Study of Assessment the Guava status in Khanyounes

As part of the project titled:
“Improving Palestinian small-scale producers’ access to and power in olive, high value fruit, and small ruminant value chains”
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Abstract:

In Gaza Strip guava deterioration is a complex issue, as several causes are contributing in such deterioration with different degrees. Meloidogyne sp, Fusarium and complex disease recorded in the study area. Obviously, Meloidogyne sp, Fusarium sp-exposed trees to extensive root decay caused by this fungus and Nematoda. The symptoms of the aforementioned diseases include chlorosis, wilting, scorching of leaf margins and leaf drop, yield reduction, and plant death within months are noticable. Since in many Guava cultivated clusters in Mawasi Khanyouns infested orchards have been decimated with the same symptoms. Such symptoms are apparently clear in all zones, in particular zone “A” North western Mawasi (Abadallah Area), Guava planation in this zone is almost depleted and scattered orchards are still surviving in miserable circumstances in term of diseases and lacking care of the growers themselves. compounded by saline irrigation water and poor agricultural practices undertaken by Guava growers.

These diseases are extending to the other zones including Midwestern Mawasi (Astal & Agha) and Southern Mawasi (Sha’aer Zoa’rab, Laham and Najar), the latest zone has been declined before two seasons, as plant death was noticed in different infected orchards.

This study aimed to assess the incidence of guava decline in Khanyouns and to appraise the guava farming with respect to the orchard management practices, cultivar status and major production constraints. Therefore, soil, water and root samples from declining, infested orchards were collected from zone. “A” ,”B” and “C” respectively The results of the analysis of these samples proved the presence of Meloidogyne sp, Fusarium sp and Diplodia. Moreover, soil is classified as coarse texture (sandy soils), slightly to moderately saline with low holding capacity of water and nutrients.

Irrigation water is tolerant with guava crop, as it is classified moderately saline, whereas in some plots in zone “A” and “B” irrigation water is considered saline, which is seriously affected guava yield.

appraisal the guava farming in Mawasi Khanyouns with respect to the orchard management practices, and major production constraints. Management practices were found poor in terms of serving guava orchards by the growers and it largely contributes to the causes that undermining the yield.

Pests attack guava trees in Mwasi Kahnyouns are similar in the study area, the pests recorded are: Medfly, Aphid gossypi, Hibiscus mealy bug, scale insect and Trips.

Apparently, the major causes of the deterioration in the study area were identified and described with full analysis in this study.

1.0 Introduction:

"Guava (Psidium guajava Linn.) belongs to the family Myrtaceae and is one of the most gregarious fruit trees. Guava fruit contains high amounts of vitamins A, B1 (Thiamin), B2 (Riboflavin) and C. The vitamin C contents of guava fruit are four times higher than those of citrus. Guava is believed to be originated in tropical and sub-tropical regions e.g. America (Mexico to Peru). At present, it is mainly produced in South Asian countries, Latin countries, Cuba, Brazil, Pakistan, India and Middle east". Gomes et al 2002

In Gaza Strip it has been known for the last 120 years. The species was probably brought into Gaza from Egypt and became a popular tree in domestic gardens. Later, different Guava varieties were introduced e.g. Israeli *Ben Dov* and *Indian* in addition to local one. Before disengagement in 2005 there was commercial plantations of about 3000 dunms in Mawasi Khanyouns, from which the fruit was exported and sold in the local market.

The climate in Gaza Strip is typically Mediterranean, relatively mild, wet winters and hot, dry summers. Under these conditions the guava, although considered an evergreen, sheds most of its leaves during the winter and flowers in March/April; the fruit ripens from August/September to December. The major commercial varieties are Indian, 'Ben-Dov' and local one. These varieties are highly productive and yielding of 4-5 t/dunm, before the current rapid declining.

In nineties of last century, guava had become a large-scale crop whose marketing relies, to a large extent, on exports to Arab Countries and moved to West Bank market. The guava can adapt to a wide range of soils and water qualities and, therefore, could be attractive for expansion its plantation. It is considered as a crop with an export potential once ban to export agricultural products from Gaza is being removed.

The yield reduction occurs due to different and compounded reasons including; harmful diseases, poor management practices, low fertility soil, saline water, attack of insect pests, extensive fruit drop.

Despite large area under guava production before 2005, which was reached 6000 dunms over all Gaza Strip. Planted area was sharply decreased to reach 3193 dunms in 2015 (MoA report 2015). Furthermore, in 2017, the total planted area according to un-published figures of MoA is 1860 dunms, whereas, (Mawsai Khanyous forms 50% of total planted area) and total produce is 4,400 tons. Correspondingly, per dunm yield was merely 4.5 tons/dunm which further dropped to 2.5 tons/dunm in 2015.

Since 2007, up to 2000 dunms of guava orchards have been cut down in Mawasi Khanyouns owing to this problem. Therefore, present study was aimed at finding the core areas with higher deterioration incidence and to identity- the possible causes of the deterioration.

2.0 Methodology:

This study was conducted by experts' team comprising of pomologist, entomologist, socioeconomic, and two soil and water experts, during December 2017-January 2018. The methodology was focused on two directions for the aim of identified root causes of the problem:

Firstly, the problem was analyzed, using cause effect methodology, such methodology examined the extent to which inputs and other cultivation factors e.g. water, soil, pests and diseases are contributing in rapid declining of the guava production cycle over the last years. Furthermore, causes were identified, analyzed and remedial measures were recommended.

Eleven soils, nine waters and 17 Nematoda and Fusarium samples were collected from-preidentified sites of the cultivated Guava orchards in Mawasi Khanyouns. Which was covered the three main zones of guava growers in Mawasi Khanyouns Moreover, fifteen visits to affected orchards were conducted in terms of recording and diagnosing pests and diseases.

Secondly, A primary survey of guava growers in major guava growing areas was made and data from 25 guava growers in the pre-identified zones (A, B,C) were collected. Furthermore, three Focus Group Discussions (FGDS) were conducted, one in each zone with the aim to capture the existing practices of Guava growers in terms of serving their Guava orchards including irrigation practices, Farm Yard Management and Chemical Fertilizers applied, pesticides application, combating diseases practices, the existing extension services and the previous and current production.

a participatory approach methodology (quantitative and qualitative methods) was employed to deeply understand guava orchards management. Such approach examined the extent to which the farmers practices and inputs used for serving their orchards are efficient e.g. fertilizers, manures, irrigation methods, spread of diseases and pesticides usage are contributing to the stated problem.

3.0 Results and Findings

3.1 Productivity:

Since last decade the guava production has been adversely affected by a decline problem. Decline of guava is a national problem either in Gaza Strip and West Bank as well. It has resulted in yield reduction and consequently in rapid shrinking of the planted areas.

A survey conducted showed in many orchards, a large number of guava plants has declined and become unproductive in the Mawasi Khanyouns.

Table (1) planted area and production

Year	Area "dunms"	Production tons	Yield ton/dunm
2007	4670	18,680	4.0
2011	3602	12,670	3.50
2015	2790	5775	2.07

Source: MoA reports

The table shows the rapid decline in the plantation area and consequently in the total production. A survey conducted by assessment team showed that the total plantation area in Mawasi Khanyouns doesn't exceed 700 dunms and the average productivity per mature tree ranged between 50-75 kg. Thus, the total production of Mawasi Khanyouns does not exceed 1500 tons.

3.2 Cultivar status:

The varietal status of guava plantation showed four types are cultivated in the study area; local and Improved local variety, Israeli variety "Ben Dov", Indian and Egyptian varieties. The survey indicated as shown in table (2), Indian variety is dominated by 42% of total guava populations, whereas Ben Dov was reported in majority of (30%), local cultivars were reported (25%) and Egyptian of 3% of guava population.

Table (2) Cultivar status

Variety	Percentage%
Local &Improved local	25
Ben Dov	30
Indian	42
Egyptian	3

Indian cultivar

Local Cultivar

Ben DOV

3.3 Agricultural practices:

Twenty five guava's farmers were interviewed, three focus group discussions (FGDs) were respectively held in different Guava growers clusters including North western Mawasi (Abadallah Area) Midwestern Mawasi (Astal & Agha) and Southern Mawasi (Sha'aer Zoa'rab , Laham and Najar) to deeply understand guava growers practices toward their guava orchards. Either semi-structured interviews with Guava growers or FGDs were highlighted the following aspects:

3.3.1 Cropping system

Gazans farming system has the tradition of growing at least few guava fruit plants in the homestead garden. However, guava was being increasingly cultivated on commercial scale during eighties of last century. Notwithstanding, in recent years, the commercial guava plantation started declining primarily due to different reasons including Nematoda, Fusarium, Saline water, poor soil parameters, poor farmers practices, pests and diseases.

Majority of the guava growers 80 % were cultivating guava as the main crop in their fruit orchards while 20 % of the guava orchards had the guava plantation as the intercrop either with vegetables or other fruits e.g. citrus and olives. It was observed that greater number of young guava orchards had majority of fruit crops as secondary crops.

