

Performance Evaluation of Apple Varieties at Wadla District, Notrh Wollo, Ethiopia

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ABSTRACT

Apple is one of the important fruit crops in the highland areas of Ethiopia. However, its productivity is very low compared to other countries particularly that temperate regions. This is partly attributed to lack of adaptable, high yielding and better quality apple varieties to farmers. To solve this problem apple variety trial was carried out at Wadela District from 2012–2019. The trial was laid out in randomized complete block design with three replications. Low to medium chill grafted apple seedlings were planted at a spacing of 3.0 m between rows and 3.0 m between plants. Each plot was planted three seedlings. On average irrigation water was applied on 7 days interval. Necessary plant protection and agronomic practices like training and pruning were applied as required. Scion diameter, rootstock diameter, girth ratio, canopy diameter, plant height, mean fruit weight and fruit yield data were collected for two consecutive years. Yield data was collected two times within a year. Anna variety gave significantly highest fruit yield (9.52 t ha⁻¹) followed by Gransmith (8.92 t ha⁻¹). On the other hand, Crispin gave the lowest fruit yield (7.77 t ha⁻¹). Fruit yield obtained by Anna and Gransmith were higher by 23% and 15%, respectively compared to the lowest yielding variety Crispin. Similarly, Anna and Gransmith also gave significantly the highest mean fruit weight of 85.98 and 62.34 g, respectively as compared to variety Crispin which gave a mean fruit weight of 41.01 g. Farmers also select Anna variety by their criteria setted. Therefore, Anna and Gransmith are recommended for producers at Gashena conditions and similar agro-ecologies.

Keywords: Apple; Variety; Fruit; Yield

INTRODUCTION

Apple (*Malus domestica*) is a woody plant belonging to the family, Rosaceae and sub-family Maloideae or formerly Pomoideae [1]. Under normal growing conditions an apple will develop into a small to medium-sized tree, of 5–10 m height, freely branching with long shoots and various types of short spurs. When growing unattended in the tropics it will revert to a stiff, overcrowded upright bush of 2–4 m in height [2]. The exact origin of the plant is not clearly known. However, it is the most ubiquitous of temperate fruits and has been cultivated in Europe and Asia. There are suggestions that it originates from central Asia, where its wild ancestor is still found today [2,3]. Apple is the most important fruit and it is the leading table fruit served, because of its attractive appearance, easily cultivable and can be stored at normal temperatures for every months.

Apple requires an elevation of 1600-2700 m. Apple is a very nutritious, aromatic and delicious fruit and very rich in vitamins A, B and C. It contains about 11% sugar besides essential minerals in appreciable amounts. It has color appeal, stimulates appetite and is most refreshing [3]. Apple fruits are alkaline because they contain pectin with alkaline pH. They are also important to prevent

constipation for ease defecation of solid waste, because pectin from the apple takes in excess water in the intestines, making a soft bulk that creates a mild, non-irritating stimulant. Apple can be used in many different forms; cooked, made into preserves, jellies, canned, candied, as fresh apple juice and made into cider or vinegar. Moreover, the peel is used for making pectin [4]. The proverb “an apple a day keeps the doctor away” strengthens the idea that apple fruit is an excellent source of very important food nutrient.

Apple accounts for 50% of the world’s deciduous fruit tree production. The leading apple growing country is China, producing about 41% of the world’s apple; followed by United States, India, and Turkey. In Africa, the leading producer is South Africa, followed by Egypt and Kenya [5]. In 2017, from 4933841 hectares of land 83139326 tons of apples with a productivity of 16.85 t ha⁻¹ was produced in the world [6].

In Ethiopia, fruit production has been dominated by tropical and sub-tropical fruit types which include banana, citrus, papaya, mango, avocado, lemon, etc. these are mainly grown in the lowland areas of the country [7]. While Ethiopian highlands are endowed with the climate of low temperature (having diverse topography

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and agro-ecological zones covering about 50% area of highland with 2000–4500 m.a.s.l. altitudes), lands with a mosaic of soils, and ample water resources suitable for the production of highland fruits like apple. Apple is a moderate climatic zone fruit tree and thus regarded as an exogenous crop to Ethiopia. It is introduced by Missionaries from abroad some 65 years ago [8].

Generally, apple is becoming as income-generating crop for rural communities. Thus it plays an important role in poverty alleviation. However, the performance of apple varieties in Ethiopia particularly Eastern Amhara sub region is poor and farmers grow low yielding as well as poor quality apple varieties. Therefore, the objective of this study was initiated to identify well adaptable and high yielding apple varieties for Gashena and similar areas.

MATERIALS AND METHODS

The experiment was conducted at Wadla District Gashena trail site of Sirinka agricultural research centre during July, 2012 to December, 2019. Gashena is situated at 11 ° 46' N latitude and 38 ° 45' E longitude, at 2865 meters above sea level and it receives a mean annual rainfall of 1127.80 mm. The average annual minimum and maximum temperatures were 12°C and 24°C, respectively (SARC 2018). The soil type of the trial site is clay loam that has good drainage property. Eight low and medium chill apple varieties namely: Anna, CP-92, Princisa, Bond Red, Golden delicious, Crispin, Jona Gold & Gransmith were used as experimental material. The appropriate type of grafted seedlings were planted in a well-prepared hole with a depth, diameter and width of 50, 50 and 50 cm, respectively on July 10, 2012 in randomized complete block design with three replications at a spacing of 3.0 and 3 m × 3 m with a population density of 1111 plants ha⁻¹. There were 3 plants per plot. Irrigation water was applied on a weekly basis. Necessary plant protection and agronomic practices like training and pruning were applied as required. Data like scion diameter, rootstock diameter, girth ratio, canopy diameter, plant height, mean fruit weight and fruit yields were collected for two consecutive years. Farmers' opinion was collected once at fruiting stage and set their criteria to evaluate apple varieties. After setting their criteria they evaluate apple varieties and gave rank on the setted criteria. Vegetative data was collected after dormancy while yield data was collected two times within a year. Data were analysed using SAS 9.0 software (SAS 2002). Least Significant Difference (LSD) at 5% probability level was carried out for mean separation.

