Current Status and Constraints of Mango (*Mangifera incica* L.) Orchards in Hamelmalo- Locality, Eritrea

Mohammed H. Mekki[1,2*], Belay T. Keleta[1], Adiam F. Haile[1], Lidia W. Tewelde[1], Miriyam T. Gebretnsae[1], Nahom N. Tekie[1,] Shewhat M. Kiflezgi[1], Yorsalem M. Weldehaimanot[1]

1. Department of Horticulture, Hamelmalo Agricultural College, The State of Eritrea.

2.Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan.

***Corresponding author:** m.mekki2017@gmail.com

+249122483976 - +291 7726459

Abstract

Mango (*Mangifera indica* L.) is one of the most tropical and subtropical fruit in the world. It is also an important fruit in Eritrea especially in the Anseba region (Hamelmalo, locality) where it is grown extensively and occupies considerable area of land. General features of mango production in Eritrea is conventional by small farmers and does not cover domestic demand. This research aimed to examine and evaluate the current status and agricultural operations contributing to prevailing mango trees performance in Hamelmalo locality, Eritrea (February, 2024). A questionnaire and interview with 56 mango farmers from Hamelmalo, Wazintet and Fredarb villages indicate that most of the farmers loose between 25 to 50% of mango fruits product at the orchard level, more than half of the farmers referred reduction of the mango trees to fruit alternate bearing of the trees, majority of orchards affected with powdery mildew, approximately half of orchards affected with fruit flies, majority of the farmers do not know how to control pests, majority of farmers use irregular spacing between trees in one orchard, most of farmers plant seeded mango seedlings from their nurseries using (uncertified mother plants), most of them cultivate seedy mango seedlings, most of orchards irrigated by surface irrigation (connected single basins), majority add only organic fertilizer and most of farmers did not receive any advisory services. Therefore, advisory services for mango production is highly needed to improve mango production and quality in Hamelmalo locality.

Keywords: Fruit loss (%); Plant spacing; Irrigation; Fertilization; Fruit alternate bearing and Agricultural extension role

الوضع الراهن و العقبات التي تواجه بساتين المانجو في محلية حملمالو –أرتريا

محمد مكي [1,2]، بلاي كليتا[1] ، اديم هايلي[1] ، ليديا تولدي[1] ، مريم قبرتنساي[1]، ناهوم تخلي[1] ، شاويت لفلزقاي[1] ،
يورسليم ولدي هيمانوت[1]

1- قسم البساتين ، كلية حملمالو الزراعية، ارتريا

2- كليةالعلوم الزراعية، جامعة الجزيرة، ود مدني، السودان

+291 7726459 : +249122483976,

البريد الإلكتروني:m.mekki2017@gmail.com

مستخلص الدراسة

تعتبر المانجو من أهم أنواع الفاكهة الاستوائية وشبه الاستوائية في العالم. كما أنها فاكهة مهمة في أرتريا وبالأخص في إقليم عنسبا (محلية حملمالو) فهي مزروعة بصورة مكثفة في مساحة مقدرة . عموماً ملامح إنتاج المانجو في أرتريا تقليدي بواسطة صغار المزارعين ولا يغطي الإستهلاك المحلي. وبالتالي هذا البحث يهدف إلى دراسة وتقويم الوضع الراهن و العمليات الفلاحية التي تؤثر على أداء أشجار المانجو في محليةحملمالو – أرتريا (فبرير،2024م). الإستبيان و اللقاء مع 56 مزارع مانجو من قرية حملمالو، وازنتيت و فيردارب أكدت أن غالبية المزارعين يفقد ما بين (25-50%) من إنتاج ثمار المانجو على مستوى الحقل، أكثر من نصف المزارعين أرجع أسباب نقصان أشجار المانجو إلى ظاهرة تبادل الحمل، غالبية البساتين مصابة بفطر البياض الدقيقي، تقريبا نصف البساتين مصابة بذبابة الفاكهة، غالبية المزارعين لا يعرفون كيف يسيطرون على الأفات، غالبية المزارعين يستعمل مسافات زراعة غير منتظمة في البستان الواحد، معظمهم يزرعوا شتول مانجو بذرية من مشاتلهم الخاصة (باستخدام أُمهات غير معتمدة)، معظمهم يزرع شتول مانجو بذرية ،معظم البساتين يتم ريها عن طريق الري السطحي (أحواض مقرونة)، الغالبية يضيف سماد عضوي فقط، معظمهم لم يتلقوا أي خدمات إرشادية. بالتالي الخدمات الإرشادية لإنتاج المانجو مطلوبة لتحسين إنتاج وجودة ثمار المانجو في محلية حملمالو.

