J. Agric. Food. Tech., 4(5)7-15, 2014

ISSN 2090 – 424X
Journal of Agriculture and Food Technology
www.textroad.com

Survey on Apple Production and Variety Identification in Chencha District of Gamo Gofa Zone, Southern Ethiopia

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Received: August 13, 2014
Accepted: October 10, 2014

ABSTRACT

Apple (*Malus domestica*) is one of the most important temperate fruits grown in the highland climates of Ethiopia by virtue of high altitude. Chencha district in the Southern region hosted the first apple trees introduced to Ethiopia and grown for a long time; however, the achievements from apple production so far remained minimal. There is inadequate information on productivity and variety identification. Therefore, a survey on productivity and variety identification of introduced apple trees in Chencha district of Gamo Gofa Zone was carried out in 2013/14 cropping season. The study was aimed to assess status of apple production and productivity, investigate apple tree management practices carried out by the growers and identify apple varieties and rootstocks. A total of 181 randomly selected respondents were interviewed using semi-structured questionnaire from nine administrative units (kebeles). Results of the survey showed that farmers lacked knowledge on importance of the crop and did not invest in good crop management as it demands revealing that the fruit tree was neglected by research and development. For most farmers, land holding size was estimated to be below 0.25 hectare. Due to very low level of the fruit tree management practices farmers applied, fruit yield was found to be in the range of 4.2 - 8.3 tons per hectare as comparison to 40-60 tons per hectare achievable in good growth conditions somewhere else in the world. A total of sixty apple varieties were identified in the study area, out of which Bonded Red (BR), Crispin, Grany smith, Jonagored and Red delicious were extensively cultivated. MM106 is reported as a good root stock in the study area. Therefore, applied research on agronomic packages for improving productivity, identification of best varieties for Chencha and similar agro-ecology should be promoted through field trials; communication on current knowledge and sharing of information on interventions in production of apple is recommended.

KEY WORDS: Apple, Productivity, Variety identification, Chencha, Management practices.

INTRODUCTION

Apple is a temperate climate fruit tree native to many parts of Europe and Asia. The leading apple growing country is China, producing about 41 per cent of the world's apples, followed by the United States [6]. Depending on the tree density, mature trees typically bear 40–200 kg fruits. Apples are grown for several values they provide to growers: diversification of income generation for the household, nutritional values especially vitamins, soil conservation, and supplement seasonal production decrease for staple crops.

Temperate fruits such as apple require a period of low temperatures (cold season) for their successful growth and flowering and a season of relatively high temperatures (hot season) in order to mature fruit of good quality. The presence of temperate climate at higher altitudes *per se* is not adequate for successful production of those fruits in tropical zones like Ethiopia. The complexity of different seasons in tropics has great impact on their production process and this need to be well understood and possible management aspects applied.

Although apple, pear and plum are among important crops used for food security and income generation in other African countries, they were not well recognized fruits in Ethiopia [15]. They are highly valued fruits adapted to temperate climate; however, they can grow in tropical highlands where temperate climate prevails. Among the temperate fruit grown at Chencha, apple is widely cultivated while pear and plum received very low attention. In Ethiopia, apple was first brought to Chencha by Missionaries about 60 years ago and established in the garden of

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Chencha Kale-Hiwot Church. However, it was recently that the crop is viewed as valuable and its production has received attention to transforming the lives of many farmers in Chencha and the trend is expanding to the neighboring districts as well as to other parts of the country. Following the expansion of its production in Chencha and other areas, there is a growing demand for apple in central and local markets in Ethiopia. The country has also a potential to export apple, if production and quality is further improved. Hence, in Ethiopia great potential exists for temperate fruits to contribute to economic development and poverty alleviation by improving the living standard of the poor farmers in addition to the environmental sustainability aspects.

