TECHNICAL OPERATIONAL MANUAL

JUMBO PEANUTS

AGRICULTURAL SECTOR MODERNIZATION PROJECT (ASMP)

SENIOR AUTHOR: JULIAN VELEZ, Ph.D.
International Agronomist, ASMP

Contents

Figures

Tables

INTRODUCTION

The Origin of Peanuts

Peanuts are believed to have originated in South America, particularly in regions that are now part of modern-day Peru and Brazil. Archaeological evidence suggests that peanuts were domesticated over 3,500 years ago by indigenous peoples in these areas.

From South America, peanuts spread to Central America and eventually to Mexico. The Spanish and Portuguese explorers played a significant role in introducing peanuts to Europe and Africa in the 16th century. By the 19th century, peanuts had made their way to the United States, where they became widely cultivated, especially in the southern states. Today, peanuts are grown in various parts of the world, including Africa, Asia, and the Americas, making them a globally popular crop and snack.

Jumbo peanuts, often referred to as "Virginia peanuts," originated in the United States, specifically in the southeastern region. The cultivation of jumbo peanuts began in the early 20th century, particularly in Virginia and North Carolina. These states were known for their ideal climate and soil conditions for growing high-quality peanuts.

The jumbo variety is characterized by its larger size, which is a result of selective breeding and cultivation practices aimed at producing peanuts that are more suitable for roasting and snacking. Over time, jumbo peanuts have gained popularity not just in the U.S. but also in various international markets, further establishing their reputation as a premium snack option.

Economic Importance of Peanuts

Peanuts hold significant global economic importance due to their diverse uses and contributions to agriculture, food production, and industry. Here are some key points highlighting their economic impact:

1. Agricultural Production: Peanuts are a major cash crop in many countries, particularly in the United States, China, India, and several African nations. The crop provides livelihoods for millions of farmers and contributes to rural economies.
2. Food Industry: Peanuts are a staple ingredient in various cuisines worldwide. They are used to produce peanut butter, cooking oils, snacks, and confectionery products. The demand for peanut-based products continues to grow, particularly in health-conscious markets.
3. Nutritional Value: Peanuts are rich in protein, healthy fats, vitamins, and minerals, making them an essential dietary component in many regions. Their affordability and nutritional benefits contribute to food security, particularly in developing countries.
4. Oil Production: Peanut oil is widely used in cooking and food processing. It is valued for its high smoke point and flavor, further driving demand in culinary applications.

5. By-products: The peanut industry generates various by-products, including peanut meal and cake, which are used as animal feed, and peanut shells, which can be utilized in bioenergy production and as mulch in agriculture.
6. Export Markets: Countries like the United States, Argentina, and India export significant quantities of peanuts, contributing to international trade and economic growth. The global peanut market is influenced by trade policies, tariffs, and international demand.
7. Sustainability: Peanuts are nitrogen-fixing plants, which can improve soil health and reduce the need for chemical fertilizers. This characteristic supports sustainable agricultural practices.

Peanuts play a vital role in the global economy, supporting food security, agricultural livelihoods, and international trade. Their versatility and nutritional benefits make them an important crop in the global food system.

Economic Importance of Jumbo Peanuts

Jumbo peanuts, a specific variety of peanuts known for their larger size and premium quality, carry unique global economic importance due to several factors:

1. High Market Value: Jumbo peanuts typically command higher prices in the market compared to smaller peanut varieties. Their size and quality make them desirable for roasting and snacking, which enhances their economic value, particularly in consumer markets where premium products are sought.
2. Export Opportunities: Countries that cultivate jumbo peanuts, such as the United States (especially Virginia), have significant export markets. These exports contribute to national economies and trade balances, as jumbo peanuts are popular in international markets, particularly in Europe and Asia.
3. Food Industry Demand: Jumbo peanuts are widely used in the food industry, particularly in snacks, confectionery, and gourmet products. Their larger size makes them ideal for products like roasted peanuts, peanut brittle, and specialty nut mixes, driving demand and economic activity in food processing sectors.
4. Agricultural Sustainability: Like other peanut varieties, jumbo peanuts are nitrogen-fixing crops, which can improve soil health and reduce the need for chemical fertilizers. This characteristic promotes sustainable agricultural practices, benefiting both the environment and the economy.
5. Culinary Popularity: The gourmet nature of jumbo peanuts has led to their popularity in culinary applications, including as a snack and in various recipes. This demand supports local farmers and producers, contributing to the agricultural economy in regions where they are grown.
6. Job Creation: The cultivation, processing, and distribution of jumbo peanuts create jobs in agriculture, food processing, and retail sectors. This fosters economic growth in rural areas where peanut farming is a significant activity.
7. Nutritional Benefits: Jumbo peanuts, like their smaller counterparts, are a rich source of protein, healthy fats, vitamins, and minerals. Their nutritional profile

supports food security and health initiatives, particularly in regions where they are a dietary staple.

Jumbo peanuts contribute significantly to the global economy through their high market value, export potential, and demand in the food industry. Their cultivation supports sustainable agricultural practices and job creation, making them an important crop in the global food system.

OPTIMAL GROWING CONDITIONS

Growing Jumbo Peanuts require specific agro-ecological conditions to ensure optimal growth and yield:

1. Climate:
    a. Temperature: Peanuts thrive in warm climates, with optimal growing temperatures between 70°F to 95°F (21°C to 35°C). They are sensitive to frost, so they should be planted after the last frost date.
    b. Rainfall: Peanuts require about 20 to 30 inches (500 to 750 mm) of rainfall during the growing season. While they can tolerate dry conditions, consistent moisture is crucial, especially during flowering and pod development.

2. Soil:
    a. Type: Well-drained sandy loam or loamy soils are ideal for peanuts. These soil types promote good water drainage and aeration, which are essential for root development.
    b. pH Level: The optimal pH for peanut cultivation is between 6.0 and 6.5. Soils that are too acidic or too alkaline can hinder nutrient availability.
    c. Nutrient Content: Peanuts benefit from soils that are rich in organic matter. They also require adequate levels of phosphorus and potassium. Nitrogen levels should be managed carefully, as peanuts are nitrogen-fixing plants.

3. Sunlight:
    a. Peanuts need full sun for at least 6 to 8 hours a day. Adequate sunlight promotes healthy plant growth and maximizes yield.

By ensuring these optimal agro-ecological conditions, farmers can maximize the potential of jumbo peanuts, leading to healthier plants and higher yields.

LAND PREPARATION

Primary Land Preparation

1. Deep ploughing using a disk or mouldboard plough as large as possible, from 30 cm to 60 cm (12” to 24”) in diameter.

2. Incorporation organic matter, commercial compost (12 MT per hectare or 5 MT per acre) and other soil amendments as required by broadcasting all over the plot surface.
3. Deep plough again perpendicular to the first pass.

Secondary Land Preparation

1. Heavy Soil Textures
   a. Disk harrow using a disk harrow implement with disks having a diameter from 18 cm to 24 cm (7" to 10").
   b. Two passes perpendicular to each other are required.
2. Light Soil Textures
   a. Cultivate using a tine tiller implement.
   b. Two passes may be required in sandy clay loam soils.