الكلمات المفتاحية: خسارة الثمار(%)؛ مسافات الزراعة؛ الري؛ التسميد؛ تبادل حمل الثمار ودور الإرشاد الزراعي

1- Introduction

Agronomic cultural practices including mango tree spacing, irrigation, fertilization, pruning and pests control are known to influence mango yield and fruit quality. Production of highly yields of good mango fruits needs properly managed irrigation and fertilization programs. Planting of grafted mango plantlets for orchard establishment have so many advantages like: grafted plantlets will take advantages of the rootstocks on which they grafted (e.g. dwarfing character) and also the new trees will be 100% true to type to the commercial mother plant from which the scions were taken, this in addition, they will start fruiting earlier than seedy trees.(Sarkar and AbdurRahim, 2012, Beshir *et al*., 2019, Dutta *et al.*,2019, Burondkar *et al*., 2000).

Mango is grown commercially in the Hamelmalo locality not less than seven decades. However, in spite of long experience in mango production and suitable environmental conditions, production systems are far below regional and international standards. Old mango local cultivars clones are dominant in the area with high height and large canopy, irrigation systems are traditional (surface irrigation), there is a lack of fertilization, pruning, alternate bearing and pests control programs that damage the fruits and increase post harvest losses.

Hence, in order to solve the existing mango yield problems and future plan to have a sound mango industry at Hamelmalo locality, there is a need to study the factors involved in mango yield and quality.

Objectives

To study current status and agronomic practices to the prevailing mango performance in Hamelmalo locality.

2- Materials and Methods

1.1 2.1. Experimental site

The study was conducted at Hamelmalo locality, which is located between latitude 15^0 53´Nand longitude $38^0$66´E and its altitude is 1330m above sea level. It has semi-arid climate with annual mean rainfall of 436mm and temperature between 18 to 40^0C with average of 24^0C.

2.2. Data collection

Ccollection of Data included a prepared questionnaire and interview with mango farmers. A questionnaire was designed to evaluate current status of mango orchards and agronomic cultural practices at Hamelmalo locality. Mango growers were selected randomly (by using Simple Random Sampling) from the three villages of Hamelmalo locality for interview. The villages were: Wazintet, Fredarb and Hamelmalo. The sample size of each village (as shown in the table1) determined by using this formula:

$n=\frac{Z^2_{\alpha/2}pq}{e^2}$ (Bowen and Starr, 1982)

Whereas:

n=sample size

$Z^2_{\alpha/2}$= confidence interval

p=population proportion

q=odds ratio

e=error term

$n = \frac{(1.64)^2 0.3*0.7}{(0.1)^2} = 56.469$

Table (1): Sample size of randomly selected mango farmers from the three villages.

Name of selected village	No. of farmers	Sample size
Wazintet	101	18
Fredarb	134	20
Hamelmalo	094	18
Total	329	56

The prepared questionnaire covered the following:

1. Experience of mango growers in mango production.
2. Fruit species beside mango trees.
3. Fruit loss (%) and the reasons of mango reduction.
4. Type of pests and methods for control.
5. Spacing between mango trees.
6. Source of mango seedlings and type of plantlets.
7. Irrigation methods and irrigation interval.

8. Nutritional program: fertilization and type of fertilizer.
9. Extension role.

2.2.3. Data analysis

Collected Data were analyzed using Statistical Package for Social Sciences to calculate frequency distribution and simple percentage for descriptive analysis.

3- Results and Discussion

Figure (1) shows farmers experience in mango growing at Hamelmalo locality. The results showed that, 91.1% of respondents have experience greater than 5 years. This indicates that most farmers practiced mango growing for a long period and have accumulated experience in mango cultivation and they know well the importance of mango cultivation. This result agrees with Mekki *et al.*, 2016 who found 90% of sweet orange growers at River Nile State, Sudan practiced orange cultivation for five to more than 20 years.

