P≤0.01) in performance.Koibatek, recorded the highest grain yield of 2.5t/ha then Marigat 0.4t/ha and lastly Fluorspar 0.2t/ha (Table 6). The mean grain yield for the sites was 1.01t/ha (Table 5). However, seven genotypes (ICEAPs 01147, 1147-1, 01159, 00911, 0979-1, 00850 and 1154-2) produced a mean grain yield of over 1.01t/ha (1.03-2.7 t/ha).

Table 2. List of 16 medium duration pigeonpea genotypes used in the study during long rains of April- October 2014 cropping season indicating their source and status of release.

Germplasm name	Source	Status
ICEAP 01147	ICRISAT	Pre release
ICEAP 01179	ICRISAT	Pre release
ICEAP 1147-1	ICRISAT	Pre release
ICEAP 01159	ICRISAT	Pre release
ICEAP 00554	ICRISAT	Pre release
ICEAP 01541	ICRISAT	Pre release
ICEAP 00540	ICRISAT	Pre release
ICEAP 00911	ICRISAT	Pre release
ICEAP 00902	ICRISAT	Released in Kenya (Egerton University)
ICEAP 01150	ICRISAT	Pre release
ICEAP 00068	ICRISAT	Released (Tanzania)
ICEAP 00557	ICRISAT	Released (Tanzania, Mozambique and Malawi)
DICEAP 00850-Local check	ICRISAT	Released in Kenya (Leldet seeds)
ICEAP 0079-1	ICRISAT	Pre release
ICEAP 1154-2	ICRISAT	Pre release
KAT 60/8	ICRISAT	Released in Kenya (KALRO) and Uganda)

ICEAP 1147-1 recorded high and consistent grain yield a cross all sites with a mean grain yield of 2.7 t/ha and it is the only genotype that outperformed the local check ICEAP 00850 and Egerton Mbaazi M1 (Table 6).

Genotypes flowered at a range of 108 to 116 days with average days of 111days (Table 5). The sites varied significantly (P ≤ 0.01) with Koibatek flowering early after105 days, 110 days in Marigat and late (119 days) in Fluorspar (Table 4). Similarly the genotypes reached physiological maturityat mean days of 134. KAT 60/8 matured early after 130 days while ICEAP 00850 (check) with ICEAP 00540 maturing late after 137.8 days (Table 5). Sites significantly (P ≤ 0.01) differed with Fluorspar recording the longest period of 137.83 days, followed by Koibatek 133.35 daysand Marigat 131.35 days (Table 4).

Table 3. Rainfall and Temperature from January to December 2014 (period of the study) for the three sites.

	Marigat		Fluorspar		Koibatek	
Month	Rainfall	temp	Rainfall	Temp	Rainfall	temp
Jan	100	33	14.00	30.2	100	27
Feb	90	34	25.90	26.46	60	28
Mar	150	34	87.80	29.89	80	28
Apr	200	32	46.80	28.25	180	26
May	145	33	130.00	21.88	220	25
Jun	120	32	83.20	30.6	300	25
Jul	115	31	243.80	25.12	200	24
Aug	160	31	170.60	27.2	250	24
Sep	90	33	65.10	34.45	360	26
Oct	145	33	314.80	26.79	330	25
Nov	100	32	123.70	28.22	410	25
Dec	125	33	85.00	29.36	550	26
Total	1540	391	1390.7	328.42	2940	309
Average	128.3	32.58	115.89	27.37	245	25.75

Source: weather-average/rift valley/ke.aspx.

100 seed weight variations among the genotypes was significant (P ≤0.05) with a range of 12.9 to 14.3. Site variation was highly significantly (P≤ 0.01), Koibatek recorded the highest weight of 14.9g while Marigat recorded 12.7g and Fluorspar 12.9g (Table 4).Number of secondary branches per plant exhibited low variation (P ≤0.05) among the genotypes with ICEAP 00557 recording the largest number of 11 and KAT 60/8 lowest number of 6.2. However, high significant variations between the sites were revealed. Marigat scored higher number of 11, then Koibatek 9 and Fluorspar 3, culminating to an average mean of 7.79 (Table 4).

Table 4. Table of means for quantitative traits, significant levels and coefficient of variation of 16 pigeonpea genotypes at three locations, April-October 2014 cropping season.

Trait	Marigat	CV (%)	Koibatek	CV %	Fluorspar	CV%
Days to 50% flowering (D50% F)	111*	5	105**	2.4	120**	2.3
Days to physiological maturity (DPM)	131**	3.2	133*	2.4	138**	2.3
Secondary branches/ plant (Branches)	11**	11.4	9*	24	3*	30
Pods/plant (PPP)	145**	23.9	227*	21	32*	43
Seeds/ pod (SPP)	4NS	11.7	5NS	8.8	5NS	10
Plant height at maturity (HM)	137*	12.4	143*	6.4	113*	8.3
100 seed weight (100 SW)in *g*	13*	8.3	14.9*	5.6	13*	9.9
Grain yield (GY)in t/ha)	0.4**	16.9	2.5**	16.2	0.2**	24

Table 5. Table of means for grain yield (t/ha) and yield components for 16 pigeonpea genotypes across three sites during April-October 2014 cropping season.