3.3.2 Farm Yard Manures (FYM) and Chemical Fertilization

In Mawasi Kahnyouns, manure and fertilizer application of guava orchards was found poor and/or on ad hoc basis. The requirement of Manure and Fertilizers to the Guava crop varied with the varieties, the age of the plants, and the fertility status of the soil, climatic conditions and the management practices adopted. Guava were borne on the basis of the current season's growth, and therefore, manures and fertilizers motivated the vegetative growth and the bearing of guava fruits. The Fertilization of the Guava plants not only increased their yield but also improved the quality of the Fruits.

Results of the soil analysis, indicated low fertility soil, means low nutrients holding capacity. Regarding the application of FYM the survey showed that majority of growers (84 %) are regularly using FYM in guava orchards to maintain fertility level while 16% was found not applied FYM. Manure is usually applied in a ring around tree. Such rings are dug around base of the tree, 30 cm away from main trunks. Ring is dug manually to a depth of 8-10 cm, manure is properly mixed with soil followed by irrigation.

Obviously, manures are not well fermenting and most of guava growers are applied manures without fermentation, details of the fermentation process are annexed. Furthermore, doses of Manures applied for the Guava orchards are less than required despite the fact of bad quality of local manures, as it mixed with huge quantity of sand either originated by poultry or cow farms. At the time of establishment of new guava orchard, growers normally use 1 plastic container (16 liters) of FYM per tree, and for mature and productive tree growers normally use 2-3 (32-40 liters) plastic containers of such bad quality FYM. Growers normally use FYM, soon after the end of season (November-December) of guava orchard, which is correct practices and helps guava plant become healthier and produce more flowering in early March. Moreover, all respondents complained about the efficiency and the effectiveness of local manures compared with the previously used manures that had been imported from Israel.

Regarding, to chemical fertilizer Use of fertilizer for guava plants depend heavily on soil nutrients and particularly nitrogen, phosphorus ad potash. Matured trees may require as much as 1-1.25 kg of actual nitrogen per year. In study area results showed (68 %) of the guava orchards received chemical fertilizers (13/13) and rarely 11/7/22, while 32 % of these orchards not received it. It was noticed growers applied 5-7 kg of 13/13 per dunm twice a year. It was also observed that guava growers have not recognized the importance of potash although potash requirement for guava tree is higher than any other essential nutrient.

Survey showed negligible proportion of 16% of Guava orchards neither received farmyard manure (FYM) nor chemical fertilizer, whereas 68% of guava orchards received the combination of FYM and chemical fertilizer

It is worth noting that most of the required chemical fertilizers were banned to move to Gaza years ago. Thus, growers are using substitutes with less quantities than recommended. Finally, it was observed that growers do not follow any recommendations made by agronomists in terms of nutrient requirements for their guava orchards but they rely on their own experience and fertilizers merchant's advices.

3.3.3. Pruning:

Many literatures showed that pruning time of the guava tree significantly influenced the duration of plants phenological phases. Despite the importance of pruning time and how growers practiced such task, it is essential to determine the effect of this practice on the quality of the fruit. Pruning factor can consider one of key factors that interferes with the attributes that define guava fruit quality, such as the size of the fruit, the pulp and core features. Results showed only 30% of Guava growers were applied proper but timely wrong pruning while the majority of 70% applied slightly pruning on randomly basis. Majority of the surveyed orchards trees showed space less around trees and tree canopy are not well exposed to sunlight to encourage tree growth.

The distinction should be made between two types of pruning for guava trees 1) pruning for trees less than 3 years 2) trees aged over 3 years.

For the both types it recommended pruning must be carried out in mid of February, but unfortunately all surveyed guava growers are doing it late of December when they applied FYM.

For trees less than 3 years:

- In Mid of February, guava growers should prune the trees.
- Trim the tree to get a cup shape.
  Select the strongest upright stem as the main trunk and prune off all the others at ground level.
- Trim out all upright shoots that compete with the main trunk, including suckers that grow to the sides of the shrub. Not pruning the canopy until the tree is more developed.
- Remove some of the branches at the tip of bigger branches so that there are 6 buds left from the base.
  Thin out crossing branches. (refer to annexes)

For trees over 3 years

- In Mid of February, guava growers should prune the trees.
- Trim the guava tree the following spring to remove water shoots -- the fast-growing upright shoots that form just below a pruning wound. Remove all

branches that depart from the lower 1.30 cm of the trunk to encourage a higher canopy. Select several strong lateral branches evenly spaced around the tree to serve as the framework for the canopy. Prune back these branches to one-half their length, making the cuts at outward-heading lateral branches; remove all competing branches. Remove all flowers as they appear, so the tree can invest its energy in growth.

- Remove competing upright branches and maintain the tree with a single trunk. Prune back the tree's upper branches to open up the canopy to sunlight to further encourage growth. Prune out crossing and inward-heading branches. Make each cut at a lateral branch with a diameter at least one-third that of the cut branch. Trim out low branches and those with tips that touch the ground. Check for and remove suckers. (refer to annexes)

Experts advised guava growers to spray trees just directly after pruning with fungal copper pesticides e.g. Cosid 2-4 gram/ liter twice each 15 days, and Skeper 600 cm3/liter twice each 15 days.

Note: Annex (4) shows full pruning process of guava trees

Fig. (1) The guava trees without pruning

3.3.4 Irrigation:

Irrigation of Guava at different ages is important to ensure a uniform stand. Although over-irrigation is decidedly harmful, too little water can also cause damage. Symptoms of over and under irrigation are virtually identical. Regular examination of soil moisture in the subsoil is important to prevent over irrigation. In this respect it is better to check the moisture contents of the soil (digging with the hand, tool, or installed device), regular water applications are required. In the study area irrigation practices were awful, as most of Guava growers are following incorrect practices either in the supplied quantities or the intervals which leads to harmful impact on the trees themselves. Farmers constantly started to supply irrigation water on daily basis, before two weeks of flowering, mostly in March, continued to fruiting period June/July and till the end of the season (October-November).

3.3.5. Irrigation intervals

It was found that 95% of guava growers irrigated on daily basis on the season (starting March/April-November), and then day after day out of the season. Moreover, in winter it depends on the rainfall but most of the respondents told they supplied irrigation water

each week if there is a shortage in rainfall and 5% irrigated day after day in the season and twice a week out of the season

3.3.6 Irrigation quantity:

Despite the fact, soil analysis showed sandy coarse soil, with low holding capacity for water. The survey showed the following results:

- 48% of guava growers are supplying 6-10 m^3/ dunm
- 24% 2-5m^3/ dunm (Most of these orchards with young trees)
- 16% 11-15 m^3/ dunm
- 12% more than 15 m3/dunm.

It is quite clear majority of the surveyed guava growers are supplying excessive irrigated water to their orchards than is required. Only category II, which forms 24% who are suppling quantities close to the requirements and their orchards are less affected by disease and to some extent trees are healthy e.g. Yahia Sha'er and Ahmad Zoa'rab.

Since guava trees have shallow root systems. In sandy coarse soil, as the one in the study area irrigation water directly moved to lower soil strata without optimal utilization of such irrigated quantities to planted area. Moreover, soil has marginal water- and nutrient-holding capacities. Therefore, managing irrigation to meet plant water needs and avoid leaching of fertilizers into the aquifer and consequently reducing fertilizer use as irrigation management becomes more precise in mainly wetting the rhizosphere;

3.3.7. Irrigation networks:

According to soil analysis results soil can be classified as coarse sandy, where moisture storage capacity is minimal and where the conveyance and spreading of water by surface or tube flooding would involve inordinate losses by excess and non-uniform seepage. Most of literatures and soil experts recommended that such soils can be irrigated quite readily, by means of drip irrigation system, the polyethylene pipe should have ten drippers with discharge capacity of 4 L/hr for each one, and must circulate as ring around the trunk to follow the horizontal shade of the guava tree to maintain continuously favorable moisture conditions at a more nearly optimal level.as illustrated in table (9) .Such irrigation systems will improve varieties and can attain their high yield potential and can respond to great amounts of fertilizer. It is worth noting that irrigation experts recommended drip irrigation as this type of irrigation is highly recommended for use in coarse and sandy soil of low-moisture features. In drip irrigation irrigation, there is usually different outlets for every tree and can obtain good cover around the trunk. Moreover, drip irrigation is slow

application of water drop by drop, at a point or grid of points which maintains required moisture at rhizosphere.

The survey showed the following results in terms of the use of irrigation network in the study area:

- Open field (Shallow irrigation 15%)
- Drip irrigation 30%
- Mixed Drip irrigation & semi surface with 50 mm tube 30%
- Sprinklers 25%

Survey showed that the most common practices of guava growers among the ones who used to supply irrigated water either by drip irrigation or sprinklers are not suited the grid of drip irrigation or the sprinklers in proper manner to achieve good coverage around the trunk or to distribute water evenly. Furthermore, the capacity of grid irrigation or sprinkler found exceeded the recommended outlets quantity or what is required. Thus, the team has suggested in the annexes the recommended irrigation method, how to be placed around the trees and the recommended outlet capacity of the grid points.