Since its introduction in 1950's, several varieties of apples were grown at Chencha area and the area has become a source of grafted apple seedlings for similar other areas of the country so far. Apple begins bearing fruits in Chencha after four to five years of planting, depending on varieties, root stocks on which it is grafted and soil conditions. However, yields varied depending on varieties, age, tree management (pruning and training) and agronomic practices (watering, cultivation, manure application, disease and insect pest management) applied. Appropriate standards for tree management and agronomic practices have not been determined for successful apple fruit production in Chencha area.

Appropriate varieties need to be selected in terms of adaptability, productivity, fruit size, taste, maturity time, pollination characteristics, shelf life, and resistant to prevailing diseases and insect pests. Variety selection remains the most important hindering factor for successful apple production in Chencha area.

In spite of such long years of experience in apple production and trade at Chencha, scientific research is scantly to determine the adaptation and performance of the different varieties. Thus, it calls for research work to assess the production and productivity as well as types of apple varieties at Chencha district to have baseline information before establishing permanent experimental plots at field condition. For this reason, the present study was carried out with the following objectives: to asses status of apple production and productivity, investigate apple tree management and agronomic practices applied by the growers and identify apple varieties and rootstocks in use at Chencha district.

METHODOLOGY

Study site description

The study was conducted at Chencha district, which is located in the Gamo Gofa administrative zone of the Southern Nations, Nationalities and Peoples' Regional State (SNNPR) of Ethiopia. The district encompasses 50 'kebeles', the lowest administrative level in Ethiopia. The altitudes of the district range from 1600-3200 masl. It has two agro-ecological zones: 'dega' (2300-3200 masl, 82%) and 'woinadega' (1500-2300 masl, 18%); with total area coverage of 37,650 ha. The population of the district is 125,628 (Female: 66,363 and Male 59,263) and 21,655 households, of which 2461 households are female headed [3]. It is one of the most populous districts in the zone. The major means of livelihood for the district is subsistence agriculture followed by traditional weaving and causal labor employment [19].

Sampling

From the list of households at 14 apple producing units (kebeles) at Chencha district, nine of them were included for the study. Based on their apple production potential, experience in grafted seedling raising and apple fruit production status, households from these kebeles were categorized into clusters of model, medium and minor apple producers, of which 50%, 30% and 20% households were considered in the sampling, respectively. Then total of 181 randomly selected households were interviewed for data collection.

Data collection

A semi-structured questionnaire was developed after pre-testing to collect data on the production and productivity status of apple, tree management and cultural practices applied, and occurrence of disease and insect pest infestations and their control methods, and types and productivity of different varieties. Respondents were interviewed by trained enumerators with supervision of research team. In addition, field observation and discussion were held with experts from Kalehiwot church development organization and Chencha district agriculture office.

Data analysis

Quantitative data were analyzed using SPSS version 15.0 statistical package while the qualitative data were described and narrated. The results were then presented by using tables and percentages as under.

RESULTS AND DISCUSSION

General socio-economic characteristics

Table 1.Age and family size of the respondents

Age group (years)	Frequency	Percentage	Family size	Frequency	Percentage
41-60	85	47.0	5-7	67	37.0
26-40	77	42.5	8-10	51	28.2
> 60	17	9.4	<5	40	22.1
16-25	2	1.1	>10	23	12.7

Out of 181 respondents interviewed, 81.2% were males and 18.8% were females. This indicated there was limited participation of females in the area. The results in table 1 show that the age of most respondents (47%) fall between 41-60 years while only 1.1 % is within the range of 16-25 years. It indicates that more elder categories are involved in apple cultivation as compared to the higher (> 60) and lower (<25) age groups. The family number of most respondents (37%) ranged from five to seven while fewer respondents (12.7%) had >10 family size. Accordingly, the average family size of the respondents was 5.2. This result is slightly higher than the reports of [2], which is 4.7 (national average) and 4.9 (regional average) for Chencha district. The involvement of such age group and family size in apple production implies the presence of adequate productive labor to divide for intensive apple management activities as necessary.