Genotypes	GY (t/ha)	D50%F	DPM	HM	Branch	PPP	SPP	100 SW
ICEAP 01147	1.03	108	132	134.2	8	138	5	13.5
ICEAP 01179	0.87	109	133	132.7	7	122	4	13.7
ICEAP1147-1	1.27	112	134	142.6	9	182	4	14.3
ICEAP 01159	1.13	113	133	130.6	8	91	4	13.5
ICEAP 00554	0.98	110	132	131.9	8	126	4	13.1
ICEAP 01541	0.98	112	137	127.6	7	135	4	12.9
ICEAP 00540	0.9	115	138	120.2	7	132	4	13.8
ICEAP 00911	1.17	111	136	126.8	8	139	4	13
ICEAP 00902	0.89	115	135	127.9	10	151	5	13.1
ICEAP 01150	0.81	110	134	134	7	137	4	13.5
ICEAP 00068	0.87	115	134	127.6	6	143	5	13.9
ICEAP 00557	0.98	115	135	127.9	11	132	4	14
KAT 60/8	0.86	109	131	136.4	6	131	5	13.6
ICEAP 00850[C]	1.21	116	138	141.9	8	147	4	13.4
ICEAP 0979-1	1.18	109	134	128.1	7	119	4	13.7
ICEAP 1154-2	1.18	109	134	125.1	7	127	4	14.2
Genotype	**	*	**	*	*	**	NS	*
Site	**	**	**	**	**	**	**	**
Grand mean	1.02	111.91	134.18	130.96	7.79	134.45	4.39	13.57
Gen*Site	**	*	**	*	*	*	NS	*
CV%	27.1	3.6	2.7	9.5	40.8	27.3	10.2	7.9
LSD	0.25	3.76	3.4	11.68	2.97	34.39	0.42	1

Key:*, **, *** and NS indicate significance levels at 0.05, 0.01, 0.001 and non-significance, respectively. Genotype with superscript (C) is a local check.

Genotypes revealed significant ($P \leq 0.05$) variations in height at maturity. ICEAP 1147-1 was the tallest with a height of 142.6 cm while ICEAP 00540 was the shortest (120.2 cm).The average height at maturity was 130.96 cm (Table 5). However, Fluorspar genotypes matured at a shorter mean height of 113.31 cm while Marigat and Koibatek matured at relative height of 136.48 and 143.08 cm respectively (Table 4).

Genotypesvaried significantly ($P \leq 0.01$) in number of pods per plant with a mean of 134. ICEAP 1147-1 recorded the highest number of 182 while ICEAP 01159 the least of 91 (Table 5). There was significant ($P \leq 0.01$)variation between sites with highest number in Koibatek 226 then Marigat 144 finally Fluorspar 31 (Table 4).

Table 6. Table of means for grain yield (t/ha) for 16 pigeonpea genotypes in each site during April- October 2014 cropping season.

Genotype	Marigat	Koibatek	Fluorspar	Mean
ICEAP 01147	0.8	2.1	0.2	1.03
ICEAP 01179	0.7	1.7	0.2	0.86
ICEAP1147-1	0.6	2.9	0.3	1.27
ICEAP 01159	0.3	2.7	0.4	1.13
ICEAP 00554	0.2	2.6	0.1	0.97
ICEAP 01541	0.2	2.6	0.1	0.97
ICEAP 00540	0.3	2.3	0.1	0.90
ICEAP 00911	0.4	2.9	0.1	1.13
ICEAP 00902	0.3	2.2	0.1	0.87
ICEAP 01150	0.3	1.9	0.2	0.80
ICEAP 00068	0.4	2.1	0.1	0.87
ICEAP 00557	0.3	2.5	0.1	0.97
KAT 60/8	0.6	1.7	0.2	0.83
ICEAP 00850[C]	0.3	2.9	0.4	1.20
ICEAP 0979-1	0.4	2.8	0.4	1.20
ICEAP 1154-2	0.2	3.2	0.1	1.17
Genotype	**	**	**	**
Grand mean	0.4	2.45	0.2	1.01
CV%	16.9	16.2	24.08	19.06
LSD	0.11	0.66	0.08	0.13

Correlation between grain yield and its yield components

The association was undertaken to determine the effect of each component on grain yield performance. Some of the associations were significant at 5% while others at 1% probability (Table 7). The correlation analysis revealed a positive significance between grain yield with height at maturity (r=0.48***), secondary branches/plant (r=0.23**), pods/ plant (r=0.73***), seed/ pod (r=0.26*) and 100 seed weight (r=0.66***), but a negative significant correlation with days to 50% flowering (r=-0.60***) (Table 7).