3.3.8 Propagation

Guava is propagated by both its seeds and also by the vegetative processes. But the common propagation practices either in Gaza Strip or West Bank are seeds propagation, since it is easier, cheaper and growers owned the skills as stated by the respondents among guava growers in the study area and through contacting prominent nurseries and guava growers in West Bank. Despite the fact of seed propagation cannot maintain the genetic purity and results in large variation in the seedling population because of segregation and recombination of characters during sexual reproduction. Variation in the plants affects the fruit quality, shape, size and yield. Fruits Expert in Gaza Dr. Isamel Abu Zinadah deemed that seeds propagation eventually resulted in deterioration of trees particularly for aged trees (over 20) years. Moreover, Dr. Abu Zanadh states that the current deterioration in the sector can be attributed to this reason among others. Thus, fruit experts who interviewed during the course of preparing this study recommended vegetative propagation.

It is worth noting that the consultant team has introduced new seeds prorogation technique which proved its effectiveness in West Bank for resisting Nematoda for the first 3-4 years. (refer to annex 1)

3.3.9 Extension services:

Extension services was found very minimal and the only way to gain knowledge among Guava growers, either through trial and error method or exchanging experiences among each other. It was notices that Guava growers used to combat diseases in their orchards by wrong pesticides, which have adversely effects on the plant itself and consequently on the production as well. Moreover, respondents were indicated that lots of manures and pesticides that have been available in the local market with less effectiveness ingredients than recommended.

4.0 Soil Analysis

Guava is adapted to a wide range of soil types including sands, loams, rock-based soils, and should thrive in any soil that has good internal and surface drainage. For the purpose of identified the soil characteristics eleventh soil samples were collected, covering the study area of Mawasi Khanyouns. Samples were covered the both infected and non-infected orchards including the proposed demo-sites. The below tables show samples analysis and physical and chemical features.

Table (3). Mechanical analysis of Mawasi-Khan Younis soil

Sample No.	Sand	Silt	Clay	Texture
1	97.3	0.2	2.3	Sandy Soil
2	90.3	7.9	1.3	Sandy Soil
3	94.6	3.3	1.6	Sandy Soil
4	96	3.3	0.7	Sandy Soil
5	96.2	2.5	1.3	Sandy Soil
6	95.8	2.9	1.1	Sandy Soil
7	98.3	1	0.6	Sandy Soil
8	94.7	2.7	2.6	Sandy Soil
9	93.8	2.7	3.5	Sandy Soil
10	92.7	3.9	3	Sandy Soil
11	90.0	2.1	7.9	Sandy Soil

Table (3) shows mechanical analysis of Mawasi-Khan Younis soil. According to the mechanical soil analysis, the soils of the total area have coarse textured sandy soil. These soils are good aerated and having good drainage and no infiltration problems, but they have low cation exchange capacity (CEC), low fertility and low water and nutrients holding capacity.

Table (4). Chemical characteristics of Mawasi-Khan Younis soil

Sample No.	pH	EC (dS/m)	CaCO3 (%)	OM (%)	TKN (mg/kg)	P mg/kg)	K (mg/kg)

1	8.7	0.360	<0.1	0.15	59	5.2	145
2	8.3	0.550	1.5	0.41	38	5.5	220
3	8.1	0.340	2.4	0.41	55	4.4	145
4	8.1	0.265	1.8	0.38	43	5.2	120
5	8.4	0.550	1.5	0.21	33	2.9	215
6	7.6	0.840	1.5	0.41	33	1.6	130
7	8.1	0.465	1.5	0.59	52	6.2	73
8	8.6	0.300	3	0.36	103	ND	82
9	8.6	0.240	2.2	0.58	17	ND	41
10	8.3	0.260	0.75	0.31	25	ND	40
11	8.1	0.375	2.2	0.41	29	ND	75

Table (4) shows the physical and chemical characteristics of the targeted area soils. The pH of Al Mawasi soil ranges from 7.6 - 8.69, which are considered as moderately alkaline soils (Hazelton and Murphy, 2007). The high pH adversely affects the availability of phosphorus and micronutrients in the soil and also increase the volatilization of ammonia from ammonium fertilizers and consequently reduces the efficiency of nitrogen fertilizers.

In terms of soil salinity, the EC values of the analyzed soil samples as soil/water-ratio (1:1) range from 0.265-0.840 dS/m (< 1.1 dS/m) are considered as non-saline soils according to Dahnke & Whitney (1988). Such soil salinity has negligible effects on guava crop. According to FAO (2006), the soil analysis showed low content of calcium carbonate (0 – 2% CaCO3), which are considered as slightly calcareous soils, except sample No. 3 is moderately calcareous soils (2.4% CaCO3).

Concerning soil fertility status parameters, the soil samples analysis showed very low content of soil organic matter ranging from 0.15-0.41% according to Herrera (2005), except sample No. 7 has low content (0.59% OM), which indicate that the targeted sandy soil are not healthy soils and having low biological activities, low CEC, low water and nutrients holding capacity. Moreover, the soil analysis showed very low TKN (33-59 mg/kg), very low available P (< 7 ppm) and low to moderately K content according to Smart (2012), and low content of micronutrient (Fe, Mn, Zn, and Cu) according to Zbiral (2016), which means that these soils are of low fertility status.

5.0 Water Analysis:

The term salinity used herein refers to the total dissolved concentration of major inorganic ions (i.e. Na, Ca, Mg, K, HCO3, SO4 and Cl) in irrigation, drainage and ground waters. Soils that contain a harmful amount of salt are often referred to as salty or saline soil.
The quantity and kind of salts present in the groundwater is probably the most important single parameter for evaluating the suitability of water for irrigation.

Table (5). Chemical characteristic of irrigation water

Sample No.	pH	EC (dS/m)	TDS (mg/l)	Cl (mg/l)	HCO3 (mg/l)	B (mg/l)	SAR
1	6.86	4.480	2778	772	236	< 0.1	3.2
2	7.53	1.71	941	338	181	< 0.1	6.0
3	6.98	6.050	3751	1215	203	< 0.1	6.1
4	6.75	2.550	1581	560	214	< 0.1	5.2
5	7.41	2.430	1507	560	126	< 0.1	8.9
6	6.87	3.100	1922	656	192	< 0.1	3.3
7	7.06	3.501	2170	720	203	< 0.1	5.1
8	7.42	3.620	2244	714	351	< 0.1	5.2
9	7.30	3.600	2232	708		< 0.1	5.2

Table (5) shows the chemical characteristics of irrigation water in the targeted Mawasi-Khan Younis area. The pH values of water samples range from 6,75 -7.57, which are within the value permitted for irrigation (pH = 6 – 8.5) according to FAO (1994). Concerning irrigation water salinity, the electrical conductivity (EC) value of the water sample No. 2 (1.7 dS/m) is considered as slightly-saline water (< 2dS/m), whereas, The EC of the both samples No. 4 and 5 are less than 4 (2.55 and 2.43 dS/m), and suitable for irrigation of most crops (< 3 dS/m). It is considered as moderately saline water (2 – 4 dS/m) according to FAO (1992). Water samples No 6,7,8,9 are varied between (3.1-3.6) and still considered as moderately saline water and tend to be close to the upper permissible limit means (2-4). The water samples No. 1and 3 have higher EC values (4.48 and 6.05 dS/m) respectively are not suitable for irrigation of Guava crop.

- Boron content of all samples is very low (less than 0.1 mg/ l), which has a little bit adversely effect on guava crop. Sodium Adsorption Ratio (SAR) values of all water samples are less or around 6, which are within the value permitted for irrigation (0 - 15), and having no Na impact on soil according to FAO (1994). For more information “annex 5” shows full details of Boron deficiency.

- Cl analysis reflect the effect of EC as shown above.

The key to the effective use of saline irrigation waters and salinity control is to provide the proper amount of water to the plant at the proper time. The ideal irrigation scheme should provide water as nearly continuously as possible, though not in excess, as needed to keep the soil water content in the root zone within optimum safe limits. The method and frequency of irrigation and the amount of irrigation water applied may be managed to control salinity.

For saline water, irrigations should be scheduled before the total soil water potential (matric plus osmotic) drops below the level (as estimated above) which permits the crop to extract sufficient water to sustain its physiologic processes without loss in yield. Keeping soil moisture levels higher between irrigation events effectively dilutes salt concentrations in the root zone, thereby reducing the salinity hazard.

Note: Annex (6) shows the piezometer installation to measure the effect of surface ground water on guava trees as suggested by the soil and water expert and to be installed in the proposed demosite.