Table 2.Respondents' levels of education and source of livelihood

Education Level	Frequency	Percentage	Livelihood source	Frequency	Percentage
Primary School	72	39.8	Agriculture only	78	43.1
Illiterate	61	33.7	Weaving and agriculture	46	25.4
Secondary School	41	22.7	Agriculture & trading	40	22.1
Diploma	6	3.3	Agriculture, weaving & trading	15	8.3
Degree	1	0.6	Trading only	2	1.1

As indicated in Table 2, most of the respondents (39.8%) attained primary school education and 26.6% were above secondary school. But a significant portion of the respondents (33.7%) had never been to school. The finding is in consistent with the result obtained by [7] who found that over 57% of the sampled households in Chencha district were illiterate which might influence the adoption modern agronomic practices. Most respondents (43.1%) based their livelihood only in agriculture. On the other hand 55.8% of the respondents depended on weaving, trading and agriculture. Small proportions (1.1%) of respondents were engaged in trading only.

Table 3. Importance and potential of apple production to improve household income

Importance	Frequency	Percentage	Potential	Frequency	Percentage
Cash and food	97	53.6	Both fruit & grafted seedling	129	71.3
Cash only	77	42.5	Fruit production	24	13.3
Food only	4	2.2	Grafted seedling	20	11.0
Other	3	1.7	No idea	8	4.4

As depicted in table 3, for majority (53.6%) of households, apple is important for cash income and as a supplementary food, but 42.5% of the respondents produce apple for cash only while very few produce for food purpose. The results reveal that apple is produced in the study area basically for cash. It is in consonance with those of [1] who reported that around 80 % of Chinese farmers eventually converted their land to apple growing in order to gain more cash income.

From the total interviewed households, 71.3% recognized that both fruit production and grafted seedling multiplication and selling are basic to improve family livelihood in Chencha district. Similarly about 13.3 and 11% of the interviewed apple growers viewed the potential of apple to provide benefits from fruit production and grafted seedling multiplication, respectively. Achievements in apple orchards establishment in Chencha district has not been developed in spite of the long history of its introduction to the area (Tewoflos and Vigand, 1995). Till recently more farmers were involved in grafted seedling multiplication than establishing their own orchards (Temotewos, 2008). From the Chencha district alone, more than 15, 000 grafted apple seedlings were sold annually out to other parts of Ethiopia (CWAO, Personal communication). The seedlings are raised not only to plant in their own orchards but also to earn money from sale to other parts of the country. However, very recently apple production trend in

Chencha district is on orchard establishment than seedling sale as the farmers realized that fruit production is feasible than seedling multiplication for long term income and food benefits [7].

Apple production patterns

Table 4.Respondents' plan to improve apple production and farm size of their apple orchards

Future plan	Frequency	Percentage		Farm size (ha)	Frequency	Percentage
Both fruit and seedling	113	62.4		0.025-0.25	73	40.3
Selling fruit	42	23.2		0.25-0.5	41	22.7
Expanding production	14	7.7		<0.025	38	21.0
No idea	7	3.9		0.5-0.75	17	9.4
Selling seedling	5	2.8		>1ha	12	6.6

The future apple production plan for 62.4% of the interviewed apple growers was to engage in both orchard establishment for fruits production and grafted seedling multiplication for own use and sale. Furthermore, it was reported that producing apple for fruit is getting much greater future attention (23.2%) than seedling multiplication (2.8%) in the study area (Table 4). The respondents' plan to run both fruit production and seedlings multiplication seems to continue in the future. This is also in line with the potential of both activities recognized by the respondents to change their livelihoods (Table 3).

Farm size covered by apple in the study area range from 0.025 to >1ha (Table 4). The result revealed that majority (40.3%) of the respondents' devoted only small portion (0.025-0.25ha) of their land for apple farming. Nevertheless, 38.7% of respondents devoted more than $1/4^{th}$ ha of their land for growing apple; it was rare to find farmers with more than one hectare of apple orchard. Almost all respondents owned the land by themselves and no households were found with rented apple farms. The farm size under apple tree is insignificant compared to the area's potential for apple cultivation to provide adequate benefits to the household. An orchard of 30 to 35 acres can provide sufficient income for a family [12].