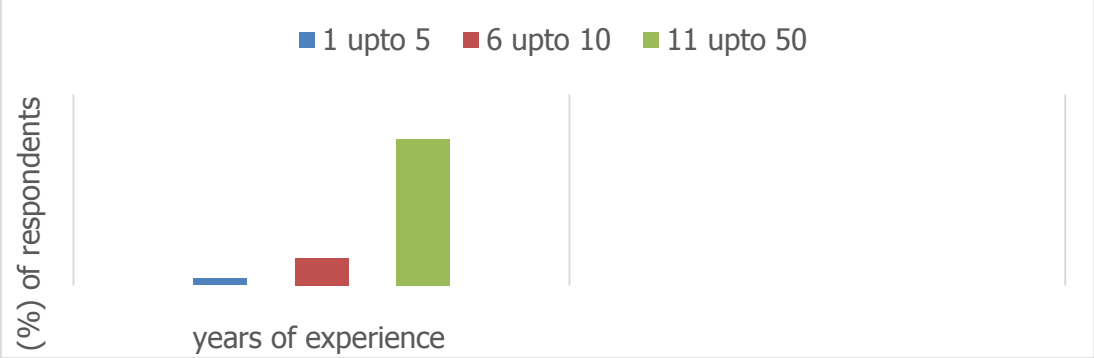

Figure (1): Respondent's experience in mango growing at Hamelmalo locality (February, 2024).

Table (2) shows mango orchards which grow fruit tree species beside mango. The results showed 94.6% of most mango orchards grow fruit trees other than mango, 73.2% of the orchards grow orange with mango trees, 39.3% grow lime, 23.2% grow papaya, 12.5% grow guava, 10.7% grow mandarin and 3.6% grow sour orange. Mekki *et al.*, (2016) found 100% of orchards in River Nile State, Sudan grow Mango, Banana and Guava with orange trees.

Table (2): Fruit species beside mango trees at Hamelmalo locality (February, 2024).

Parameter	Frequency	Percentage
Sweet orange	18	32.1
Sweet orange+ lime	10	17.6
Sweet orange +guava	04	07.1
Sweet orange +papaya	03	05.4
Lime	03	05.4
Lime+ papaya	03	05.4
Sweet orange +papaya + guava	02	03.6
Lime +mandarin	02	03.6
Lime +sour orange	01	01.8
Papaya +mandarin	01	01.8
Papaya +sour orange	01	01.8
Sweet orange +lime +papaya	01	01.8
Sweet orange +lime + guava	01	01.8
Sweet orange +papaya + mandarin	01	01.8
Sweet orange +mandarin	01	01.8
Lime+ papaya+ mandarin	01	01.8
None	03	05.4

Table (3) shows mango fruit loss (%) at the orchard level and the reasons behind mango trees reduction. The results showed that, most of respondents (82.1%) loss between 25 to 50% of their product at the orchard level. This amount 25-50% of fruit loss is very high. 66.1% of respondents referred the reasons of mango trees reduction to alternate bearing of mango trees, 55.4% referred to difficulties and fruit loss through harvesting methods, 51.8% referred to inconvenient post harvest handling, 39.3% referred to the pest's infection and 28.6% referred to improper and constraints of cultural practices. Aga and Gagabo, (2024) referred the main reasons of mango product loss at orchard level in Ethiopia to: birds, wind, injury, pathogens and maturity stage.

Table (3): Mango Fruit loss (%) in orchard level and the reasons of mango trees reduction at Hamelmalo locality (February, 2024).

Parameter	Frequency	Percentage
Fruit loss(%)		
25 up to 50%	46	02
20%	82.1	03.6
15%	02	06
10%	03.6	10.7
The reasons of mango trees reduction		
Harvesting +post harvest handling	17	30.4
Alternate bearing +pest	08	14.3
Alternate bearing +cultural practices +pest +harvesting	06	10.7
Alternate bearing +pest +harvesting	06	10.7
Alternate bearing +cultural practices +post harvest handling	06	10.7
Alternate bearing +post harvest handling	05	08.9
Alternate bearing +cultural practices	03	05.4
Alternate bearing Alternate bearing +cultural practices+ harvesting	02 01	03.6 01.8
Pest +harvesting +post-harvest handling	01	01.8
Pest +harvesting	01	01.8

Table (4) shows type of mango pests and methods of control at Hamelmalo locality. The results showed that, 53.6% of orchards affected with fruit flies, followed by 37.5% mango stone weevils and mango hopper also record (37.5%). 80.4% of orchards were affected with powdery mildew, while anthracnose reaches (39.2%). Most of the farmers (82.1%) do not know how to control pests.

Mango is attacked by about 400 insects and mite's pest. However, a few are of major economic importance. These include Leafhoppers, stem borers, fruit flies, stone weevil, mealy bugs and others. Of them fruit flies and stone weevils are of quarantine importance and restrict the international trade of mangoes (Reddy *et al.*, 2018). Integrated pest management (IPM) modules are still remain the preferred option for farmers in mango pest management in order to have a residue-free and to protect the biodiversity of orchard ecosystems, is crucial that workable management strategies are evolved (Reddy *et al*., 2018).

Table (4): Type of mango pests and methods for control in Hamelmalo locality (February, 2024).