Tractor

1. A tractor size 75 to 99 HP (75 to 85 POT), four-wheel drive, is best to pull large ploughing equipment.

Drainage

Drainage is of particular importance for Jumbo Peanuts as the crop is susceptible to several root diseases. Good internal drainage provided by a network of drainage ditches to quickly evacuate high amounts of rainfall are very important practices to prevent Fusarium Wilt, Phytophthora root rot and other soil borne diseases affecting Jumbo Peanuts.

Evacuation Drainage

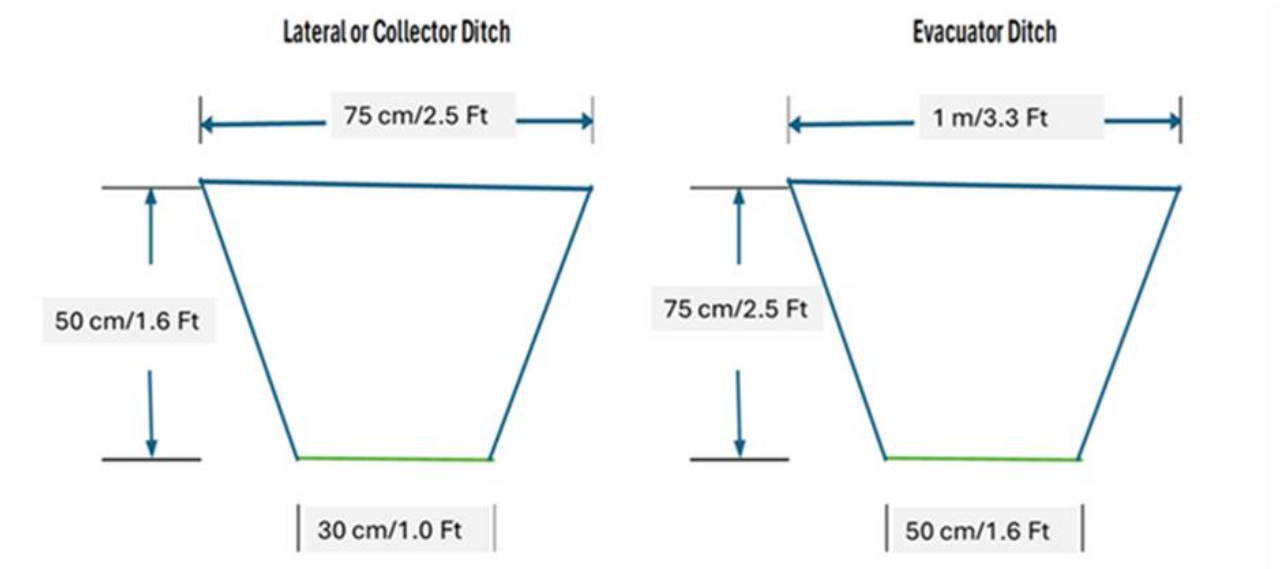


Figure 1: Size of Drainage Ditches

For small plots, a “U” type evacuation drainage design is recommended. This system is made up of two lateral drainage ditches (collectors) at the extreme ends of the plot that drain into a primary drainage canal (evacuator) that evacuates the water away from the plot into a safe area, avoiding damage to property or goods. All drainage ditches must be trapezoidal in shape to avoid the collapse of the walls into the ditch and subsequent loss of depth by sedimentation. Grass or small plants can be promoted on the walls of the ditches to keep them stable. The size of the laterals and evacuator should be as shown below:

All ditches must have a slope or gradient of at least 0.1% which is equivalent to a drop of 1 m in 1,000 m. This slope is also expressed as 0.001

This on-farm simple drainage system can evacuate 4 mm of rain per hour or 96 mm per day. Catastrophic conditions such as flooding can occur with rainfall greater than 100 mm per day. These conditions will cause damage to crops and can only be mitigated with macro drainage work done by the Government.

Before making the ditches, it is necessary to observe the slope of the plot. It is recommended to place the large evacuator ditch cutting across the terrain and along the lowest section of the plot. Then, the lateral ditches are placed perpendicular to the evacuator. The planting beds should drain into the laterals or collectors, which, in turn, drain into the large evacuator

If necessary, for crops that are planted in the East-West direction such as the double row planting of fruit trees, the laterals can be made to cut across the double rows to force them to drain into the large evacuator placed along the lowest section of the plot.

Surface Drainage

After a heavy rain, wet spots often remain in different locations, especially if the field has not been levelled or does not have a slope gradient sufficient to force the water out of the plot by gravity. In these cases, it is recommended for the farmers to drain all the wet spots by manually guiding the water out of each spot into a nearby drainage ditch or canal using a hoe type tool. Two or more wet spots can be connected to be finally drained into a drainage ditch or canal.
Draining Wet Spots Using Surface Drainage

Figure 2: Draining Wet Spots Using Surface Drainage

VARIETIES

The ANKG Jumbo Peanut hybrids, specifically ANKG 01, ANKG 02, and ANKG 03, are notable varieties cultivated in Sri Lanka, each with distinct characteristics and advantages:

1. ANKG 01:
    a. Yield: Known for its high yield potential, ANKG 01 produces a significant quantity of peanuts per acre.

b. Kernel Size: This hybrid features large, attractive kernels, making it suitable for both local consumption and export markets.
c. Disease Resistance: ANKG 01 is bred for resistance to common peanut diseases, which helps reduce crop losses and the need for pesticides.
d. Growth Habit: It has a robust growth habit, allowing for better adaptation to various soil types and climatic conditions.

2. ANKG 02:
   a. Early Maturity: ANKG 02 is characterized by its early maturity, allowing farmers to harvest sooner and potentially grow multiple crops in a single season.
   b. High Oil Content: This hybrid is known for its excellent oil content, enhancing its flavor and nutritional value.
   c. Pest Resistance: ANKG 02 is designed to be resistant to prevalent pests, which contributes to healthier crops and reduced management costs.
   d. Versatility: It performs well in both wet and dry zones, making it a versatile option for different farming conditions in Sri Lanka.

3. ANKG 03:
   a. Exceptional Quality: ANKG 03 is recognized for its exceptional kernel quality, which appeals to consumers and processors alike.
   b. Robust Plant Structure: This hybrid has a strong plant structure, which aids in its resilience against adverse weather conditions.
   c. Yield and Size: Like its counterparts, ANKG 03 offers high yields and large kernel size, making it economically viable for farmers.
   d. Nutritional Benefits: It also boasts a favorable nutritional profile, making it suitable for health-focused markets.

These ANKG hybrids contribute significantly to improving peanut production in Sri Lanka by offering farmers better yields, disease resistance, and marketable quality, ultimately supporting the agricultural economy of the region. The preferred hybrid in some of the Districts is the ANKG 03.

SEED INOCULATION WITH RHIZOBIUM BACTERIA

The relationship between legumes and Rhizobium is vital for nutrient cycling in ecosystems, showcasing the interdependence between different organisms. It is a classic example of mutualism, where both partners benefit from the association. This symbiotic relationship enhances soil fertility by increasing nitrogen content, which benefits subsequent crops. Additionally, it reduces the need for chemical fertilizers, promoting more sustainable agricultural practices.

