

Research Article

Fruit characterization of different avocado (*Persea americana* Mill.) genotypes in eastern mid-hills of Nepal

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ABSTRACT

The total of thirteen different avocado (*Persea americana* Mill.) genotypes were collected for evaluating the fruit characteristics in the laboratory of Agricultural Research Station, Pakhribas during November 2017. The fully matured fruits from the farmer's field at Patle, Dhankuta were collected. The criteria for selecting the genotypes were fruit weight, fruit length, fruit diameter, seed weight, pulp weight, pulp to fruit ratio and the seed weight percentage. The result suggests the potentiality of the genotypes PAKAV002 and PAKAV010 in most of the evaluated characters as compared to the tested genotypes. The genotypes PAKAV008 and PAKAV007 were disliked as they have 32.59% and 28.39% of seed weight to the total fruit weight. The genotypes PAKAV002 and PAKAV010 had the average fruit weight ranging (307.1 g and 346.8 g), maximum of pulp to fruit ratio 62.34% and 56.97%. Similarly, genotypes PAKAV010 (11.425%), PAKAV013 (11.96%) and PAKAV002 (14.47%) had low seed weight to the total fruit weight which is regarded important factor for avocado selection and evaluation. This result shows that the genotypes PAKAV002 and PAKAV010 should be further evaluated for fruit characteristics and the quality.

Key words: avocado, characterization, evaluation, genotypes

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INTRODUCTION

Avocado (*Persea americana* Mill.) is a new fruit crop for Nepal where few farmers are growing them in their backyard area. Though, there are no commercial scale productions of avocado in Nepal, now-a-days farmers are attracted towards growing the fruits. Avocado is grown both in tropical and subtropical areas, where there is rainfall during the summer Pisani and Ritenour, 2017. The avocado fruits are good source of proteins, carbohydrates, vitamins and trace amount of vitamins. It contains exceptional quantities of soluble and insoluble dietary fiber which is regarded as the best solid food for the babies. Along this, avocados contain oil of polyunsaturated fatty acid predominantly the oleic acid (Colquhoun *et al.*, 1992). The concentration of the oil available in the fruit may reach upto 40% of the fruit weight in the wet basis which is the promising characteristics of the fruit. It depends on the variety, growing climatic condition, harvesting time of the fruit, topography where the fruit are grown (Dixon *et al.*, 2004). The quality of the harvested fruit depends on the season to season and even depends on the growing area (Rouse & Knight, 1991). There are some findings on the quality of the fruits as water deficit or excess irrigation during fruit development reduces fruit quality. Harvesting during the fully matured stage of fruits is good to attain the quality (Kruger *et al.*, 2002; Pak *et al.*, 2003). The genotype to be a promising one should be a high yielder with low disease susceptibility along with these characters, the consumers should be focused on the genotype to be promising (Rouse & Knight, 1991). Climate and topography where the fruit is grown, size of the fruits, skin color of the fruit, smooth or roughness of the skin of the fruit, flavor, available of fiber or fibreless fruit pulp, color of the pulp, pulp percentage in the fruit are the other factor for the preference of the varieties (Rouse & Knight, 1991). The demand of the fruits in the urban area and the nutritive value has created ample space for its commercialization. In avocado, it is difficult to identify the fruits ready to harvest as the fruits do not ripen on the tree. The physiologically maturity of the fruits has to be determined before harvesting for quality assurance. During maturation stage, while the fruits are still in the trees, there is a correlation between oil content and dry weight to find the maturity stage of the fruit (Ratovohery *et al.*, 1988). In the variety 'Hass', California maturity standards has developed a minimum of 20.8% dry matter content is required for harvesting from 28 Nov. to 16 Jan., depending on the size (Obenland *et al.*, 2012). There is a great variation in fruit characteristics among the avocado genotypes available in the farmer's field. However, information regarding the avocado fruits characteristics is not available for the genotypes grown in Nepal. Therefore, this study aimed to collect, assess and compare some fruit characteristics of the diversity of the avocado fruits grown in the farmer's field.

MATERIALS AND METHODS

Plant materials

The fruits at fully matured stage were harvested from fifteen and more than fifteen years old trees from the farmers' field at Patle area of Dhankuta Municipality in November 2017. The fruits were selected from thirteen different genotypes difference in the shape of fruits and the growth habit of the trees. The fruit trees were grown in the similar agronomic and cultural

practices at the altitude of 1300 -1400 m masl. Immediately after the harvest of the fruits, they were taken to the central laboratory of Agricultural Research Station, Pakhribas for the characterization of the fruits.