Parameter	Frequency	Percentage
Insect pest		
Fruit flies	15	26.8
Mango hopper	11	19.6
Fruit flies+ mango weevil	09	16.1
Mango weevil	06	10.7
Fruit flies+ mango hopper	05	08.9
Mango weevil+ mango hopper	03	05.4
Mites	02	03.6
Mango weevil+ mites	02	03.6
Mango hopper+ mites	01	01.8
Fruit flies+ mango weevil+ mango hopper	01	01.8
None	01	01.8
Disease		
Powdery mildew	31	55.4
Powdery mildew +anthracnose	14	25.0
Mango anthracnose	08	14.2
none	03	05.4
Pest control		
Chemical	07	12.5
Physical	01	01.8
Biology +chemical	01	01.8
Chemical +physical	01	01.8
Not at all	46	82.1

Figure (2) shows regularity spacing between mango trees at Hamelmalo locality. The results showed that most of respondents (80%), plant mango seedlings with irregular spacing in one orchard. This result is agreed with Aga and Gagabo, (2024) who found Ethiopian farmers typically paid little attention to spacing between mango trees. Because of their age and the majority of farmers did not know much about spacing, which resulted in an uneven development pattern with some mango orchards growing closer to another and others farthest from one another. All operations depend heavily on space and improper spacing might cause productivity issues (Seid and Zeru, 2013). One of Aga and Gagabo, (2024) recommendation to train mango growers at Eastern and Western Ethiopia on proper spacing between mango trees.

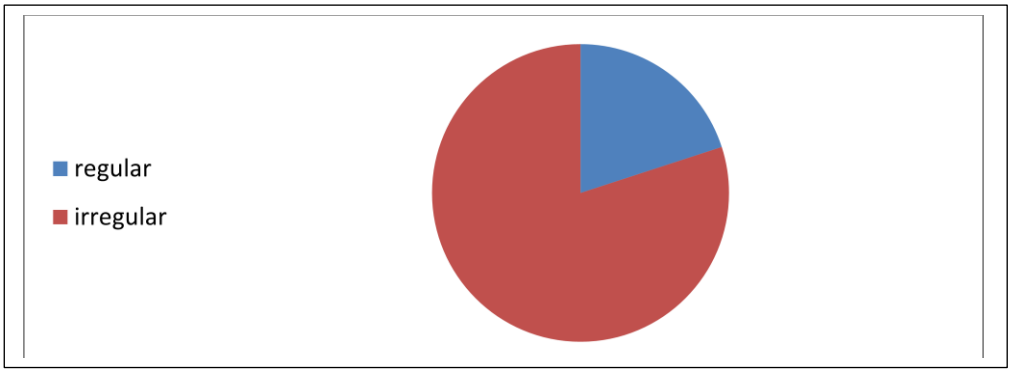

Figure (2): Regularity spacing between mango trees (February, 2024)

Table (5) shows source and type of mango seedlings. The results showed that, 92.9% of respondents use uncertified seedlings from their nurseries (own or neighbor), while MOA contribution is very low and only 7.1% of respondents brought mango plantlets from MOA. Most of respondents (92.9%), use seedy seedlings while only 7.1% use grafted plantlets. Seedy seedlings are two polys embryonic and mono embryonic, mainly mono embryonic give trees not true to type and in most cases with less yield and fruit quality than their parents. Poly embryonic will not give advantages of Asexual propagation. Unfortunately, in Eritrea still local cultivars not identified. In a similar previous studies done by (Mekki *et al.*,2016) it was found that 85.4% of orange growers at River Nile State Sudan establish their orchards with seedlings from their own nurseries.

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Table (5): Source of mango seedlings and type of plantlets in Hamelmalo locality (February, 2024).

Parameter	Frequency	Percentage
Source of seedlings		
Own nursery	51	91.1
MOA	04	07.1
Neighbour	01	01.8
Type of plantlets		
Seedy	52	92.9
Grafted	04	07.1

The methods of irrigation and irrigation interval of mango orchards at Hamelmalo locality is shown in Table (6). The results showed that, most of respondents 98.2%, use connected single basins and no orchard irrigate through drip irrigation. Irrigation of orchards with connected single basins, leads to the contact of irrigation water with tree stems. This is not recommended because it leads to spread diseases. Irrigation by Hose is difficult, needs a long time and will not add accurate amount of water. This result agrees with Mekki *et al.*, (2016) who found most of sweet orange farmers 80%, in River Nile State, Sudan use surface irrigation, flat (as one piece). Results showed, 71.4% irrigate their trees once a week or two weeks while still 28.5% irrigate every three weeks to monthly. Its good most of respondents irrigate weekly or once every two weeks, but unfortunately the farmers do not have an idea about actual water required by the tree within different seasons. Singh *et al*., (2020) found 91.82%) of mango growers at Bijnor district with lack of knowledge about drip irrigation schedules.