6.0 Pests and Disease diagnoses:

Survey of guava pests was carried out in Mawasi Khanyouns through several visits to the areas planted with guava namely, zone “A” northwestern Mawasi “Abadalla area), zone “B” Midwestern Mawasi (Astal & Agha area) and zone “C” Southern Mawasi (Sha’aer Zoa’rab, Laham and Najar). The major experimental methods used were; detection of plant parts to determine guava infestation. The pathologist used the simplest but most productive method of monitoring, which was visual inspection of leaves and fruits, because these can yield information’s about the eggs laid, larvae developed, and adults hatched. Survey results showed that pests species attacked guava were aphids, medfly, mealy bugs, circular scale insect and thrips

Survey showed guava growers usually controlled aphids by using insecticides e.g Marchal and Confidor, however, a number of effective natural enemies found but most of these enemies are killed or disappeared due to using of pesticides to control different pests.

From these natural enemies which present are anagyrus sp, Lady bird.and .lace wing, The result showed that Medfly (Ceratitis capitata) appeared in flowering season . Med fly attacked guava fruits in September near the maturation of fruits. Medfly was controlled by spray had been taken with insecticide like siperin 20 & Roger in the beginning of March till October. It is worth noting that siperin 20 is a major factor of killing natural enemies. Some guava growers used cultural practices like removing the infested fruits from farms to prevent reinfection.

The survey showed that insect Hibiscus mealy bug is one of the most important pests which attacked guava as it attacks the leaves, branches and fruits, and weakened plants by puncturing the tissues and consuming sap, production of large amounts of honeydew upon which sooty mould developed, resulting in reduction of photosynthetic efficiency and in premature leaf drop.

. Guava growers control this insect by using many chemical pesticides such as Marchal Confidor 200SL, Dorsban in the beginning of March.

6.1 Guava Diseases:

17 samples were collected from the three aforementioned zones as shown in the table below. Nine samples were positive in terms of Fusarium sp. In the three zones targeted by the study, it was clearly noticed that guava infected by "Wilt disease" which caused by this fungus namely, Fusarium sp. It considered one of the most important disease of guava in Mawasi Khanyouns in particular zone "A" and "C", with moderate presence in zone "B"

"Affected plants show yellow coloration with slight leaf curling at the terminal branches, becoming reddish at the later stage and subsequently shedding of leaves take place. Twigs become bare and fail to bring forth new leaves or flowers and eventually dry up. Fruits of all the affected branches remain underdeveloped, become hard, black and stony. The entire plant becomes defoliated and eventually dies" A.K. Misra Guava diseases.

. It was noticed the spread of the disease increased in land planted with guava where farmers are planted vegetables between or close to guava trees, such case was clearly noticed in zone "A&B" at Said Agha, Qasem Al-Fara and Manar Al-Astal orchards. Unfortunately, none of the surveyed farmers are controlling correctly this disease and majority of them mixed between the Fusaruim sp and Meloidogyne sp, as both of these disease are showed similar symptoms. Therefore, farmers advised to control this disease by irrigated soil by fungicides.

.Meloidogyne sp disease which was recorded in infected guava orchards as shown in table (6), caused galled roots. The analysis showed that progressive root galled in guava trees not only found in zone "A", in which the infected guava orchards are exceeding 75%, but also extended to the third zone "C" as the infected orchards by Meloidogyne sp of about 20%. It is worth noting that symptoms of Fusarium sp & Meloidogyne sp are close to each other and led to the same result death of the plant.

"Meloidogyne sp may have galled roots and some root rot for several months without secondary symptoms. The onset or worsening of symptoms, which results in plant death within months, often occurs following a high production season or drastic pruning" Guava diseases A.K. Misra

Survey showed most of the farmers are controlling Meloidogyne sp by irrigated infected soil with Namacur, but obviously guava growers applied it wrongly once late of December or early of January at the time of Nematoda being dormant. According to many literatures, experts and practitioners in the field. They advised growers to apply twice doses late of February and mid of march as Meloidogyne sp started to be reactivated.

For more details of Nematoda and Fusarium s.p. control. The details are attached in annexes.

Table (6): Occurrence of Nematoda, Fusarium and complex diseases

Zone	No of Samples	Diseases		
		Nematoda sp	Fusarium sp	Both
A	6	4	3	3
B	7	0	2	0
C	4	1	4	1
Total	17	5	9	4

Three samples were found affected by complex disease, means Meloidogyne sp & Fusarium sp in the both zone" A" and "C". In this disease complex, known as guava decline which leads to extensive fungal root decay. Some of guava growers controlled Nematoda disease by Nemacur.

Furthermore, the occurrence of Diplodia Fungi was recorded in the both zone" A" and "B", with minimal level, also such fungi caused drying branches.

Note: Annex (7), table (11) shows full details of soil, water and diseases analysis

7.0 Conclusion

In conclusion, this study tried to highlight the main causes that are contributing in the current rapid decline of Guava sector in the study area.

1. Soil are sandy with low water and plant nutrients holding capacity and having low organic matter and low soil fertility.
2. The majority of Irrigation waters (67%) have EC>3 dS/m and it is considered saline.
3. Poor farming management and agricultural practices, which strongly contribute to declining in yield and impoverishing soil.
4. majority of cultivars in the study area are old (20-25 years) and need to be renewed.
5. Minimal extension services provided.
6. Fusarium sp., and Meloidogyne sp were affected the whole study area.
7. The study diagnoses the pests that attacked guavas in the study area. The most important insect was medfly and Mealy bug. The most important diseases are wilting and complex diseases.

8. Obviously, the yield reduction occurs due to multiple reasons including; poor management practices, extensive fruit drop, low fertility soil, saline water, attack of insect pests and diseases which are considered as major factors that affect guava production.

9. The weakness of economic return of guava product urges majority of farmers in Mawasi Khanyouns to ignore the best practices and to show obvious slack in serving their orchards. Majority of respondents, reported the price went down compounded by the rapid decline in the production urge them not to responding in proper way for serving their guava orchards.

Specific Conclusions:

This part will highlight the conclusions for each zone (A,B,C)

Zone: "A"

According to the FGD held in Zone "A" /Mawsai Al-Abadallah was covered of almost of 1200 dunms of guava orchards in the past, the serious deterioration occurred late of 2005, most of guava orchards were affected with different diseases including; Meloidogyne spp, Fusaruim spp and Diplodia spp. Such harmful diseases were seriously affected guava orchards, compounded with saline water as most of the ground water wells are shallow in this area and are largely exceeding the threshold of 3.0 Ds/m. This situation urges dozens of farmers there to leave their orchards without any services as the production was seriously dropped and the infestation was widely spread which resulted in uprooting of more than 1050 dunms of guava orchards in zone A over the last decade. The remaining scattered cultivated area is not exceeded 150 dunms as illustrated in the below Map. In fact, the consultant team suggested an ideal orchard for the demo site namely Sameh Abu Shmas orchard as it encompassed 50 dunms all of them are cultivated with guava with different cultivars including Ben Dov, Indian and local, irrigation water is 1,7 Ds/m, which is perfect for guava, the orchard divided into three plots the first one is on the hill, which is seriously deteriorated by complex disease and the lower plot is newly affected, it is worth noting that the age of trees is 12 years in the aforementioned plots. The third plot of six dunms is newly cultivated and the age of seedling is one and half year

Fig. (2) Zone 'A'

Zone: "B" (Agha, Astal, Majaydah and Lham)

Zone "B" covered of an area extends from Asda'a to AlQsa University till Zoa'rb neighborhood, according to the field visits and FGD held there, in 2012, guava orchards occupied of 1000 dunms. Guava orchards started deterioration after 2012, to reach only 220 dunms in 2017 as shown in fig.(3),, as serious disease started to spread e.g. Fusarium sp, and water more and more become saline as the water analysis in this zone showed two samples out of four are exceeding 3.5 Ds/m which considered a little bit saline water and the other two is hovering around 3 Ds/m, which is still acceptable for irrigating guava plant. This zone is free of Nematoda based on diseases survey but Fusarium sp was found as illustrated in table 6. It is worth noting that zone B is the lesser affected zone in terms of diseases in the study area. In contrast, the situation there is not thriving and huge areas of planted areas were depleted, therefore, it is recommended to allocate 2 grants assistance to this zone to encourage farmers there.

Fig. (3) Zone 'B'

Zone: "C" (Zoa'rab, Najar, and Shaa'er)

Zone "C" extends from Zoa'rb neighborhood to the southern part of Mawasi Rafah, according to the field visits and FGD held there, Guava orchards seriously started to decline in 2015, noteworthy, the deterioration in this zone is rapidly extended to cover the whole area over the last three years and drastically devastated the orchards as the area reduced from 800 dunms to 300 dunms in 2017, as shown in fig. (4), diseases is widely spread in this zone Nematoda, Fusarium sp, and Diplopodia were found there, with high percentage of Fusarium, as all samples analyzed from Zone C showed incidence of Fusarium sp, and one sample out of four was positive in terms of Nematoda. Irrigation water more and more become saline as the water analysis in this zone showed all samples are exceeding 3.1-3.5 Ds/m which considered a little bit saline water. In fact, zone "C" is required special attention and at least 3 out of 5 grants assistance must be directed to this zone. Despite the fact, the actual need is exceeding this low profile effort. Thus, a comprehensive program in terms of controlling diseases and improving

agricultural practices must be on PARC's near future plan to revitalize the remining sustained orchards.