Experimental design

The study was conducted in Completely Randomized Design (CRD). The treatments were thirteen genotypes as; PAKAV001, PAKAV002, PAKAV003, PAKAV004, PAKAV005, PAKAV006, PAKAV007, PAKAV008, PAKAV009, PAKAV010, PAKAV011, PAKAV012 and PAKAV013. A total of nine fruits from each genotypes were collected and made three replicates where, each replicate had three fruits for analysis.

Physical properties

The characterization was done following the test guidelines for Avocado developed by International Plant Genetic Resources Institute (IPGRI, 1995). During the data recording period possible morphological and pomological characteristics were recorded. The morphological characters of the fruits were evaluated during the analysis. Each fruits were weighed individually in a digital balance for fresh fruit weight. With the help of a digital vernier calliper the length and diameter of the fruits and the seeds were measured. Similarly, pulp weight and fruit/pulp ratio were calculated during the study period.

Statistical analysis

The collected data were analyzed using Genstat 18th edition software. Analysis of variance (ANOVA) was performed and the significant differences between treatments were determined using least significant difference (LSD) test at probability level of 0.01 or 0.05 where the effects of the treatments were significant at 1% or 5% level of probability, respectively (Kunwar and Shrestha, 2014).

RESULTS

Fruit characteristics

The results on the physical properties of the fruits showed highly significant in all the measured characters except in the pulp to fruit ratio Table 1. During the study period, fruits of genotypes PAKAV012 (143.4 g) followed by PAKAV005 (144.4 g) were the smallest and PAKAV009

(403.3 g) the largest followed by PAKAV010 (346.8 g) in the fruit weight. While comparing the average mean fruit length, it was measured minimum in PAKAV005 (6.96 cm) and maximum in PAKAV009 (13.17 cm). In addition, PAKAV004 (6.13 cm) and PAKAV006 (9.25 cm) had the minimum and maximum fruit diameter. The amount of the pulp in the fruit is the important character for evaluating the avocado fruits. Genotype PAKAV012 (45.0 g) and PAKAV005 (61.0 g) had low pulp weight while, PAKAV010 (195.7 g) and PAKAV002 (191.6 g) had high pulp content in the fruits. It shows that the heavier the fruit weight the more is the pulp content in the fruit. While comparing the ratio of pulp/fruit ratio, the genotype PAKAV012 (31.24%) was

low and the genotype PAKAV002 (62.34%) had the highest percentage of pulp in the fruit followed by PAKAV010 with (56.97%).

Table 1. Fruit characteristics of avocado fruits at eastern mid-hills of Nepal during 2017

Genotypes	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Pulp weight (g)	Pulp/fruit ratio (%)
PAKAV001	256.4	11.26	6.78	133.4	52.17
PAKAV002	307.1	9.40	8.11	191.6	62.34
PAKAV003	174.9	7.79	6.55	72.2	41.24
PAKAV004	160.8	9.46	6.13	77.8	48.31
PAKAV005	144.4	6.96	6.16	61.0	42.24
PAKAV006	281.8	11.47	9.25	141.4	50.48
PAKAV007	192.5	11.39	6.36	63.9	34.90
PAKAV008	189.0	7.79	6.69	79.7	42.14
PAKAV009	403.3	13.17	7.94	191.0	47.71
PAKAV010	346.8	10.25	8.35	195.7	56.97
PAKAV011	277.1	9.56	7.41	161.8	60.04
PAKAV012	143.4	8.76	6.15	45.0	31.24
PAKAV013	162.5	8.60	6.10	85.7	52.33
Mean	233.8	9.68	7.07	115.4	47.85
F-test	**	**	**	**	NS
LSD (0.05)	40.02	0.57	0.48	50.18	18.96
CV%	10.2	3.6	4.1	25.9	23.6

*, significant at $P \leq 0.05$. **, $P \leq 0.01$, LSD, least significant difference. CV, coefficient of variance

Seed characteristics

The result on the seed weight, size and percentage seed weight showed highly significant difference among the tested genotypes. The seed in the avocado fruits are large which determines the amount of the edible pulp around the seed which is the most important character of avocado to be considered during the evaluation and selection process of avocado. The result of the seed present in different tested genotypes are presented in the Table 2. The genotype PAKAV013 (18.96 g) followed by PAKAV004 (21.18 g) and PAKAV012 (32.61 g) had low seed weight. The genotypes PAKAV009 (63.78 g) and PAKAV008 (61.72 g) had the maximum seed weight. Similar trend was seen in the length and diameter of the seed. The seed to fruit ratio shows the following trend where, the genotypes PAKAV008 (32.68%), PAKAV007 (27.82%) and PAKAV005 (25.74%) have the seed weight more than 25% of the fruit weight and discarded for commercial production.