The working of the relationship is described below:

Nitrogen Fixation

1. Nitrogen Needs: Legumes, like peas and beans, require nitrogen for growth, but they cannot use atmospheric nitrogen (N_2) directly.
2. Rhizobium's Role: Rhizobium bacteria have the unique ability to fix atmospheric nitrogen into ammonia (NH_3), a form that plants can use.

Root Nodules Formation

1. Infection: When legumes are in the soil, they release specific chemical signals (flavonoids) that attract Rhizobium bacteria.
2. Nodule Development: Upon contact, the bacteria infect the root hairs of the legumes and stimulate the formation of root nodules, which are specialized structures that house the bacteria.

Mutual Benefits

1. For Legumes: The plant receives ammonia produced by Rhizobium, which boosts its growth and overall health.
2. For Rhizobium: In return, the bacteria gain access to carbohydrates and a protective environment within the root nodules, which are rich in nutrients.

Inoculating seeds with Rhizobium bacteria is essential for improving nitrogen fixation in leguminous plants. Shown below is a step-by-step guide on how to inoculate seeds effectively, including methods to ensure the inoculum adheres well to the seeds.

Figure 3: Rhizobium Inoculum for Seed Inocilation

Materials Needed:

1. Rhizobium inoculum: This can be in the form of a commercial inoculant or a prepared culture. The inoculum used by the ASMP in demo plots produced by IFS is applied at a rate of 250 gm/Acre.
2. Seeds: Choose seeds of leguminous plants (e.g., beans, peas).
3. Adhesive: Use a non-toxic adhesive, such as a sugar solution, molasses, or a small amount of water.
4. Mixing container: A clean bowl or container for mixing.
5. Gloves: To maintain hygiene and prevent contamination.

Steps for Inoculation:

1. Preparation of Seeds:
    a. Start with healthy, clean seeds. If they are not pre-treated, you may want to soak them briefly in water to help the inoculum stick better.
2. Preparation of Inoculum:
    a. If using a dry powder inoculant, follow the manufacturer's instructions to prepare it. For liquid cultures, ensure that the culture is fresh and has a suitable concentration of Rhizobium.
3. Mixing the Adhesive:
    a. Create a suitable adhesive mix. A common method is to dissolve 1-2 tablespoons of sugar or molasses in a small amount of water to form a syrup-like solution. This will help the inoculum stick to the seeds without being harmful.

4. Inoculating the Seeds:
    a. Place the seeds in the mixing container.
    b. Add the adhesive solution gradually while stirring gently to coat the seeds evenly.
    c. Incorporate the Rhizobium inoculum into the mixture. Sprinkle it over the seeds while continuing to mix gently. Ensure that each seed is thoroughly coated with the inoculum.
5. Drying the Seeds:
    a. Spread the inoculated seeds out on a clean surface (like a paper towel) and allow them to dry slightly. This helps prevent clumping while ensuring the inoculum adheres properly.
6. Planting:
    a. Once the seeds are dry to the touch, but still moist with the inoculum, they are ready for planting. Plant them promptly to maximize the effectiveness of the inoculum.
7.Best Practices:
    a. Timing: Inoculate seeds right before planting to ensure the bacteria remain viable and effective.
    b. Storage: If not planting immediately, keep the inoculated seeds in a cool, dark place to retain viability.
    c. Avoiding Contamination: Always use clean tools and containers to prevent contamination from unwanted microbes.

HIGH DENSITY PLANTING

Planting Equipment

Jumbo Peanuts is planted by direct seeding or sowing the Peanuts seeds into the ground by hand or by using a manual planter seeding machine which is a hand-operated agricultural tool designed for planting seeds like Peanuts, peanuts, and soybeans. Typically, it consists of a hopper to hold seeds, a mechanism to dispense them at regular intervals, and a handle for pushing or pulling the device along rows in the field.

The planter may feature adjustable settings to control seed depth and spacing, ensuring optimal growth conditions. Some models include a furrower to create planting rows, while others may have a covering mechanism to ensure seeds are adequately buried after planting. This tool is useful for small-scale farmers or gardeners who prefer a more hands-on approach to planting.

Figure 4: Manual Seeder Planter

Planting Pattern and Plant Spacing

Figure 5: Using the Manual Seeder Planter

Jumbo Peanuts are planted using a triangular or Zig Zag planting pattern that increases the surface space available for an individual plant to explore, as well as the soil volume the plant can use to take up water and nutrients. The spacing between plants within a row is 30 cm (12 inches) and rows are placed 30 cm (12 inches) apart from each other.

Figure 6: Planting Pattern for Irrigated Peanuts

The laterals of the high discharge drip tape irrigation system are spaced at 60 cm (24 inches) in order to have one drip line in the middle of two peanut rows. These spacings of plants and drip lines create a double row planting system with double rows at 60 cm (24 inches) from each other as follow below:

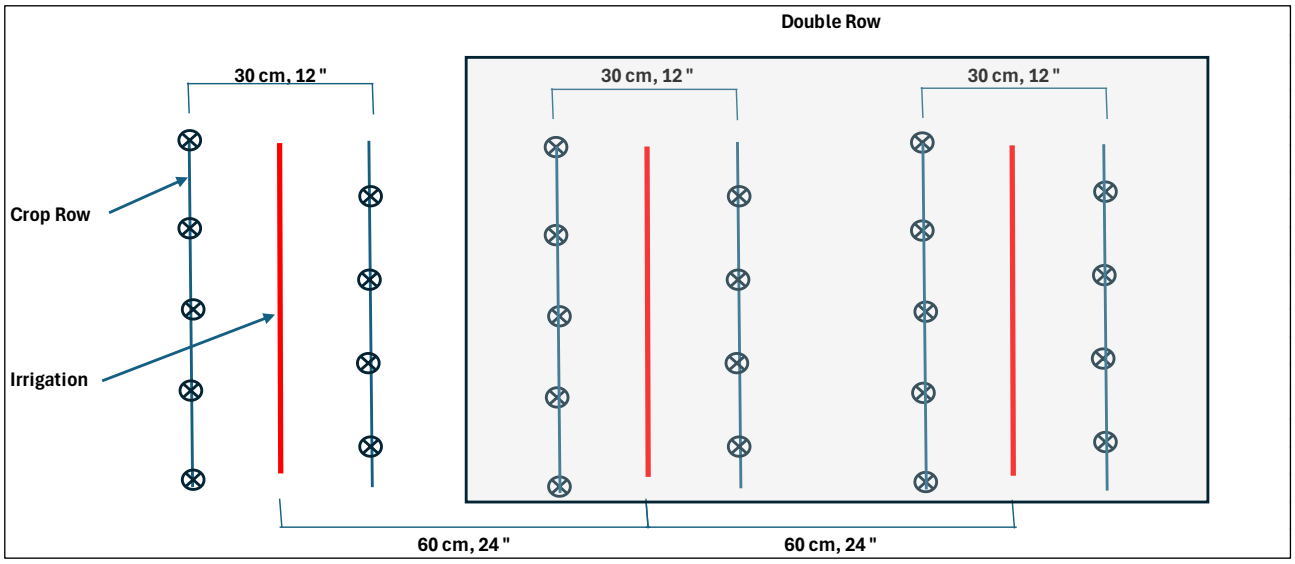


Figure 7: Planting Pattern for Jumbo Peanuts with Drip Tape Irrigation

The resulting population density is 22,400 plants per half an Acre. In the traditional plantings of Jumbo Peanuts in Sri Lanka, the farmers use a 45 cm (18 inches) x 15 cm (6 inches) rectangular planting pattern that results in a population density of 29,867 plants per half an Acre. This population density level yields smaller kernels that do not meet the market specifications for the size of Jumbo Peanuts. Therefore a the triangular planting pattern described above is highly recommended.