Fig. (4) Zone 'C'

8. Recommendations:

1. Regularly addition of well digested manure to sandy soil as shown in table (7), to improve soil physio–chemical properties and consequently improving water, nutrients and soil holding capacity with time, biological activity, supplying nutrients in slowly available forms resulting in increased yield.

2. Regularly addition of chemical fertilizers requirements according to the Palestinian recommendations as shown in table (7) to supply nutrients required to guava trees and improve soil fertility status resulting in healthy guava trees.

Table (7). Recommendations of MoA:

Young trees (< 3 years)	Old trees (> 3 years)
2-3 m3 manure/dunum in Nov.	3-5 m3 manure/dunum in Nov.
0.5 kg super phosphate/tree in winter	1 kg super phosphate/tree in winter
200-300 g N/tree	400-500 g N/tree
225 g K/tree	450- 675 g K/tree

To ease the application of FYM and chemical fertilizers for poor sandy soil in Mawasi Khanyouns., the consultant team prepared table (9) which guide farmers to more practical application in terms of doses required and application time, with consideration of the available chemical fertilizers in the local market

Table (8). Fertilizers Recommendations for sandy soil, poor in organic matter and nutrients.

Time	Young trees (< 3 years)	Old trees (> 4 years)
November	75-liter manure/tree	100-liter manure/tree
January	350 g of (13-13-13)/tree	500 g of (13-13-13)/tree
February	300 g of (13-13-13)/tree	500 g of (13-13-13)/tree
March	350 g of (13-13-13)/tree	00
At fruit set	300 g of (11-8-22) + 25 ml Ca NO3 sol./tree	850 g of (11-8-22) + 250 g of K2SO4 + 50 ml Ca NO3 sol./tree
July	300 g of (11-8-22) + 25 ml Ca NO3 solution/tree	850 g of (11-8-22) + 250 g of K2SO4 + 50 ml Ca NO3 solution/tree

3. Using the physiology acidic affected fertilizers such as ammonium sulfate, (NH4)2SO4, urea CO(NH2)2, super phosphate Ca(H2PO4)2 + 2 CaSO4, and potassium sulfate K2SO4 to reduce the pH of soil with time.

4. Applying the irrigation requirements + leaching fraction (20-25%) regularly according to the Palestinian recommendations and trees age as shown in Table (9) or according to the local evaporation pan results:

Table (9). Irrigation rate for guava trees (Lit./tree/2 days)

Month	Young trees (< 3 years)	Old trees (> 3 years)
Mars-April	٢٠	35-40 (40)
May	٤٠	64-85 (75)
June-September	٥٥	80-100 (90)
October	٣٢	50-60 (55)
November	٢٤	40-50 (45)
Total	430 m3	732 m3

It is recommended that guava trees can be irrigated quite readily by means of drip irrigation system (Taftouf) with discharge capacity 4l/ h, laying as a circle with 10 drippers around the trunk of each tree. The circle should follow the horizontal shade of the guava tree to maintain continuously favorable moisture conditions at a more nearly optimal level for the roots hairs of tree and therefore improving the water absorption capacity of the tree.

It is important to fertilize with micronutrients first during flowering time, then after fruit set and then 2 months later.

5. Introduce new cultivar which salt tolerant and disease resistant.

6. Applying the irrigation requirements + leaching fraction (20-25%) regularly according to the Palestinian recommendations and trees age as follows (Table 6 and 7).

7. Develop a control program for pests and encouraging cultural control

8. Develop a comprehensive and lengthy extension services program solely for guava growers in cooperation with MoA and the coops/NGOs in the area. Such program must outline the best practices of all aspects conceding farm management.

9. Develop a comprehensive plan for the affected guava orchards by wilting disease and complex disease with the recommended treatment method as shown in table (8). Such plan should include monitoring tools for early detection of Fusarium sp and Meloidogyne sp.

10. Non-conventional water resources is required to be introduced in guava orchards to alleviate the salinity of irrigation water e.g. ‘water harvesting ponds, small check dams to retain runoff……etc.

11. Fruit experts is highly recommended the vegetative propagation for the newly planted areas and it could be an opportunity to PARC to introduce it in the planned demo sites. Furthermore, they recommend to establish a program either by PARC & Oxfam or other interested actors in the agricultural sector.

In this respect, the consultant team and through its survey in the West Bank found a newly seeds prorogation technique which proved its effectiveness in WB for resisting Nematoda for the first 3-4 years. Such techniques might be applied in Gaza (annex 1 shows more details)

12. Due to the importance of pruning and as majority of guava growers were not conducting such service in proper manner and in wrong time. It is highly recommended that PARC can intervene with a comprehensive pruning program in Mawasi khanyous to assist guava growers there.

13. The consultant team recommend to establish the demo site in Zone "A" for the reasons mentioned earlier and to convince the guava growers there who left their orchards, to replant it with guava in order to revitalize this sector.

14. Water experts, recommend to install piezometer device in particulate at the lower orchards, to measure the effect of shallow water table at the rhizosphere. Moreover, it could install at demo-site to analyze such effect (annex 6 shows more details).

15. The study highlighted that the propagation practices are very bad and convey soil diseases. Thus, establishment of a nursery to produce controlled seedlings is highly recommended. The nursery requirements are annexed.

16. The old infested trees by diseases particularly Nematoda should be removed if it is not responding to the recommended control and to disinfect the place of infected trees, as detailed in annex (1).

17. Trees with old age in particular the ones exceeding 20 years have to be removed gradually and replaced by new seedlings.

Table (10) Pests and Recommended Control Ways

Medfly			
Pesticides	**Time**	**Doses**	**No. of Doses**
Malathion+ Bominal	**15 July**	**3cm^3/lit**	**Two weeks**
Bio feed traps			

Aphis gossupi			
Malathion 50	1st April	1cm^3/lit	Twice/15days
Confidor	٤/١٥	2cm^3/lit	3-4/15 days
Mealy bug			
Dorsban	1st April-July	1-5cm^3/lit	8/15 days
Confidor	٤/١٥	2cm^3/lit	3-4/15 days
scale insect الحشرات القشرية			
Confidor	٤/١٥	2cm^3/lit	3-4/15 days
Fungal diseases **Nematodes (Meloidogyne sp) النيماتودا**			
Nemacur	At the begging of the season for mature trees and at the plantation for newly planted	1-2 cm3/lit	Twice at the season each 15 days
***Fusarium sp**			
Befestin, Deslan	1st April-Begging of the season	600جم/الدونم	Twice at the season each 15 days
Diplodia sp			
Cusaid/Skeber	After pruning	600 gr/dunm	Twice each 10 days, with paint on affected area

*: In terms of Fusarium sp, in case of serious infestation it is recommended to up root tree and in case of planting new area it is recommended to apply Adigan and Condor 15/lit/dunm and the interval between them 5 days.

9.Guava plantation in the West Bank Qaliqlia

In order to enrich the study, the consultant team contacted and made several interviews with farmers, nurseries and officials in Qaliqlia to highlight the situation of guava sector which can be summarized in the following points:

- According to MoA in Qaliqlia and the interviewed farmers, the planted area reduced by ¼ in qaliqlia over the last 5 years.
- Nematoda is widely spread and it could be the major cause of such declining
- Agricultural practices are better than Gaza. As the economic return is more higher and input materials are of best quality e.g. manures, chemical fertilizers and pesticides and these materials are not banned.
- Guava growers and nurseries are followed seeds prorogation, but they followed a method that enable them to produce seedlings to some extent are resisting Nematode in particular of the first 3-4 years. Nurseries propagated seeds in artificial soil and then planted it fields (the method is explained in Annexes).
- Pruning is conducted in mid of February.
- FYM is applied in a matter of high quality compost in Dec.
- Irrigation quantity of 2-3 m^3/dunm on daily basis in the season or 5-6 m^3/dunm each two day.
- Sprinklers in clay soil are using for irrigation and drip irrigation in sandy soil.
- Applied chemical fertilizers similar to the recommended one in table (8).
- Guava growers, controlling Nematode in early stage by irrigated Nemacur twice a year as recommended in the study
- Water is non-saline
- For completely deteriorated orchards by Nematode. They rooting up guava trees and replaced it by Avocado.
- There are some experimental plots irrigated by using re-used waste water (at small scale) not only for guava but also for Avocado (the one used in cosmetics).
- Gauva growers kept trees till 12 years and after that they replaced it gradually with new seedlings.