Table 5.Response on types of rootstock cultivated and fruit yield in kg per tree

Type of rootstock	Frequency	Percentage		Yield (kg/tree)	Frequency	Percentage
MM106	105	58.0		15-30	65	35.9
Local (unknown)	29	16.0		<15	55	30.4
Have no idea	22	12.2		30-50	28	15.5
MM 104	16	8.8		50-75	17	9.4
MM 111	9	5.0		75-100	11	6.1
MM 109	0	0.0		>100kg	5	2.8

In apple production, type of root stock used determines tree growth, type of pruning and training system to be applied. About four types of root stocks were used in the study area with varying percentages of distribution at household levels (Table 5). More than half of respondents presented MM106 as good root stock in the study area while 12.2% of them had no idea about the type of root stock being used. However, farmers who used MM106 in wet soils lost their bearing trees suddenly. MM106 is susceptible to crown rot [6]. Local rootstock (used by 16% respondents) is the name farmers gave to the type of rootstock with unknown origin or unidentified. It was reported by farmers as susceptible to root rot disease. Root stocks such as MM104 and MM111were also used by fewer respondents. MM111 is drought tolerant and resistant to woolly apple aphid and tolerant to drier soil conditions [6]. MM111, semi-dwarf rootstock is quite disease resistant and will usually produce fruit in three to six years [4].

Since almost all farmers grow mix of variable age of cultivars with no standard orchard lay out in their gardens, it was difficult to assess productivity of their orchards. Thus, the respondents were asked to estimate the yields of trees ≥10 years old. The result indicated variable yield from less than 15 to more than 100kg/tree with decreasing percentage of respondents for increasing trends in yields (Table 5). The variation in yield could probably be attributed to potential of different varieties, tree ages and cultural practices, among others. Majority (69.7%) of respondents achieved yields more than 15 kg/tree while 33.8% of them obtained more than 30kg/tree. This result is higher as compared to the average yield obtained in Mekelle area of Tigray region, where from all mature trees, productivity was estimated at an overall average of 4.13 kg per tree [8]. The finding thus indicates that with proper selection of varieties and improved cultural practices there is a great potential to improve yields per tree in the study area.

Table 6. . Source of grafted seedling and farmers' preferable season for multiplication

Source of planting material	Frequency	Percentage		Farmers' preferable season	Frequency	Percentage
World Vision Ethiopia	74	40.9		June to August	77	42.5
Own source	55	30.4		April to May	60	33.1
District agriculture office	32	17.7		Have no idea	23	12.7
Kalehiwot Church	15	8.3		August to Sept.	18	9.9
Agriservice Ethiopia	5	2.8		Sept. to November	3	1.7

Producing quality grafted seedling is a pre-requisite for good apple fruit production as it determines the productivity of the tree in the orchard. The result describes that apple producers in the study area acquire grafted seedlings from different sources, i.e. own source, NGOs and government (Table 6). Among NGOs, World Vision Ethiopia Chencha Area Development Program has been the major donor of grafted seedlings to apple producers in Chencha district. It has encouraged orchard establishment by the farmers in the district while Chencha district agriculture office sales for lower price to encourage apple cultivation. The provision of grafted seedlings in this case is important particularly for farmers who lack expertise in nursery practices and/or who cannot afford costs of multiplication. In spite of its positive impact, lack of cultivar composition in terms of pollinating groups and poor knowledge of orchard lay out may lead to poor yields. Therefore, strict attention is needed to maintaining quality as well as cultivar composition of grafted seedlings by an expert before distribution.

When farmers were asked to notify appropriate season for raising grafted apple seedlings, majority (42.5%) prioritized (June up to August) to be suitable season for raising seedling followed by the end of (April to May) on their farm according to the prevailing environmental conditions. Some (12.7%) respondents do not know the preferable months for raising apple seedling. These could be those who receive already grafted seedlings from other sources. Selected root stocks are usually planted in the nursery from April to May and scion grafting is carried out from June to August in the main rainy season in Chencha district [15].