The efficient use of water on field level, will lead to save water and improve quantity and quality of crops production. Different irrigation techniques are available to irrigate fruit trees, but not all of them are suitable to irrigate mango. In traditional irrigation systems, a huge amount of water is lost in conveyance systems and at the farm level as well as farmers prefers to adopt traditional flood irrigation methods such as border, basin and furrow without considering the actual crop water requirements hence, water is being lost unnecessarily due to deep percolation. These traditional methods have less efficiency and consume more water as compared to modern irrigation systems. Drip irrigation is one of the most efficient irrigation systems which are used to irrigate mango. It can play a significant role in overcoming the scarcity of water mostly in water shortage areas to

uniformly distribute water in agricultural fields and it has advantages over conventional surface irrigation as an efficient means of applying water, especially where water is limited. Bush *et al*., (2020) found out, Drip irrigation system saved the amount of water applied by 25-30% as compared to traditional basin irrigation system of mango orchards under Sudan dry land conditions. Drip irrigation system with 75% of mango tree water requirement regime (ETc) raised fruit yield (90.1kg/tree) and water use efficiency (1.91kg/m3) as compared to basin irrigation. In Sudan, mango plantations are irrigated with the conventional basin irrigation system and the farmers applied water more than the crop required and associated with poor timing and a lack of uniformity in water applications, which leaving parts of the field over or under irrigated relative to crop needs Bush *et al*., (2020). According to Neguse *et al*., (2019), the majority of mango farmers in Eastern and Western Ethiopia used supplementary irrigation (87.6%).

Table (6): Methods of mango orchard irrigation and irrigation interval in Hamelmalo locality (February, 2024).

Parameter	Frequency	Percentage
Methods of irrigation		
Connected single basins	55	98.2
Hose	01	01.8
Irrigation interval		
Once a week	19	33.9
Once in two weeks	21	37.5
Once in three weeks	05	08.9
monthly	11	19.6

Table (7) shows fertilization of mango trees and type of used fertilizers. The results showed that, most of respondents (82.1%), use organic fertilizer only and still 16.1% not add any type of fertilizer and no one use balanced fertilizer. They use chicken, goat and cattle organic fertilizer. Mainly organic fertilizer added to improve physical characteristics of the soil and it is not a balanced fertilizer. Farmers who do not add fertilizer to mango trees, think mango trees at fruiting stage do not need fertilization. Optimum supply of macro and micronutrients is of critical importance in improving the yield and quality of horticultural crops. Alike, the quality and yield of mango plants significantly increase by balanced application and uptake of macro and micronutrients. To understand the effective use of macro and micronutrients, it is suggested to analyze the soil and plant leaves for their nutrient status can be useful to formulate fertilization strategies for higher fruit production and quality (Khan and Ahmed, 2020). This result is a greed with Aga and Gagabo, (2024) who recommended to train mango growers in Ethiopia on how and when to apply fertilizer to mango trees.

Table (7): fertilization and type of fertilizer in mango trees at Hamelmalo locality (February, 2024).

Parameter	Frequency	Percentage
Organic	46	82.1
Urea	01	01.8
Not at all	09	16.1

Table (8) shows Extension services for mango growers at Hamelmalo locality. The results showed that, 92.2% of respondents not get any type of support (as training, information or other services from MOA). This indicates the Extension role and contact with mango farmers in Hamelmalo locality is very weak. Even the only one farmer get some information from MOA. This reflects the totally absence of extension services in the area. According to Neguse *et al., (*2019), skill gap is one of major constraints of mango production in Eastern and Western Ethiopia. Singh *et al*., (2020) found that among the socio-psychological constraints, lack of coordination among the beneficiary and state/district horticulture department got the first rank with (90%) respondents followed by inadequate extension activities were conducted by state/district horticulture department (80%).

Table (8): Extension services for mango growers in Hamelmalo locality (February, 2024).

Parameter	Frequency	Percentage
Support	01	01.8
Not at all	55	92.2

4- Conclusion and Recommendations

Conclusion

There is a very low level of farmer knowledge regarding orchard spacing, pruning, fertilizer application, availability of new varieties and pest and disease control. The main obstacles were pests, knowledge and skill gaps and availability of better cultivars. Availability of agricultural inputs included fertilizers and pesticides.

Recommendations

Extension services are highly required to improve agronomic cultural practices in mango orchards at Hamelmalo to achieve a good mango yield and quality.

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