RESULTS AND DISCUSSION

The combined Analysis of variance (ANOVA) showed that scion diameter was highly variable among the cultivars studied; the highest values were being recorded for cultivars Anna (5.20 cm) and Golden delicious (4.16 cm), whereas the lowest value was found in Jona Gold (Table 1). The result is in line with [8,9]. Moreover, it was observed that the longest rootstock diameter of (6.17 cm) was recorded by the cultivar Anna, whereas the smallest diameter (3.29 cm) was scored by Jona Gold. Similar result was recorded by EIAR (2002) [9].

Cultivars showed a significant ($P < 0.05$) difference in the girth ratio. Significantly, highest ratio was obtained from cultivar CP-92 and Golden delicious with an average value of 87.80 and 85.46 %, respectively (Table 1); while the lowest was recorded for Princisa, with 63.96%. Similar result was reported [9]. Least Significant Difference (LSD) at 5% probability level was carried out for mean separation. Varieties showed significant variation in terms of plant

height. Significantly, the tallest plants were recorded by Anna followed by Bond red variety with plant height value of 3.09 and 2.72 m, respectively (Table 1). Whereas, the shortest plant height value was recorded by Crispin (2.19 m). In addition, cultivars showed significant variation in canopy diameter. Anna scored the highest canopy diameter value (1.84 m). On the other hand, CP-92 scored the shortest canopy diameter with value (1.08 m) (Table 1). The result is in line with [10].

The cultivars studied differed significantly in mean fruit weight, the highest weight being reported for Anna followed by Gransmith with an average value of 85.98 and 62.34 g, respectively. The lowest were found for Crispin and Jona Gold with 41.01 and 51.97 g, respectively (Table 1). Fruits from cultivar Anna gave relatively highest total yield 9.52 t ha⁻¹. In contrast, Crispin gave the lowest yield of 7.77 t ha⁻¹ [13]. This yield is equal to most country of the world (FAO 2011). But there are countries their productivity of the crop reaches up 40.5 ton ha⁻¹ [11]. Generally, temperate fruit productivity is low in tropical areas due to biotic and abiotic stress (pest, chilling, flower physiology, field management, etc)

Table 1: Combined yield and vegetative data of apple varieties at Gashena

Variety	DAU (cm)	DAU (cm)	GR(%)	PH(m)	CD (m)	MFW (g)	FY(t ha ⁻¹)
Anna	5.2	6.17	84.94	3.09	1.84	85.98	9.52
CP-92	3.43	3.92	87.8	2.35	1.08	53.5	8.05
Princisa	2.94	4.62	63.96	2.35	1.3	57.06	7.88
Bond Red	3.44	4.11	84.25	2.72	1.31	61.98	8.73
G. delicious	4.16	4.84	85.46	2.79	1.36	56.08	8.43
Crispin	2.99	3.52	81.98	2.19	1.15	41.01	7.77
Jona Gold	2.33	3.29	73.45	2.46	1.14	51.97	7.88
Gransmith	3.36	4.14	82	2.51	1.45	62.34	8.92
LSD (5%)	0.48	0.62	9.49	0.23	0.28	13.48	0.7
CV (%)	14.41	15.04	12.42	9.59	21.85	19.45	7.2

Farmers were invited to set their criteria and select their favorite varieties. High yielding, fruit shape, fruit size fruit color and taste were the main farmer's criteria setted. Based on the value models results, Anna was identified at the first choice of farmers due to its best performance in all criteria's setted. Gransmith selected as a second choice because of its good in yield, fruit shape and fruit size. The third and fourth choice of the farmers was CP-92 and Bond Red due to its better in fruit shape and its yield advantage. During selection farmers were had a better understanding towards identifying the criteria for selection. Finally rank sum method was used to identify the promising varieties to Gashena and similar areas. Both in biological data and farmers selection methods variety Anna selected first followed by Gransmith both biological data and farmers selection methods. In general yield gap is an issue at farmers' field and it can be rectified through technological interventions [12]. Moreover, suited and selected variety was to undergo field adaptations for enhancing production. The use of sustainable yield index considering soil physical and yield variability should also be criteria for future endeavors [13].

CONCLUSION AND RECOMMENDATIONS

Anna and Gransmith varieties were found outstanding in terms of physical quality parameters like (shape, color and size) and marketable yield. Introducing these apple varieties is felt vital to the area to exploit the full potential of the crop. MM-106 rootstock is

adapted and recommended for woolly aphid. Therefore, Anna and Gransmith varieties were recommended for produces at Gashena and similar agro-ecologies. Finally, scions of the recommended varieties will be grafted with best rootstock variety MM-106 and distributed for farmers.

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