Table 7. List of apple cultivars under cultivation in farmers' fields and in nursery trials

Cultivars in farmers' fields		Cultivars in nursery trials	
BR, Crispin (Mustu), Grany smith, Jonagored, Red delicious, Golden delicious, Jonica, Red Jonagold, Royal Chencha,	Galla, Galla Chencha, Gala Must, Dorset, Elstar, Fuji, Kidd's orange red, Smoothee, Yataka, Chinango (Anna) and Princesa	Alkmene, Ariwa, Katy, Orin, Pilot, Pillar tree, Piros, Primera, Pinova, Queen Cox, Resi, Richared Delicious, Summer Red, Summerland McIntosch, Topaz, Winter Banana, Winter Gem, Nela, Rewena, Melrose, Retina, Red Spur, Ahrista, Red Jade, Dacapo, Red Sentinal	Fiesta, Gotha, Idared, Rome Beauty, Remo, Relinda, Rebella, Selena, Saturn, Scarlet O´Hara, Rubinola, Gerlinde, Angold, Bramley's Seadling and Hilliereare

Cultivar selection remains the most important step for successful apple fruit production. Respondents were asked to list the cultivars they considered as highly productive based on their marketing opportunities. The result indicated that BR, Crispin, Grany smith, and Jonagored were more productive cultivars grown at all study locations of Chencha district (Table 7). Apple cultivars such as BR and Grany smith were specifically preferred and produced by some households, who avoid other varieties. Varieties like Golden delicious, Red delicious, Royal Galla, Dorset, Anna and Princisa, Galla Chencha, Galla must were grown by few households. It was uncommon to see farmers who grow more than five different apple cultivars in the study area. Only three respondents were found growing 15 cultivars which were found at Rehobot and Kalehiwot nursery and orchards. The finding thus implies that most households prefer to hold few (four to five) apple cultivars while several cultivars were found concentrated within the orchards of very few households. According to [17], Chencha district is conducive to producing more than 100 varieties of apples and serving as a resource base for the rest of the country.

In standard apple production systems farmers are advised to grow mix of varieties for pollen transfer. Since most apples are self-infertile, pollinizer varieties are placed in the orchard to provide pollen to the main cultivars being grown. The finding reveals that farmers in Chencha district grow mixtures of apple cultivars without considering pollinizer groups. This will have negative impact on the fruit set and yield of the cultivars at farmers' orchards [12].

The respondents also mentioned the number of apple trees per households and the estimated period they had started growing apple. Number of apple trees of the interviewed households ranged from <10 to 100. Majority (45.3%) of the respondents, however, grew 10 to 25 apple trees whereas 75 to 100 apple trees were owned by only 16 households (data not shown). This result contradicts with the recommendation made by [9] who reported as highly productive commercial apple orchards today have 150-180 trees per acre. According to most respondents,

apple had been grown in the study area since 5 to 10 years, but very few farmers replied long years of apple existence (above 20 years) in their gardens. Apple introduction into Chencha district was made around 1950s and production has increased since the last 10 to15 years [16]. The present finding reveals that apple was less promoted in the area for long and its benefit was recognized very recently.

Table 8. Apple dormancy and flowering period in Chencha district

Dormancy period	Frequency	Percentage		Flowering period	Frequency	Percentage
June - July	102	56.4		October	150	82.9
May-June	45	24.9		November	17	9.4
July- August	30	16.6		December	2	1.1
August - Sept	4	2.2		Unknown	12	6.6

June to July was mentioned as apple dormancy periods in Chencha area by majority (56.4%) of respondents (Table 8). The result also shows that the dormancy period ranged from May to September. The finding probably implies that different apple cultivars vary in their chilling temperature requirements depending on climatic conditions and cultural practice to enter into dormant stage. Therefore, June, July and August are the main dormancy seasons of apple in Chencha. In temperate regions like Europe, the dormancy periods of apple extends from December to February during which apple meets its chilling requirements [15]. Dormancy periods of apple also vary at different parts of the country. Despite the plasticity expressed by the apple species, the major apple cultivars show delayed and uneven budburst when grown in the tropical climatic conditions like the northern highlands of Ethiopia [8]. In Tigray region, Ethiopia annual variability of hours of sunshine follows a similar pattern to temperature, with least sunshine in July and August due to persistent cloud cover and a second minimum in December and January due to the astronomical position of the sun at southern latitudes [5].