IRRIGATION AND FERTIGATION

Irrigation

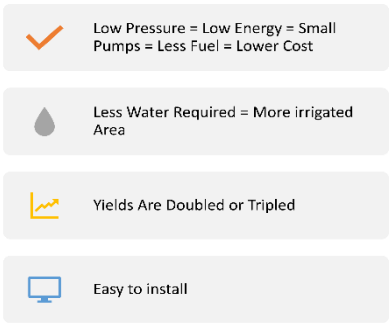


Figure 8: Advantages of Low-Pressure Irrigation

Low pressure irrigation is the best method of applying uniform and precise amounts of water directly to the root zone of the plants, as per their requirement, through emitters at frequent intervals over a period, via a pipe network comprising of mains, submains, and laterals. In this system, water is applied drop by drop or by micro jet (micro sprinkler), on the soil surface or below it (sub-surface), at a rate lower than the infiltration rate of the soil. For Jumbo Peanuts, the recommended irrigation system is a drip tape system that has emitters at every 30 cm with a discharge rate of 4 LPH (high discharge). One drip tape line is laid out in the middle of two rows of Peanuts for watering the Jumbo Peanuts crop. The technical specifications are given in the following figure:

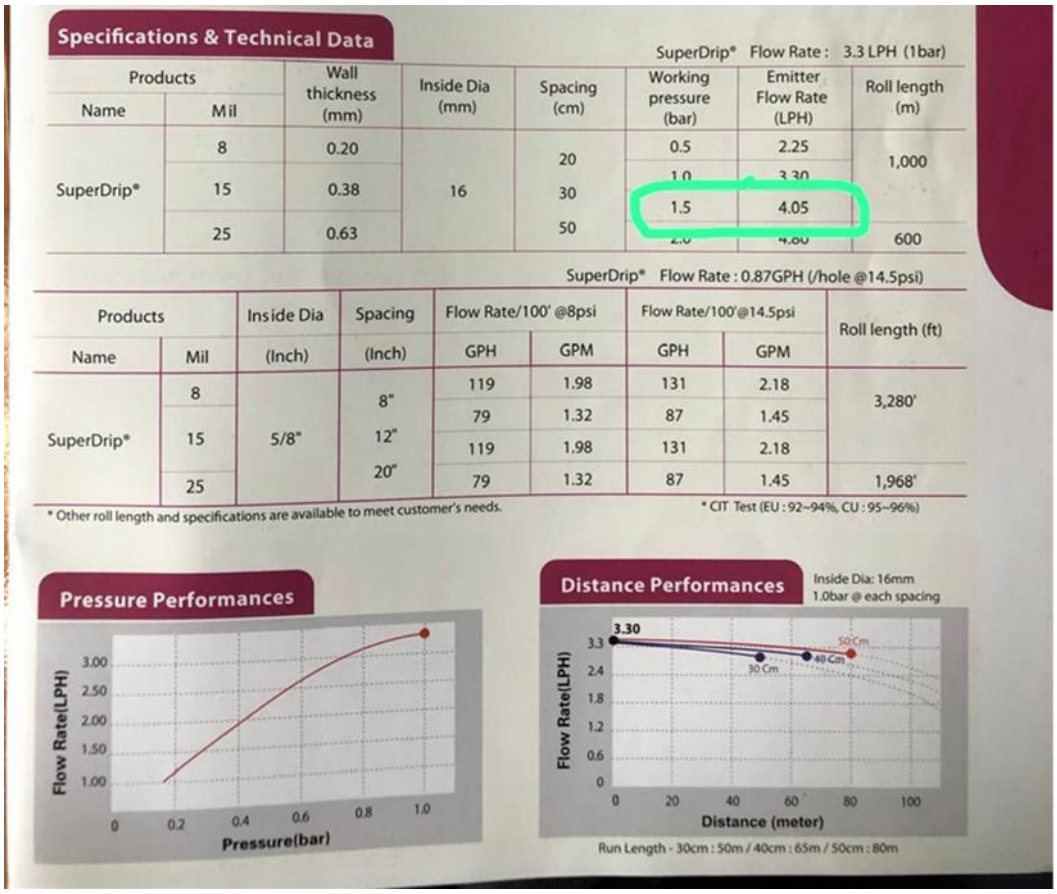


Figure 9: Specifications for the High Discharge Drip Tape

New Irrigation Concepts

- Net Area Irrigation – Water for Cultivated Area Only
- Evapotranspiration for irrigation scheduling rather than soil moisture content
- Consumptive Water Use by Crops: Different Crops Different Amounts of Water
- Water Amounts Are Adjusted to The Physiological Development of the Crops (Kc Constants per Crop)

Water Requirements

Jumbo peanuts, like other peanut varieties, have specific water requirements at different stages of their growth:

1. Germination (0-2 weeks) : In the early stages, Jumbo peanuts require consistent moisture to ensure successful germination. Water requirements are typically around 5-10 mm/day .
2. Vegetative Stage (2-6 weeks) : During this stage, the plants are establishing their leaves and roots. The water requirement increases slightly to about 6-12 mm/day .
3. Flowering Stage (6-10 weeks) : As the plants begin to flower and set pods, they need more water to support these processes. Requirements can rise to 8-15 mm/day during this critical period.
4. Pod Development Stage (10-14 weeks) : This is the most water-intensive phase, where Jumbo peanuts need ample moisture for pod filling. Water requirements can reach 10-20 mm/day .

5. Maturity Stage (14-16 weeks) : As the plants approach maturity, the water needs decrease slightly, stabilizing around 5-10 mm/day to avoid water stress as they prepare for harvest.

These values can vary based on environmental conditions, soil type, and the specific growing region.

Water Application

Low pressure irrigation systems are designed to keep the soil moisture level at field capacity which is the optimal soil moisture level for root growth and development. At this level, the soil provides ample and sufficient amounts of Oxygen and water to the roots of the different crops.

Figure 10: Mini Weather Station

At constant field capacity soil moisture, the amount of water to be applied through irrigation is the water loss by evapotranspiration, adjusted for rainfall. In other words, low pressure irrigation must provide the amount of water necessary to cover the water deficit of the crop on a daily basis to prevent the crop from suffering from water stress and losing yield potential. Modern weather stations provide evapotranspiration rates on a daily basis for farmers to properly irrigate their crops. To facilitate this modern technology process, ASMP has installed mini weather stations in 21 Clusters in different Districts of the Country.