Annexes

Annex 1: Nurseries Requirements and Qliqlia Experimental Seeds Prorogation

Guava Nursery Requirements:
A nursery is a managed site “sufficient area” most probably covered with polyethene sheets e.g. green house, equipped with irrigation source and electricity, designed to produce seedlings grown under favorable conditions until they are ready for planting, nursery must be licensed by MoA
Guava Nursery Inputs:
1. Containers polyethylene (Kal kal) sterilized trays, with dimensions of ¾, each tray contains 187 pots.
2. Polythene bags with capacity of 3 liters.
3. Galvanized steel stand for holding trays (1.2m*220m*120 m)
4. Nursery media which is designed particularly for prorogation of guava seeds that resisting Nematoda (artificial soil composed of Bittmos, Toff (small size 0-1 mm for each block). Such media is resisting Nematoda for 3-4 years. In case the growers are seeking other growth medium it must be sufficiently firm to hold the seedling or propagules during rooting and supply food and water for the successful growth of young seedlings.

Soil is a very common easily available and comparatively cheaper medium used in nursery. Sand is generally used in mother bed and vegetative plant propagation media. The other media used in nursery are peat soil, sphagnum mass, vermiculite, perlite, leaf mold, saw dust, grain husk and Coco peat. Among them vermiculite is mostly used for cuttings while sphagnum mass is used for air layering. Generally, availability of all mineral nutrients is affected by the pH of the growing medium. In growing media such as organic soils, maximum availability occurs between 5.5 and 6.5 pH. Seed, cutting, rootstock, scion, explants, etc.
4. Water for irrigation and fertilizer for major and minor nutrient supply.
Pesticides, fungicide, herbicides and growth regulators.

Nursery tools:
Axes, crow bar, wheel barrows, boxes, plastic buckets, watering cans, wire cutters, digging forks, hammer, nails, hoes, hand pruning knives, budding knives, respiratory masks, sprayers, saws, scissors, secateurs, budding and grafting knives, budding and grafting tape, germination trays, n, spade, forks, water tanker are necessary etc.

Water and nutrients are the two important inputs having direct relationship with quality of seedlings. Water quality and its proper availability to plants ensure better growth of seedlings. It may be used effectively by sprinkler irrigation system. Irrigation of seedling

with the required quantity alone reduces the occurrence of weed, pathogens, etc. Availability of nutrients to seedlings depends on the pH of the media, watering and character of species. Proper solarization of media, mixer media preparation, container filling, filled container arrangement, using well decomposed farm yard manure (FYM).

Seeds prorogation methods:

The first step is to extract fresh seeds from the fully matured ripe fruits and wash them thoroughly to remove the pulpy material clinging to the seeds, break the seed dormancy, this is done in one of two ways. Either place the seeds in a pot of semi-warm water for 40 minutes, or soak the seeds in water for two weeks prior to planting. Both of these allow the seed coat to soften and, thus, hasten germination. exposure seeds indirectly to sunlight for three days Once the seeds have been soaked and exposure to sunlight, fill a nursery pot with soilless seed starting mix. Press one seed into the center of the pot with your finger. Be sure to cover the seed with a bit of soilless mixture. Water the seeds with a misting spray and place the tray in a warm place with temperatures around 65 F. (18 C.) or above. The seeds should germinate in 2-8 weeks depending upon the temperature. Keep an eye on the seed pot and water when needed; when the top of the soil feels dry.

The second step, after five days seeds started to germinate, then trays must be distributed on the stand tables and fungal pesticides must be added to irrigation water e.g. Befestin 3cm3/lit or Delsan 3gr/lit. Two weeks later, chemical fertilizers must be added e.g. 1 kg of 13/13/13 plus 100-gram Sequestrene for 1m3 and seedlings must be irrigated once each three days of such solution up to 70 days.

The third step is to transplant seedlings after 70 days into polyethene bags with capacity of 3 liters.

The fourth step is to hardening of seedlings in a nursery as, seedlings are kept under ideal conditions; therefore, hardening is essential to make them strong enough to tolerate the harsh conditions of the planting site. It is generally done by reducing the amount of watering about one month before the date of planting.

Eventually, seedlings are ready to be planted in the permeant soils.

Experimental Guava Seeds Prorogation in Qalqlia

1. Prepare substitute soils which composes of mix Bitmos and Tuff with lenticular size (0-4 mm), and the seedlings must be transplanting after germination from polyethylene trays to these bags. The mix of such substitute soils must include the following ratios: 60% Bitmos, 25% tuff, 15 % compost. Such mix must be filled in

polyethylene bags with capacity of 3 liters. It is noteworthy that soils and bags must be sterilized.

2. The seedlings grown up till the height of 80 cm for each one, then it will be ready to be planted in the permeant soil.

Specifications of Good Guava Seedlings

1. Seedlings must be labeled with age and variety
2. Short and good canopy and a sturdy single to multi-stemmed trunk. The guava tree is an interesting plant with mottled, straight, greenish bark thickness 1-1.5 cm and long 80 cm.
3. Roots are free of soil diseases and particularly Nematoda
4. Rootstocks are free of bending and its divergent in true manner

Planation of Guava Trees in Orchards

5. Deep ploughing is essential to remove big roots. The lands should be thoroughly ploughed, leveled and manured. Leveling is important for economy of irrigation and preventing soil wash.
6. Optimum spacing to accommodate maximum number of trees 5m*5 .
7. Fruits ripening at the same time should be grouped together.
8. Irrigation networks should be laid.
9. Soil disinfection must take place prior to the planation (mid-February- mid-March), twice each 15 days, through applying Nemacur (1-2 lit/dunm) or Condor 15 lit/dunm and both of them must be mixed with Befesten 100 cm3/ dunm or Delsan 100 gr/dunm.
10. Planation of seedlings at the begging of March.
11. Irrigation. FYM and chemical fertilizers must be applied as recommended

Annex 2

Methods of pruning

Objectives of Pruning

To control the size form of guava tree, which involves number, placement, relative size and angle of branches. To obtain better quality fruits by better light distribution thus it entails the removal of diseased, crisscrossed, dried and broken branches. Moreover, to

remove the non-productive parts in order to divert the energy into those parts that are capable of bearing fruits.

Principle of Pruning

To admit more sunlight, remove unproductive branches which are producing few or no fruits and also to keep the plant in its proper vigour, vitality and to obtain optimum yields of good quality fruits.

Types of Pruning

• Thinning out

• Heading Back

• Bulk Pruning

• Thin wood Pruning

• Thinning out: When a shoot is entirely removed from the point of its origin and no re-growth is allowed to occur from the cut ends. – do not invigorate the tree

• Heading back: When the terminal portion of branch/shoot is removed and it encourages lateral growth from the remaining shoot. inother words, if a portion of a shoot is removed and the growth can develop from the remaining portion. Heading back promotes the growth of lower buds as well as several terminal buds below the cut, .when lateral branches are headed into one year old wood, the area near the cut is invigorated. The headed branch is much stronger and rigid, resulting in lateral secondary branching.

• Thin wood pruning: refers to the removal of slow growing, weak, under hanging branches or shoots which are either not fruiting or producing fruits of low quality.

• Bench Cut - removes vigorous, upright shoots back to side branches that are relatively flat and outward growing, used to open up the center of the tree and spread the branches outward. This is a major cut and should only be used when necessary.

Season of Pruning

• Dormant Pruning

Dormant pruning

• Most often done during the late winter and prior to spring time- commonly referred to as dormant pruning.

• Dormant pruning is an invigorating process.

• Heavy dormant pruning also promotes excessive vegetative vigor,

• Timing of dormant pruning is critical. Pruning should begin as late

in the winter as possible Mid of February.

Annex 3

Control Ways for treating deteriorated Guava Trees

1. Completely deteriorated guava trees (dead or nearly dead trees), should be removed and to be replaced with newly free diseases seedlings. Prior to the newly planation the places of old trees must be disinfected by irrigation of fungal pesticides e.g. Befesten 10 cm^3/tree or Delsan 10 gr/tree). Moreover, irrigation with Nemacur twice each 15 days (10-15 cm^3/ tree), then the newly seedlings will be planted safely.
2. Minor affected guava trees with age 12-15 years, must be correctly extra pruned and then applied the same quantities of fungal pesticides and Nemacur.

Annex 4

Fermentation of manures

The aim of such process is to create safe manures free of diseases and harmful pasture

The process of Fermentation:

1. Pile manures
2. Covered by polyethylene sheets
3. Moisturizing manures as required
4. Livestock manures need 3 months to be matured and for poultry 3 weeks needed

Annex 5
Boron Deficiency

Boron (B) is not required by plants in high amounts, but can cause serious growth problems if it is not supplied at appropriate levels. Boron is different from other micronutrients in that there is no chlorosis associated with its deficiency; however, it does have similar toxicity symptoms as other micronutrients.