According to Table 8, majority (82.9%) of respondents reported that apple starts flowering in October, though few responses extend the flowering start time to November and December, which could be the case for late varieties such as Grany smith. Some farmers also do not recognize the flowering time of the apples in their orchards which will result in failure to determine the maturity time of the fruits. Days after full bloom are one of maturity indices used for determining time of harvest for apple in addition to physical and chemical parameters. Furthermore, major apple fruit harvesting seasons were from March to April whereas as BR is reported to be early yielder for which its harvest begins in the mid of March while Grany smith has been late yielder, being harvested from July to the end of August in the study area. Most other cultivars were harvested within the intermediate months. Mostly two and seldom three harvests were made from a single apple tree as all fruits do not reach maturity uniformly in the study area. This is in agreement with the experience in East Java, Indonesia where two harvests are possible in one year [18].

Crop management

Almost all respondents mentioned that apple trees were pruned only once per year and significant portion of farmers do not prune their trees at all. This contradicts with fact that pruning mature trees are important to control crowding, provide optimum light exposure, and maintain uniform vigor [11].

Table 9. Fertilizer (compost) application rates and frequency of weeding for mother trees in apple orchards

Compost (kg/tree/year)	Frequency	Percentage		Weeding/season	Frequency	Percentage
10	71	39.2		2times	83	45.9
<5	49	27.1		1times	54	29.8
5-7.5	42	23.2		>3times	21	11.6
>10	10	5.5		3times	18	9.9
No idea	9	5		No idea	5	2.8

Tree nutrition is the most important part of orchard management. Large amount of nutrients are removed from the soil by the tree for fruit yield. The cheapest way to satisfy the needs of the tree is manure application, a complex organic fertilizer. Farmers in the study area do not apply inorganic fertilizer as apple tree nutrition. The practice indicated variable compost made from manure (of cattle and sheep) as well as plant biomass which was supplied at rates ranging from less than 5 to more than 10kg/tree/year (Table 9). This rate is much smaller as compared to the needs of bearing apple trees above five years. Manure requirements of apple trees vary with an increasing trend in kg/tree/year ranging from 2.0 to 2.5 in the first year to 50.0-60.0 in the ninth year. However, manure requirements are almost similar, 55 to 65 kg from 10th year onwards [6].

Some of the farmers were not measuring the amount of manure they applied. The main methods of manure application were mixing with soil during planting and band application in fruit orchard. Respondents also apply different weeding frequency from none to more than 3 times with most respondents practicing 3 times per growing season. The result thus implies that there is no standard for manuring and weeding of apple orchards in the study areas. Lower fruit yields per tree recorded could be the reflection of improper cultural practices below standard.

Farmers in the study area intercropped apple with other crops (vegetables: cabbages, beet root, carrots, and legumes such as beans and peas). This result is in line with the finding of [14] who reported that at the young apple orchard plantations, vegetables like cole crops, potato and tomato are grown to supplement the income.

Table 10. Frequency of orchard floor management per growing season

Cultivation	Frequency	Percentage		Irrigation	Frequency	Percentage
2 times	90	49.7		Irrigation 1 times	74	40.9
3 times	64	35.4		Irrigation 2 times	54	29.8
4 times	8	4.4		Irrigation 3 times	43	23.8
> 4times	4	2.2		No idea	6	3.3
No idea	15	8.3		No irrigation	4	2.2

Apple has high water need, about 800mm per year [10] and scheduled application is as critical for fruit set as for fruit development. Watering boosts flowering and fruiting and minimizes fruit drops translating to higher productivity. Cultivation and irrigation frequency varied across locations ranging from 2 to more than 4 and one to zero, respectively (Table 10). Farmers in the study area use irrigation water from spring and ground well and very few from pumped source. The finding implies that limited attention was given to management of apple trees. Findings of [4] reported apple trees should be watered weekly during dry periods, especially during the first two years after planting.