In the absence of weather station data, the amount of water to be applied is based on the consumptive water use of the crop. As a minimum, and on a daily basis, crops must receive the amount of water required for optimum growth, development and yield, defined as consumptive water use. The Jumbo Peanuts consumptive water use is defined as 5 mm/Day in this manual.

Based on this concept, the water use amount by the plant is adjusted further using the FAO Kc factors or crop irrigation coefficients that consider the phenological development of the Peanuts plant, including canopy and root development,

	Vegetative	Flowering	Pod Dvlmt
Kc Factor or Crop Coefficient, FAO	0.8	1	1.2

This daily amount can be accumulated on a weekly basis and applied in two cycles of irrigation per week. As an illustration, the chart below shows the recommended irrigation times per cycle to deliver the weekly adjusted consumptive water use of Jumbo Peanuts using the drip tape irrigation system.

Table 1: Irrigation Time for Jumbo Peanuts Based on Consumptive Water Use

Irrigation Schedule	Vegetative		Flowering		Pod Dvlmt	
Irrigation Time (Hours/Minutes)	0	29	0	45	0	52

However, it is important to note that crops may need more water than the consumptive water use on a daily basis to prevent water stress and loss of yield potential brought about by water deficits that are determined by evapotranspiration, rainfall, etc. On a practical basis, and for the sake of simplicity, more water should be applied on very hot and dry days and less on cloudy and rainy days, and the weather stations can tell us exactly how much to apply.

Fertigation

Nutritional Requirements

Jumbo peanuts, known for their large size and high quality, require specific nutrient management to achieve optimal growth and yield. As a leguminous crop, peanuts have unique fertilization needs due to their ability to fix atmospheric nitrogen. However, they still require adequate amounts of macronutrients and micronutrients for successful cultivation.

Essential Nutrients for Jumbo Peanuts

Peanuts require several key nutrients to support their growth cycle, including nitrogen (N), phosphorus (P), potassium (K), and various micronutrients. Understanding these requirements is essential for effective fertilization.

1. Nitrogen (N): While peanuts can fix nitrogen through their symbiotic relationship with rhizobia, they may still benefit from supplemental nitrogen, particularly in the early growth stages. A typical recommendation is to apply around 20-40 kg/ha of nitrogen, with the primary focus on promoting early growth and pod development (Havlin et al., 2014).
2. Phosphorus (P): Phosphorus is critical for root development and energy transfer within the plant. Soil tests should guide phosphorus applications, but general recommendations suggest applying 30-60 kg/ha of phosphorus, especially if soil tests indicate low levels of this nutrient (Graham et al., 2019).
3. Potassium (K): Potassium is vital for overall plant health, including water regulation, enzyme activation, and photosynthesis. Jumbo peanuts typically require 60-90 kg/ha of potassium, with adjustments based on soil tests and specific regional conditions (Mallarino & Vitosh, 2018).
4. Micronutrients: In addition to macronutrients, peanuts require micronutrients such as calcium (Ca), magnesium (Mg), sulfur (S), and boron (B). These nutrients are essential for various physiological functions, including fruit development and disease resistance. Soil tests can help identify deficiencies and inform supplemental applications.

Best Practices for Fertilization

1. Soil Testing: Conducting soil tests before planting is essential to determine nutrient levels, pH, and organic matter content. This information is crucial for developing a tailored fertilization plan that meets the specific needs of jumbo peanuts.
2. Crop Rotation and Cover Crops: Implementing crop rotation and planting cover crops can enhance soil fertility and structure. Leguminous cover crops, in particular, can improve nitrogen levels in the soil, benefiting subsequent peanut crops (Raper & Doran, 2020).

3. Precision Agriculture: Utilizing precision agriculture techniques can optimize fertilizer applications, reducing waste and improving efficiency. Technologies such as soil mapping and variable rate application can help farmers apply the right amount of fertilizer at the right time.
4. Environmental Considerations: It is important to consider the environmental impact of fertilizer use. Over-fertilization can lead to nutrient runoff and water pollution. Employing best management practices, such as buffer strips and proper timing of applications, can help mitigate these risks.

These nutritional requirements, especially Nitrogen, vary according to the phenological development of Jumbo Peanuts. The ASMP has introduced this new concept to fertigate Jumbo Peanuts and other crops.

Nitrogen Fertigation Based on the Phenology of the Crop

Jumbo Peanuts requires an effective nitrogen (N) application management for optimizing its growth, yield, and seed quality. Tailoring nitrogen fertilization to the phenological stages of Jumbo Peanuts is a crucial strategy for maximizing productivity and seed quality. By applying specific nitrogen rates at each phenological stage, growth and yield can be enhanced while minimizing environmental impacts and maximizing economic impacts. Careful management of Nitrogen fertilization ensures that Jumbo Peanuts cultivation remains both economically viable and ecologically sustainable.

The phenological stages and Nitrogen requirements of Jumbo Peanuts are described in the table below:

Plot Net Area (Acres)	**0.250**

Table 2: Nitrogen Fertigation Levels for Jumbo Peanuts

Phenology	Time Period	Weeks	N Kg/Ha	Urea Kg/Ha	Urea Kg/Plot/Week	Urea Kg/Plot/Application
Germination	0 - 2 weeks	2	2.2	5	0.6	0.30
Vegetative Growth	2 to 6 weeks	4	11.1	24	1.5	0.76
Flowering	6 to 10 weeks	4	13.3	29	1.8	0.91
Pod Development	10 - 14 weeks	4	11.1	24	1.5	0.76
Maturation	14 – 16 weeks	2	2.2	5	0.6	0.30
Total		16	40.0	87.0		

Fertigation Recommendations

The fertilizer application in the ASMP Clusters is based on soil test results. The Kilinochchi Jumbo Peanuts Cluster soil tests results will illustrate the process to develop fertigation recommendations. In addition, Annex 1 contains all the soil tests and the global fertilizer recommendations for all the Jumbo Peanuts Clusters.

The results of the soil tests for Kilinochchi Jumbo Peanuts indicated the following:

Low Organic Matter
Low P for Jumbo Peatnut
Low K
Low Mg
Low Micronutrients specially S, Cu and Zn
Low CEC and Cation Ratios

Therefore, the recommendations for the application of fertilizers for this soil test are as follows:

Urea
TSP
MOP
MgSO4
Foliar Micronutrients

Based on the above considerations, Nitrogen as Urea is applied according to the phenological stages of the crop as indicated above.