Table 2. Seed characteristics of avocado fruits at eastern mid-hills of Nepal during 2017

Genotypes	Seed weight (g)	Seed length (cm)	Seed diameter (cm)	Seed/fruit ratio (% age)
PAKAV001	41.20	4.90	3.60	16.06
PAKAV002	44.08	3.65	4.08	14.47
PAKAV003	42.75	4.09	4.11	24.60
PAKAV004	21.18	3.73	3.12	13.18

PAKAV005	37.08	3.41	3.90	25.74
PAKAV006	48.52	4.78	4.13	17.14
PAKAV007	52.85	6.13	4.11	27.82
PAKAV008	61.72	4.21	4.68	32.68
PAKAV009	63.78	5.41	4.26	15.82
PAKAV010	39.38	4.06	4.11	11.42
PAKAV011	42.13	4.00	4.41	15.60
PAKAV012	32.61	3.84	3.71	22.93
PAKAV013	18.93	3.29	3.14	11.96
Mean	42.02	4.27	3.95	19.18
F-test	**	**	**	**
LSD (0.05)	9.67	0.44	0.55	5.47
CV%	13.7	6.2	8.3	17.0

*, significant at $P \leq 0.05$. **, $P \leq 0.01$, LSD, least significant difference. CV, coefficient of variance

DISCUSSION

The maximum fruit weight was obtained from PAKAV009 followed by PAKAV010 (399.2 g) and (338.64 g) respectively. The results of variation in the fruit weight among the genotypes are in agreement with those result by Pisani and Ritenour (2017) where they have reported that there is difference in the weight ranging from 161.8 g to 387.4 g in R8T18 and R5T56 respectively in hybrid reciprocal crosses of 'Hass'-'Bacon'. Similarly, Poudel *et al.* (2017) has also reported that there was variation in fruit weight among pomegranate cultivars from 125.25 g to 355.4 g. The percentage of flesh in the fruits was found difference in the evaluated cultivars of avocado. The result by Pisani and Ritenour (2017) shows that R8T18 (73.7 g) and R5T56 (89.3 g) had the lowest and highest percentage of flesh in avocado fruits, respectively. Our study supports the findings where genotypes PAKAV010 and PAKAV009 had the maximum pulp weight and PAKAV012 had the lowest pulp weight. Based on the study by Obenland *et al.* (2012) and Pisani *et al.* (2014) among the nine tested avocado selection, for good horticultural and postharvest traits, the following conclusion were drawn. The four selections were best for yield, good fruit size and seed to flesh ratio among which 'Hass' was the best. Similar to their findings, we found the difference in the fruit size and fruit to pulp ratio among the genotypes. The fruit to pulp ratio of 61.41% and 59.34% where recorded maximum in the genotypes PAKAV002 and PAKAV010 respectively. The seeds in avocado fruits are comparatively large as compared to the other fruits. Seeds in avocado plays important role in the evaluation process of the genotypes. In our study, the genotypes PAKAV008 (32.59%), PAKAV007 (28.39%), PAKAV005 (26.73%) and PAKAV003 (25.62%) have the seed weight more than 25% of the fruit weight. Thus are unacceptable as a good genotypes for cultivation. The result is supported by the findings by Rouse and Knight, 1991 where, among 23 evaluated cultivars of avocado two cultivars 'Gainesville' and WB-3-13-10 were regarded as unacceptable due to their seed weight percentage being more than 25% of the total fruit weight .

CONCLUSION

The findings in the study supports to have further testing and evaluation of the genotypes for more complete data on plant growth habit, flowering time, maturity time, fruit yield, fruit quality and other traits among the diversities of the genotypes. The preliminary study shows that the genotype PAKAV009 is larger with maximum weight and length of the fruit but has low pulp to fruit ratio. While considering the commercial value, seed size and the volume of the pulp plays important role. Thus, regarding the fruit weight, pulp weight, pulp to fruit ratio and seed weight percentage the genotypes PAKAV002 and PAKAV010 are considered to be good as compared to the other tested genotypes.

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Author Contributions

Krishna Poudel designed and performed experiments, analysis of data and wrote the paper, Manoj Kumar Sah & Jawahar Lal Mandal helped during the experiments and recording the observations and Jiban Shrestha guided during analysis and write-up of the paper.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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