Function: Boron is used with calcium in cell wall synthesis and is essential for cell division (creating new plant cells). Boron requirements are much higher for reproductive growth so it helps with pollination, and fruit and seed development. Other functions include translocation of sugars and carbohydrates, nitrogen metabolism, formation of certain proteins, regulation of hormone levels and transportation of potassium to stomata (which helps regulate internal water balance). Since boron helps transport sugars, its deficiency causes a reduction of exudates and sugars from plant roots, which can reduce the attraction and colonization of mycorrhizal fungi. Ed Bloodnick.
Deficiency: Boron deficiency is expressed in the growing points of roots and shoots and also flower and fruiting structures. Often, terminal buds die and shoot internodes shorten, which leads to stubby, distorted new growth emerging from side nodes causing “rosetting” or a “bushy” appearance. Stems are brittle and new leaves may be

thickened. Roots are often short and stubby; very few root hairs are present. Flowering and fruiting are reduced and what develops is often distorted.

Boron deficiency can occur when the pH of the growing medium exceeds 6.5, because boron is tied up and unavailable for plant uptake. Deficiency can also occur from low fertilizer application rates,

Toxicity: Boron toxicity is similar to other micronutrient toxicities in which the older leaves start to show a marginal or leaf tip chlorosis that soon becomes necrotic or burned.

How to tackle Boron deficiency: Boron deficiency and toxicity can occur, but are not common since most fertilizers provide what is required for most crops. But in our case as the results of water analysis showed insufficient levels of boron less than 0.1 in all tested samples and the sufficient levels of boron between (0.3-0.5 ppm) In such case, a complete micronutrient fertilizer can be applied (which is preferred) or a boron supplement such as borax with 11% concentration, boric acid with 17% concentration, and it is recommended to spray it on leaves.

Annex (6) Piezometer

1.0 Piezometer aimed to measure the variation in the shallow water table and to monitor the level of free water in rhizome zone and at different times and it mainly installed in lower guava orchards

2.0 Perforated Standpipe & Piezometer:

Groundwater is water located beneath the earth surface in soil pore spaces. The pressure of water in the soil pore spaces is called pore water pressure.

The groundwater table and the pore water pressure are measured by two different types of instrument, ie, a perforated standpipe and a piezometer.

Depending on the types, these two instruments could be very similar looking.

They are usually placed together in the same borehole for cost-effective installation, noting the borehole itself is a high cost component of an instrument installation.

2.1 Perforated Standpipe: A perforated standpipe installed in a borehole is used for measuring the depth of the free groundwater table below the ground surface.

The standpipe is usually formed using a 20mm diameter PVC pipe, and the perforation is provided by 3mm diameter holes at 15mm centers (or another similar configuration).

The perforated standpipe should be wrapped by 2 layers of nylon mesh and surrounded by gravel in the borehole to prevent ingress of fine materials into the pipe body that might create blockage.

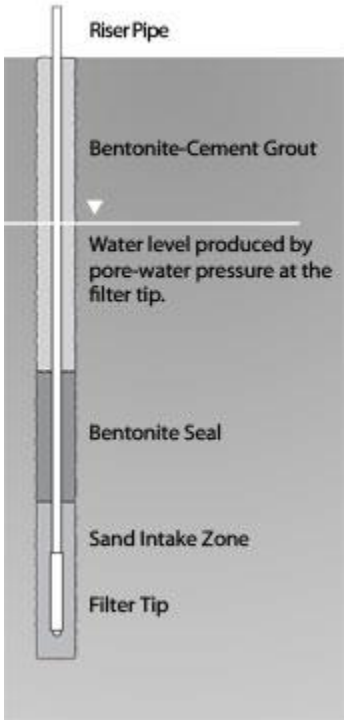
Given the perforation, groundwater is free to enter and/or leave the standpipe. Thus, the water level inside the standpipe should give good indication of the free groundwater level, depending on the permeability of the surrounding soil. In essence, a perforated standpipe is installed to displace the soil so that the water level can be measured by a suitable device such as a dip meter. An indicative arrangement of a perforated standpipe is shown in the figure below (vented cap and protection metal cover not shown).

2.2 Piezometer: A piezometer is used for monitoring piezometric water levels / pore water pressure. The simplest form of a piezometer is a standpipe piezometer, which is installed in a borehole, consisting of a filter tip joined to a solid (ie, not perforated) riser pipe. There are other types such as vibrating wire (VW) piezometers. The filter tip is placed in a gravel zone and a bentonite seal is placed above and below the gravel to isolate the pore water pressure at the tip. The annular space between the riser pipe and the borehole is backfilled to the surface with grout to prevent unwanted vertical migration of water. The piezometric water level in the piezometer indicates the pore water pressure at the level of the filter tip. Several tips can be installed in one borehole, enabling measurement of pore water pressure profiles. An indicative arrangement of a standpipe piezometer is shown in the figure below.

2.2.1 Development of Piezometer Development of a piezometer (not feasible with many piezometer types) is aimed at ensuring an efficient hydraulic connection between pore water and the piezometer. The development is very crucial since the drilling mud, which inevitably sticks to the walls and inhibits the hydraulic connection between pore water and the piezometer. The development should completely remove the sticking mud and also the fines. Under-developed piezometers will fail to provide the true information of the pore water pressure being monitored. The development, for instance, can be carried out through air compressor by alternately surging and pumping with air. The air should be injected into the piezometer to lift the water. As the water level reaches the top of the riser pipe, air supply should be shut off allowing the aerated water column to fall

Standpipe Piezometers

Applications



Standpipe piezometers are used to monitor piezometric water levels. Water level readings are typically obtained with a water level indicator. Typical applications include:

- Monitoring pore-water pressure to determine slope stability.
- Monitoring seepage and ground water movement.

Operation

The standpipe piezometer, which consists of a filter tip and a riser pipe, is installed in a borehole. The zone around the filter tip is backfilled with sand and a bentonite seal is place above that to isolate the intake zone. The remainder of the borehole is backfilled with bentonite-cement grout. Pore water flows into the standpipe until a pressure equilibrium is reached. The water level in the pipe then represents the pore-water pressure in the soil around the intake zone. Readings are taken with a water level indicator.

Advantages

- Economical components.
- Simple to read.
- Very good long-term reliability.

For more information

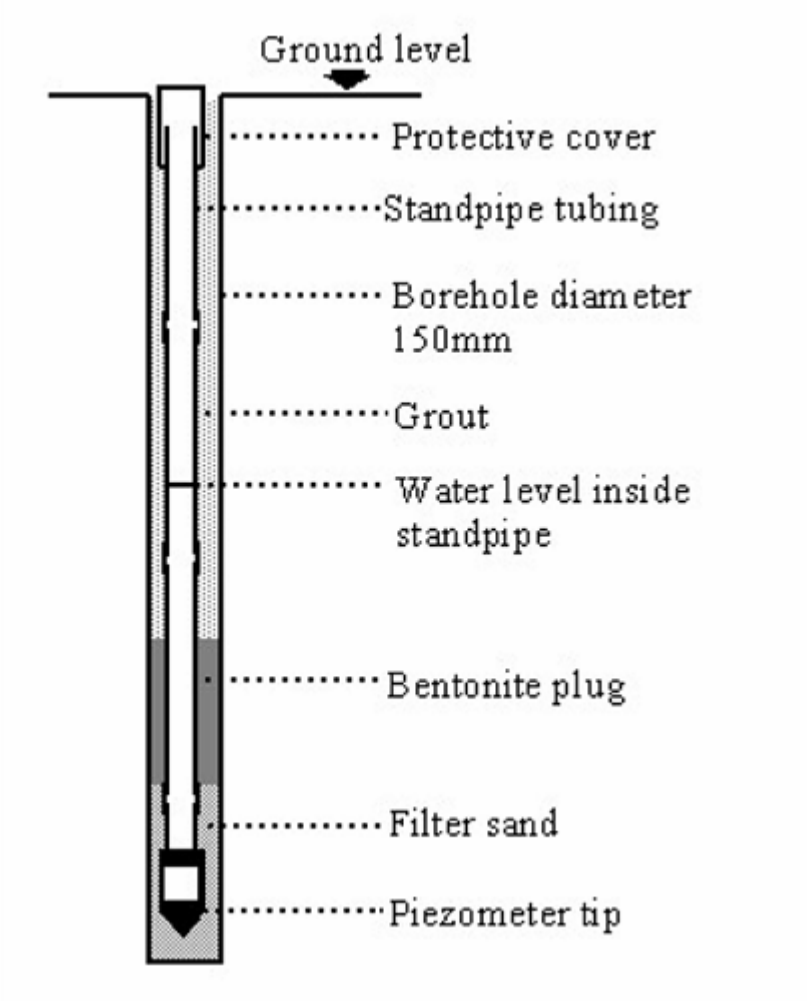
Please download the Standpipe Piezometer and Water Level Indicator datasheet. If your Water Level Indicator has seen a lot of use, you may be interested in our replacement parts page.