The recommended amounts of other nutrients to be applied through fertigation to the Jumbo Peanuts crop are shown in elemental and oxide forms below:

Recommendation	**P**	**K**	**Mg**
Kg/Ha	60.0	90.0	75.0
Lb/acre	60.0	90.0	75.0
Kg/Acre	27.3	40.9	34.1

Phosphoric Acid P (Kg/Ha)	10.0

Recommendation	**P2O5**	**K2O**	**MgO**
Kg/Ha	137.4	108.5	124.3
Lb/acre	137.4	108.5	124.3
Kg/Acre	62.5	49.3	56.5

The elemental quantities of nutrients need to be converted to fertilizer materials to make up the fertigation recommendation for the whole cropping season in Kg/Acre:

Kg/Acre	**P Acid**	**TSP**	**MOP**	**MgSO4**
Fertilizer per Season	16	130	82	376

Each of these amounts of fertilizer materials is then adjusted percentage wise according to the phenological development of the crop.:

Kg/Acre	Vegetative	Flowering	Pod Dvlmt	Tot
P Acid	5.4	5.6	5.4	16
TSP	42.9	44.2	42.9	130
MOP	27.1	27.9	27.1	82
MgSO4	124.1	127.8	124.1	376

These amounts of fertilizers are then distributed on a per week basis according to the duration of each phenological stage of the crop cycle. These calculations result in amounts of fertilizer materials per Acre and per week (Kg/acre/Week):

Crop Cycle (Days)	Vegetative	Flowering	Pod Dvlmt	Tot
Weeks	4	6	6	16

Kg/Acre/Week	Vegetative	Flowering	Pod Dvlmt
P Acid	1.3	1.3	1.3
TSP	10.7	7.4	7.2
MOP	6.8	4.7	4.5
MgSO4	31.0	21.3	20.7

The weekly amounts of fertilizers are then converted to amounts per application using 2 applications per week:

Kg/Acre/Application	Vegetative	Flowering	Pod Dvlmt
P Acid	0.7	0.7	0.7
TSP	5.4	3.7	3.6
MOP	3.4	2.3	2.3
MgSO4	15.5	10.7	10.3

Finally, the amounts per Acre per application are adjusted to the size of the net production area of the plot which for the ASMP Project is half an Acre (50 m x 40 m):

Bed Width (m)	Bed Length (m)	Bed Net Area (m2)	Number of Beds	Plot Net Area (Acres/Ha)
0.3	40	12	84	0.252

In other words, in a production area of 0.5 Acre, only 0.25 Acres will be receiving fertilizer as follows:

Kg/Plot/Application	Vegetative	Flowering	Pod Dvlmt
TSP	1.35	0.93	0.90
MOP	0.85	0.59	0.57
MgSO4	3.91	2.68	2.61

Phosphoric Acid is recommended every two weeks to keep the irrigation system free from clogging:

ml/Plot/Application	Vegetative	Flowering	Pod Dvlmt
Phosphoric Acid (ml)	100.82	100.82	100.82

The fertigation recommendation is complemented by the recommended application of other required fertilizer materials as indicated below:

Foliar Applications of Micronutrients Are Also Recommended Every Week

Irrigation and Fertigation Management Guide

To facilitate the application of water and nutrients to the Jumbo Peanuts crop, the ASMP is now issuing an "Irrigation and Fertigation Management Guide" to the farmers that gives week by week detailed instructions. This guide summarizes all the water and nutrients applications for the crop:

Table 3: Irrigation and Fertigation Management Guide

Per Plot Per Application

			Irrigation		Kg/Application				ml	
Week	Growth Face	Phenology	Hours	Minutes	Urea	TSP	MOP	MgSO4	Phosphoric Acid (ml)	Micronutrients
1	Vegetative	Germination	0	29	0.304	1.35	0.85	3.91		Foliar
2		Germination	0	29	0.304	1.35	0.85	3.91	101	Foliar
3		Vegetative Growth	0	29	0.761	1.35	0.85	3.91		Foliar
4		Vegetative Growth	0	29	0.761	1.35	0.85	3.91	101	Foliar
5		Vegetative Growth	0	29	0.761	1.35	0.85	3.91		Foliar
6		Vegetative Growth	0	29	0.761	1.35	0.85	3.91	101	Foliar
7	Flowering	Flowering	0	45	0.913	0.93	0.59	2.68		Foliar
8		Flowering	0	45	0.913	0.93	0.59	2.68	101	Foliar
9		Flowering	0	45	0.913	0.93	0.59	2.68		Foliar
10		Flowering	0	45	0.913	0.93	0.59	2.68	101	Foliar
11	Pod Development	Pod Development	0	52	0.761	0.90	0.57	2.61		Foliar
12		Pod Development	0	52	0.761	0.90	0.57	2.61	101	Foliar
13		Pod Development	0	52	0.761	0.90	0.57	2.61		Foliar
14		Pod Development	0	52	0.761	0.90	0.57	2.61	101	Foliar
15		Maturation	0	52	0.304	0.90	0.57	2.61		Foliar
16		Maturation	0	52	0.304	0.90	0.57	2.61	101	Foliar

Two Applications per Week Except Phosphoric Acid Every Two Weeks

Annex 2 gives a practical guide on how to fertigate at the field level.

WEED CONTROL

Only mechanical weed control practices are to be used for Jumbo Peanuts cultivation, including within the narrow width of the planting rows. Herbicides are not allowed because of their toxicity.

The most common mechanical weed control practices are:

1. Cultivation with a tractor using a rotavator implement in the early stages of growth of the crop
2. Motorized weed cutters that use plastic cords to cut weeds (weed eaters)
3. Workers using bush knives or any other cutting or chopping tool
4. Plastic agricultural mulch

A production system using high beds, high discharge drip tape irrigation and plastic mulch is worth exploring. Such a system should increase the internal drainage of the soil inside the high beds, allow for irrigation and fertigation practices through the high discharge drip tape irrigation system and should provide total weed control through the plastic mulch.

PEST AND DISEASE MANAGEMENT

IPM concepts and practices must be applied to manage Jumbo Peanuts pests and diseases. The Quantity/Intensity factor is a practical and easy way to apply IMP concepts in deciding whether to apply pesticides:

Quantity **Intensity**	**Coverage** **Severity**		
	Quantity		
Intensity	**Low**	**Medium**	**High**
Low	Observation	Observation	Localized
Medium	Spot Treatment	Localized	Full Treatment
High	Localized Treatment	Full Treatment	Full Treatment

Most Common Pests in Sri Lanka

Pest	**Description**	**Damage**	**Management**
Groundnut Aphid	Small, sap-sucking insect; typically green or black.	Yellowing of leaves, stunted growth.	Use resistant varieties; insecticidal soap; neem oil.
Red Spider Mite	Tiny arachnids that cause stippling on leaves.	Leaf discoloration and webbing; reduced yields.	Increase humidity; introduce natural predators like ladybugs.
Leafcutter Ants	Ants that cut leaves to cultivate fungus.	Defoliation; weakened plants.	Baiting with insecticides; barriers to nests.
Thrips	Small, slender insects that feed on plant sap.	Scarring on leaves; reduced pod quality.	Regular monitoring; insect-resistant varieties; insecticides.
Stem and Pod Borer	Larvae that bore into stems and pods.	Wilting and pod damage; reduced harvest.	Crop rotation; handpicking; use of pheromone traps.
Nematodes	Microscopic worms that attack roots.	Root galls; reduced nutrient uptake.	Soil solarization; resistant peanut varieties.
White Grubs	Larvae of beetles that feed on roots.	Root damage; plant wilting.	Soil insecticides; crop rotation.