Discussion

Photoperiod sensitivity

Day length (latitude) and temperature (altitude) affect plant phenology by influencing floral development and maturity period (Silim *et al.*, 2007). The differences in these factors therefore resulted in variations in days to 50% flowering and days to physiological maturity among the genotypes and sites. Genotypes in Fluorspar (dry) matured late after 137.83 days relative to Koibatek 133.35 days (cool) and Marigat 131.35 days (warm).

Similar results were also reported by (Manyasa *et al.*, 2009) who recorded early maturity in warm areas and late in cool places. This is basically because genotypes in cool environment tend to have large number of vegetative growth hence take more time in grain filling and maturity compared to warm environment.

Moisture levels and soil fertility

Variations in moisture levels and soil fertility influenced genotype performance in varied sites. High moisture level accelarates vegetative growth leading to higher number of branches, higher number of flowers and finally higher number of pods (Silim *et al.*, 2007).

Genotypes in Koibatek receiving higher amount of rainfall conforms to this description. ICEAP 1147-1 had the highest number of pods (182) while ICEAP 01159 the least (91.4). This is attributed to its higher efficacy in translocating photosynthate to the reproductive parts hence higher yields. Biomass accumulation and photosynthate translocation are key factors to 100 seed weight (*Robertsona et al.*, 2001) .This is governed by yield components like plant height at maturity and number of seeds per pod. The high vegatative growth contributed by high moisture and soil fertility levels in Koibatek relative to the other two sites may explain these results (Manyasa *et al*, 2009). Plant height is also influenced by photoperiod and maturity duration.

Table 7. Correlation analysis for grain yield and its yield components among 16 pigeonpea genotypes.

	GY	D50%F	DPM	HM	Bran	PPP	SPP	SW
GY	1							
D50%F	-0.60***	1						
DPM	-0.12ns	0.54***	1					
HM	0.48***	-0.49***	-0.21***	1				
Bran	0.23**	-0.43***	-0.29***	0.43***	1			
PPP	0.73***	-0.69***	-0.34***	0.63**	0.517***	1		
SPP	0.26*	0.11ns	0.17*	-0.10ns	-0.394**	-0.036ns	1	
SW	0.66***	-0.39***	-0.13ns	0.30**	0.050ns	-0.036***	0.24743**	1

Key:*, **, *** and NS indicate significance levels at 0.05, 0.01, 0.001 and non-significance, respectively.

Effect of external factors to physiological performance

Variations in days to 50% flowering among genotypes and sites is attributed to differences in rainfall and temperature distribution as stated by Silim *et al*, (2007). Genotypes in Koibatek flowered earlier (105 days) than Marigat (110 days) and Fluorspar (119 days). The early flowering in Koibatek may have been contributed by moderate rainfall during flowering period which accelarated flower initiation. This site variation is similar to results by (Silim *et al.*, 2006) who reported 119, 94, 125 and 122 days for Kabete, Katumani, Kiboko and Mtwapa respectively. It also resulted in variations in days to physiological maturity among the genotypes and sites. Genotypes in Fluorspar (dry) matured late after 137.83 days relative to Koibatek 133.35 days (cool) and Marigat 131.35 days (warm).

Differences in amount of rainfall and temperature influences height as well as general crop development (Khaki, 2014). Crops in cooler environments tend to grow tall because of higher vegetative phase that result to higher photosynthetic ability, growth and dry mater production of a plant (Changaya, 2007).

Association

The positive significant association between grain yield and plant height at maturity, number of secondary branches/plant, pods/plant, seeds/ pod and 100 seed weight indicates that they are important yield contributing traits in pigeonpea. Thus, should be put into consideration when selecting for yield potential (Rao *et al.*, 2013) and (Padi, 2003).Biomass accumulation is a precursor to yield. Therefore, the negative correlation exhibited between grain yield and days to 50% flowering is due to lack of enough time by the plant to accumulate biomass (Vange and Egbe, 2009).

High temperatures, low rainfall and high pest infestations contributed to negative associations by causing flower abortion which in turn affects number of pods per plant and 100 seed weight thus lowering the grain yield. Negative significant correlation reported in height at maturity, number of secondary branches and number of pods per plants with physiological maturity, implies that as the plant mature early, it will yield lower number of secondary branches and lower number of pods because the plant is not able to accumulate enough biomass required for the development of pods and branches (Padi, 2003).

Conclusion

The findings of this study revealed seven promising genotypes (ICEAPs 01147, 1147-1, 01159, 00911, 0979-1, ICEAP 00850 and 1154-2) that recorded high yields. This has shown the potential and adaptability of these genotypes to the local environments hence needs to be further evaluated for yield performance, adaptability, other important agronomic traits, and stability of the traits for another season. Koibatek is pigeonpea yield potential area due to favorable climatic conditions suitable for medium duration pigeonpea genotypes. The well distributed rainfall in this site enhanced grain filling. However, early cessation of rains in Marigat and Fluorspar affected grain filling as well as general crop development hence low yields. Plant height at maturity, number of secondary branches/plant, number of pods/plant, seeds/ pod and 100 seed weight are important agronomic traits and should be considered when selecting for yield potential genotypes.

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