Apple pests and diseases

Table 11. Insect pests, birds and diseases hindering apple production

Insect pests	Frequency	Percentage		Diseases	Frequency	Percentage
No idea	108	59.7		Fungal	116	64.1
Aphid on young shoots	32	17.6		Unknown	65	35.9
Birds damage on fruits	18	13.8		Bacterial	0	0.0
Leaf caterpillars	16	8.8		Viral	0	0.0

Different insect pests and diseases were affecting apple production in the study area (Table 11). About 17.6%) of respondents reported that green aphid was the major insect pest affecting apple at nursery and orchard. Most (59.7%) farmers have not identified insect pests that attacked their apple crop and hence they were not aware of any control strategies. The same was true for 35.9% respondents with regard to diseases affecting their apple crops. Among the fungal diseases powdery mildew and apple scab were the most frequent. Cultural measures practiced include cow milk mixed with chopped white onion to control powdery mildew after spraying on surface of the apple tree leaves and removal of infected parts. This finding concurs with earlier findings that apple scab, powdery mildew and green aphid were the most notorious diseases and pests [13].

CONCLUSION AND RECOMMENDATIONS

Conclusion

Chencha district has nearly more than six decades of experience in apple cultivation since its introduction. Number of trees planted per most household is very few on area below 0.25 hectare, though there is conducive environment for its production. There is a great potential for apple production in the area by virtue of high altitude to meet the chilling temperature requirements of different cultivars for successful cropping. Despite this fact, farm yields are frequently in the range 4.2-8.3 t/ha in comparison to 40 to 60 t/ha achievable in good growth conditions. Farmers lacked knowledge on importance of the crop and on its production and management practices. They did not invest in good crop management as the crop demands. World Vision Ethiopia Chencha Area Development Program

has been the major provider of grafted seedlings to the producers in Chencha district. The overall result confirmed that the fruit tree was neglected by research and extension for long.

Among sixty varieties identified in Chencha district in farmers' field as well as in nursery trials of Chencha Kalehiwot Church, five varieties viz. BR, Crispin, Grany smith, Jonagored and Red delicious were extensively cultivated. Therefore, it can be concluded that Chencha district is rich in terms of cultivar diversity than elsewhere in Ethiopia.

Selection of root stock was not based on their suitability to soil conditions and their ability to tolerate diseases. Thus, use of MM106 on poorly drained soils should be avoided. Farmers lacked knowledge and skills on the state-of-the-art and hence almost all respondents did not apply standard apple management practices.

Recommendations

- Applied research on agronomic packages for improving productivity, identification of best varieties for Chencha and similar areas should be done through field trials.
- Apple tree and orchard floor management practices need to be standardized and demonstrated to farmers through extension and outreach as crop management is a key factor determining crop productivity.
- The effort of different actors in supplying grafted seedlings to the farmers should be encouraged as this will attract more farmers to engage in orchard establishment for fruit production.
- Chilling temperature requirements of the different apple cultivars need to be determined so that variety selection to different agro-ecologies would be based on adaptability to specific climates and soil conditions.
- Due attention should be given to the composition of pollinizer varieties groups during new orchards establishment.
- Introduction and adaptation of suitable root stocks needs to be planned in future research besides the need to evaluate the existing root stocks for tree growth and performance, and varying soil conditions.
- Establishment of additional nurseries by the government is necessary to act as a sustainable source of standard grafted seedlings to farmers within Gamo highlands.

Acknowledgements

The authors wish to thank the World Vision Ethiopia Chencha Area Development Program for funding this study. Olani Kebede, the Program Director and Mescob Mamule, the project coordinator deserve due thanks for their facilitation. Support from Chencha woreda office of Agriculture staff who guided the survey team is also appreciated. Our heartfelt thanks are also expressed to development agents for their contribution during the survey and the farmers who participated in the study by giving the relevant information on apple production and management.

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