White Grub of Peanuts

Stem and Pod Borer of Peanuts

Ground Nut Nematodes

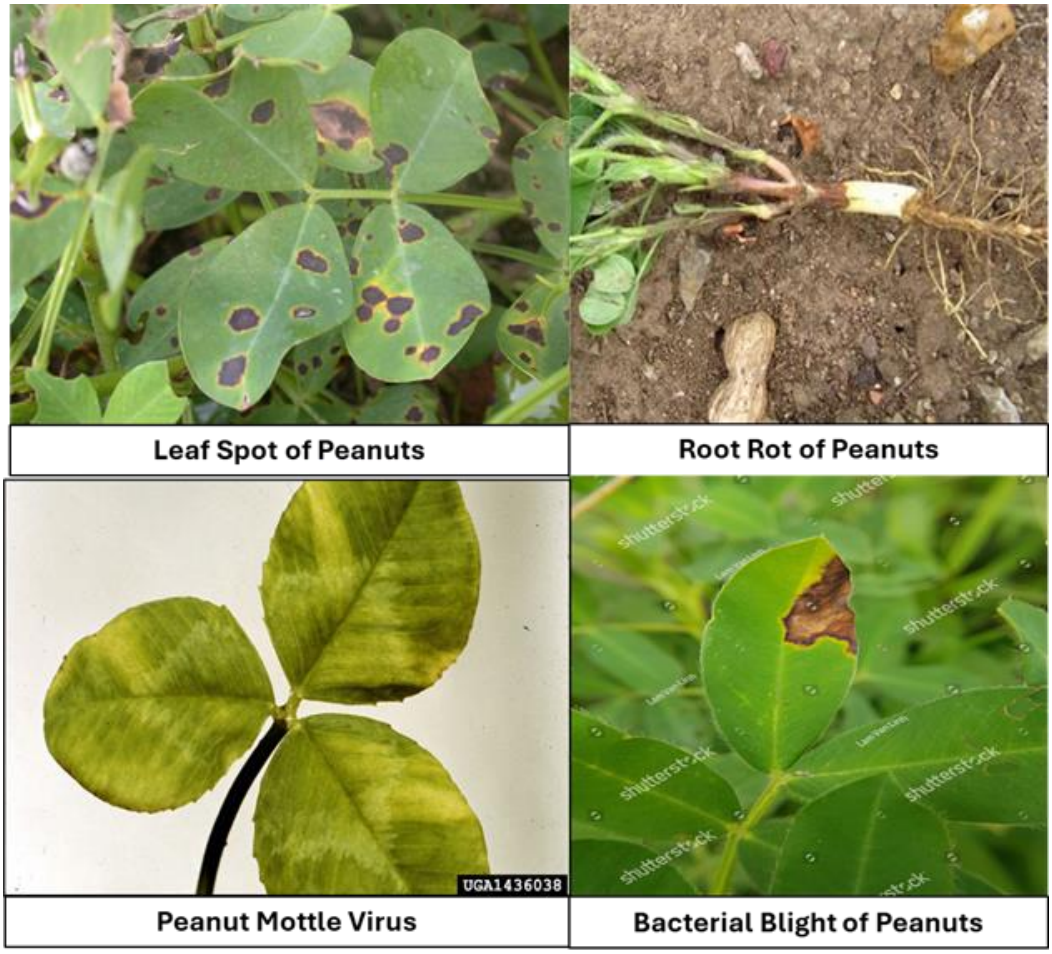
Ground Nut Aphids

Most Common Diseases in Sri Lanka

In Sri Lanka, Jumbo Peanuts is susceptible to several common diseases, which can significantly impact yield and quality. Here are some of the most prevalent diseases:

Disease	Description	Damage	Management
Leaf Spot	Fungal disease causing brown spots on leaves.	Defoliation; reduced photosynthesis.	Crop rotation; fungicides; resistant varieties.
Root Rot	Fungal infection affecting the roots, often in wet soils.	Wilting; stunted growth; plant death.	Improve drainage; avoid overwatering; use resistant cultivars.
Pod Blight	Fungal disease leading to dark lesions on pods.	Reduced pod quality; lower yields.	Good field sanitation; fungicides; crop rotation.
Wilt	Caused by fungal pathogens, leading to yellowing and wilting.	Plant collapse; significant yield loss.	Use resistant varieties; soil treatment; proper irrigation.
Sclerotinia Blight	Fungal disease causing a white, cottony growth on plants.	Wilting; pod decay; reduced quality.	Crop rotation; destroy infected debris; fungicides.
Bacterial Blight	Caused by bacteria, leading to water-soaked lesions.	Reduced leaf area; poor pod development.	Resistant varieties; crop rotation; sanitation practices.

Disease	Description	Damage	Management
Peanut Mottle Virus	Viral disease transmitted by aphids, causing mottling.	Stunted growth; reduced yield; poor quality.	Use virus-free seeds; manage aphid populations; crop rotation.



Chemical Control of Pests and Diseases

Chemical Control of Pests

Pest	Insecticide	Dosage	Management
Aphids	Imidacloprid	0.1-0.2 L/ha	Monitor regularly; apply when populations exceed threshold levels. Rotate with other classes to prevent resistance.
Leaf Miners	Spinosad	0.1-0.2 L/ha	Apply at first signs of infestation; repeat applications if necessary, particularly in wet conditions.
Thrips	Acetamiprid	0.15-0.3 L/ha	Monitor populations and apply as needed; integrate with cultural practices to reduce pest impact.
Ants	Fipronil	0.5-1.0 L/ha	Use bait formulations; apply around the base of plants to disrupt ant activity and protect peanuts.
Pod Borer	Lambda-cyhalothrin	0.2-0.5 L/ha	Apply at flowering and pod formation stages; monitor for signs of damage and reapply as necessary.
Spider Mites	Abamectin	0.2-0.4 L/ha	Apply during early infestation stages; rotate with different miticides to prevent resistance development.
Cutworms	Chlorpyrifos	1.0-2.0 L/ha	Apply at planting or when larvae are detected; monitor fields for re-infestation.
Whiteflies	Pyriproxyfen	0.3-0.5 L/ha	Apply when populations are detected; consider using reflective mulches to deter whiteflies.
Termites	Fipronil	1.0-2.0 L/ha	Apply as a preventive treatment before planting; monitor for signs of infestation during the growing season.
Armyworms	Bacillus thuringiensis (Bt)	1-2 kg/ha	Apply during early larval stages; use in conjunction with cultural practices for effective management.

Chemical Control of Diseases

Disease	Chemical	Dosage	Management
Leaf Spot	Chlorothalonil	1.0-2.0 L/ha	Apply at first signs of disease; repeat every 10-14 days in wet conditions.
Groundnut Rosette Virus	Insecticides (e.g., Imidacloprid)	0.1-0.2 L/ha	Control aphid vectors; monitor populations and apply as needed.
Sclerotinia Blight	Boscalid + Pyraclostrobin	1.0-1.5 L/ha	Apply during flowering; ensure good air circulation to minimize humidity.
Fusarium Wilt	Carbendazim	0.5-1.0 L/ha	Use as a seed treatment; practice crop rotation with non-host crops.
Downy Mildew	Metalaxyl	1.0-1.5 L/ha	Apply preventively during high humidity periods; monitor for early symptoms.
Anthracnose	Azoxystrobin	0.5-1.0 L/ha	Apply at the first sign of symptoms; repeat applications as necessary.
Powdery Mildew	Sulfur	2.5-3.0 kg/ha	Apply preventively; repeat applications every 7-14 days during humid conditions.
Alternaria Leaf Spot	Propiconazole	0.5-1.0 L/ha	Apply at the first sign of disease; monitor weather conditions for optimal timing.