On Piezometers and Monitoring Wells

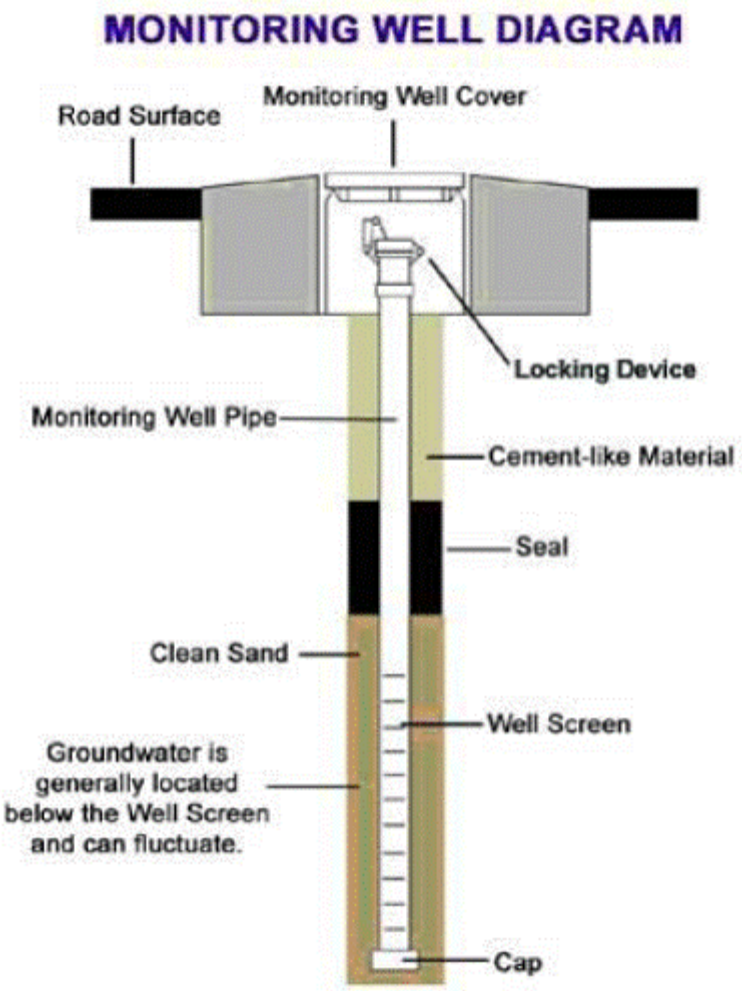
The word "piezo" in Greek means "pressure" and "meter" means to measure. Thus "piezometer" means a device to measure pressure.

In the field of study of aquifers, we use piezometers to measure the **pressure** of the groundwater at various locations and depths. Such piezometers usually consist of a small pipe or tube, the end being flush with, and normal to, the water face.

Here's a simplified diagram of a piezometer:



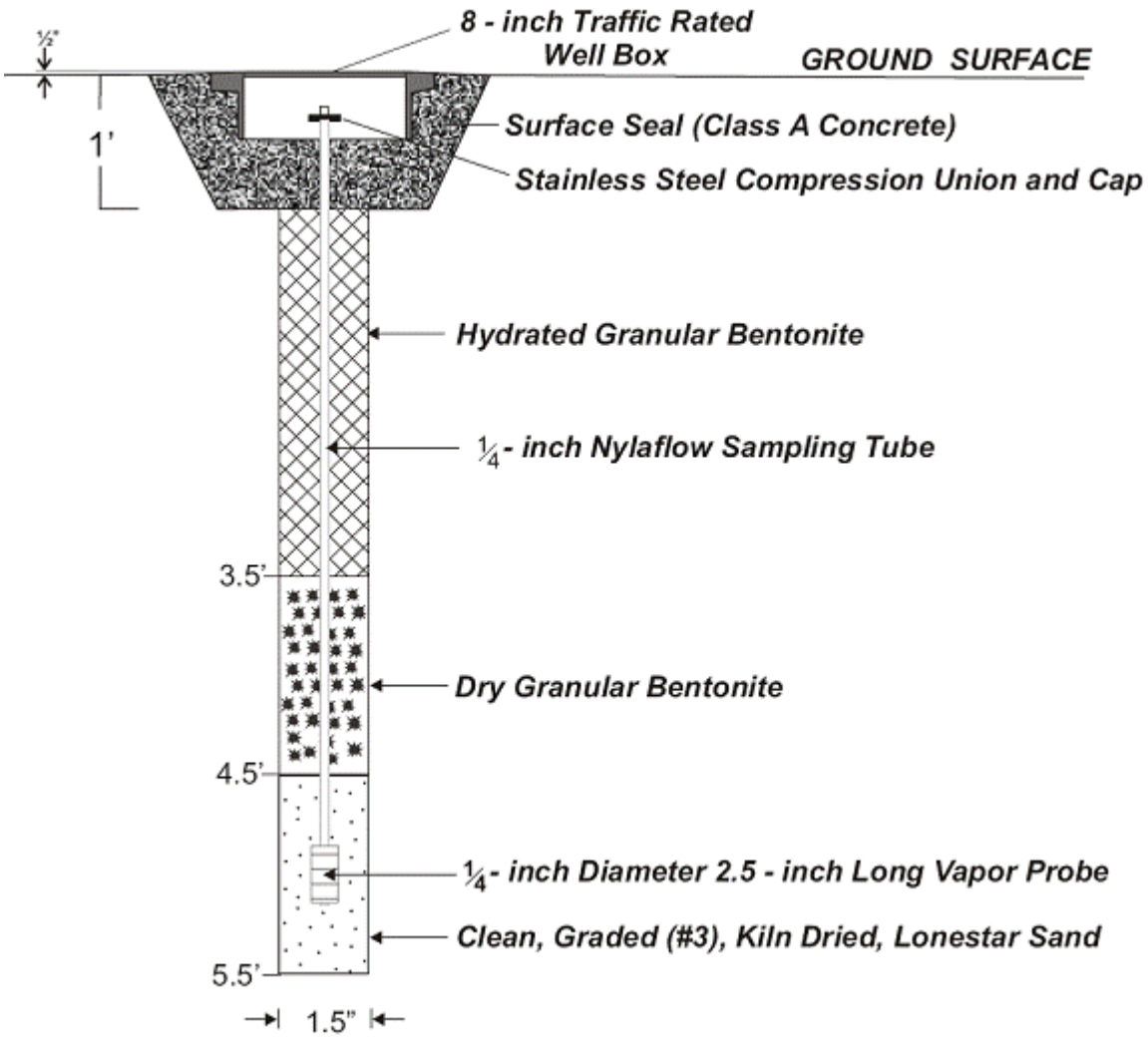
In the environmental field we use *groundwater monitoring wells* to collect water samples from the aquifer. Here is a simplified diagram of a groundwater monitoring well:



The essential difference between piezometers and monitoring wells is that in the monitoring well we have a wide range screen (usually from 20 feet below the water table to 10 feet above the water table). The screen takes into consideration the fluctuations with groundwater table and allows for free petroleum products that may reside at the water table to enter the well. In the case of a piezometer, this can't happen.

Similarly, soil gas probes are not piezometers as they measure no pressure. First off, these probes are installed ONLY in the soil, never in water. Secondly, their function is

only the collection of migratory vapors for later sampling. Here's a typical diagram of a soil-vapor probe.



You can find past issues of "Environmental Enlightenment" at www.amiadini.com Wealth of information about environmental site assessments in the real estate transactions and issues concerning assessment and cleanup of contamination in the subsurface soil and groundwater.

Call me if you've got any questions. There are **no obligations.**

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(Anne x 5) Table (11) shows Zone's (A,B,C) Samples places and results (Main Indictors)

No	Name	Zone	Water Indicator		Soil Indicators					Diseases		
			EC µS/cm	TDS mg/lit	CaCO3	O.M	TKN	Available P	K	nematodes	Fusarium Sp	Diplodia
1	Abu Hoil	A	3620	2244	< 0.1	0.15	59	5.2	145	Free	Free	Free
2	Abu Shmas	A	1710	941	1.5	0.41	38	5.5	220	Meloidogyne spp 260/250gm	Fusarium .spp –	Diplodia spp
3	Said Rabia' Agha	A	-	-	.75	0.31	25	N/D	40			
4	Sami Astal	A	6050	3751	2.4	0.41	55	4.4	145	Meloidogyne spp 20/250gm	Free	Diplodia spp
5	Said Astal	B	2550	1581	1.8	0.38	43	5.2	120	Free	Free	Free
6	Qasem Sa'ad Fara	B	2430	1507	1.5	0.21	33	2.9	215	Free	Fusarium .spp –	Free
7	Ibrahim I. Fara	B	-	-	3	0.36	103	N/D	82	-	-	-
8	Ahmad M. Zoa'rab	C	3100	1922	1.5	0.41	33	1.6	130	Free	Fusarium spp	Free
9	Yahia Sha'aer	C	3500	2170	1.5	0.59	52	6.2	73	Free	Fusarium spp	Free
10	Ibrahim Najar	C	-	-	2.2	0.58	17	N.D	41	Free	Free	Free
11	Ibrahim Sha'er	C	-	-	0.75	0.31	25	N.D	40	-	-	-
12	Manar Astal	B	4480	2778	-	-	-	-	-	Free	Fusarium spp	Free
13	Iyad Laham	C	-	-	-	-	-	-	-	Free	Free	Free

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