Disease	Chemical	Dosage	Management
Peanut Stem Rot	Mefenoxam	0.25-0.5 L/ha	Apply as a seed treatment or foliar spray; ensure good drainage in fields.
Bacterial Blight	Copper Hydroxide	2.0-3.0 kg/ha	Apply preventively during wet conditions; ensure thorough coverage of the foliage.

Guidelines for the Safe Use of Pesticides and Other Agro-Chemicals

1. Personal Protective Equipment (PPE)
    - Wear gloves, masks, goggles, and long-sleeved clothing to minimize chemical exposure.
2. Proper Training
    - Ensure all personnel are trained in safe handling and application techniques, with regular refresher courses.
3. Correct Dosage and Application
    - Follow manufacturer's instructions to avoid overuse and environmental harm.
4. Timing of Application
    - Apply pesticides early morning or late afternoon to reduce evaporation and protect beneficial insects. Avoid pre-rain application.
5. Buffer Zones
    - Maintain buffer zones around water bodies to prevent contamination.
6. Mixing and Loading
    - Mix pesticides in designated areas away from water sources and use proper containment.
7. Safe Storage
    - Store pesticides in a cool, dry place, out of reach of children and elder people and animals, with proper labeling.
8. Disposal of Containers
    - Dispose of containers according to local regulations and do not reuse them.
9. Monitoring and Record Keeping
    - Keep records of pesticide applications and monitor pest populations regularly.
10. Integrated Pest Management (IPM)
    - Combine chemical controls with other practices to reduce pesticide reliance.
11. Emergency Procedures
    - Have emergency procedures for accidental exposure or spills, including first-aid kits and contact numbers.
12. Environmental Impact Assessments
    - Conduct assessments to understand the impact on ecosystems and human health.

HARVESTING JUMBO PEANUTS

Harvesting Jumbo Peanuts requires careful attention to timing and technique to ensure the best quality yield:

When to Harvest Jumbo Peanuts

1. Timing:
    a. Jumbo Peanuts typically take about 140 to 150 days from planting to harvest, but this can vary based on weather conditions and specific growing practices.
    b. The ideal time to start checking for maturity is around 140 days after planting.

Figure 11: Harvesting Jumbo Peanuts

2. External Signs of Maturity:
    a. Leaf Color Change: The leaves of the peanut plant will begin to yellow and possibly drop off as they approach maturity.
    b. Pods: The pods should be plump and firm. You can dig up some plants and inspect the pods for size.
    c. Skin Color: The skin of the pods will often change color, becoming darker or showing signs of a tan or brown hue.
    d. Husk Condition: The husks of the peanuts may become brittle, indicating that the peanuts inside are mature.

3. Moisture Content:
    a. The optimum moisture content for harvesting peanuts is typically around 10-15%.
    b. Moisture levels can be checked using a moisture meter designed for nuts or by observing the conditions of the pods. If the pods feel dry and the skins are easily broken, it may indicate readiness for harvest.

How to Harvest Jumbo Peanuts

1. Preparation:
    a. Ensure that the soil is dry enough to support harvesting equipment. Wet conditions can lead to soil compaction and damage to the crop.
    b. Plan for harvest on a clear day to avoid excess moisture from rain or dew.

2. Harvesting Method:
    a. Manual Harvesting: For small plots, you may dig up the roots by hand using a shovel or spade, carefully lifting the plant to avoid damaging the pods.
    b. Mechanical Harvesting: For larger fields, use a peanut digger or combine. These machines dig up the plants and shake off excess soil while leaving the pods intact.

3. Field Post-Harvest Handling:
    a. After harvesting, allow the peanuts to dry in the field if possible. They can be left on the ground for a few hours to a day to reduce moisture content further.
    b. Once dried, the peanuts should be collected and stored in a cool, dry place to prevent mold and spoilage.

POST-HARVEST HANDLING OF JUMBO PEANUTS

Post-harvest handling of jumbo peanuts involves several crucial steps to ensure quality preservation and minimize loss. Here's a detailed overview:

1. Drying
    a. Initial Drying: After harvesting, peanuts should be dried quickly to reduce moisture content. The ideal moisture level for storage is around 10-12%.
    b. Methods: Use mechanical dryers, sun drying, or shade drying, ensuring that they are turned regularly to promote even drying.

2. Cleaning
    a. Debris Removal: Remove any soil, leaves, and other foreign materials. This can be done using air blowers or mechanical cleaners.
    b. Sorting: Separate damaged or discolored peanuts from healthy ones to ensure only quality peanuts are stored.

3. Storage Conditions
    a. Temperature: Store peanuts in a cool environment, ideally between 50°F to 70°F (10°C to 21°C). Higher temperatures can lead to spoilage.
    b. Humidity: Maintain low humidity levels, ideally below 60%, to prevent mold growth and degradation.
    c. Ventilation: Ensure good air circulation to prevent moisture accumulation and reduce the risk of spoilage.

4. Packaging
    a. Containers: Use breathable containers such as burlap sacks or perforated plastic bags that allow moisture to escape while protecting the peanuts from pests.
    b. Sealing: Consider vacuum sealing for longer-term storage to minimize exposure to air and moisture.

5. Monitoring
    a. Regular Checks: Periodically inspect stored peanuts for signs of spoilage, pests, or moisture accumulation. Prompt action should be taken if issues are found.

6. Pest Control
    a. Preventive Measures: Implement pest control strategies, such as using traps or natural repellents, to minimize the risk of infestation.

ANNEX 1: SOIL TEST RESULTS AND FERTILIZER RECOMMENDATIONS

Kilinochchi, Northern Province

sample code	lab no	PH	OM	EC	Ca	Mg	K	NH4 - N	P	S	Cu	Fe	Mn	Zn	CEC	Ca/Mg	Ca/K	Mg/K	Ca+MG/K	Ca Sat
		1:2.5, H2O	%	S/cm	Exchangeable (meq/100g)			Available (ppm)							Cmol/kg	Cation Ratios				
Passion	R6 451	6.36	0.81	100.2	2.49	0.66	0.27	31.6	21	40	2.6	53.5	9.6	3.7	3.42	3.8	9.2	2.4	11.7	72.8
Jumbo peanut	R7 451	6.31	1.08	121.2	3.25	0.92	0.39	52.3	16	41	4.7	153	30.1	2.8	4.56	3.5	8.3	2.4	10.7	71.3
Passion/Jumbo peanut	R8 451	6.47	1.08	45.6	2.26	0.79	0.51	47	28	41	3.1	116.8	47.4	2	3.56	2.9	4.4	1.5	6.0	63.5

Interpretation:

- Low Organic Matter
- Low P for Jumbo Peatnut
- Low K
- Low Mg
- Low Micronutrients specially S, Cu and Zn
- Low CEC and Cation Ratios

Fertilizers Required:

- Urea
- TSP for Jumbo Peanuts
- MOP
- MgSO4
- Foliar Micronutrients

Irrigation and Fertigation Farmer's Guide

Per Plot Per Application

			Irrigation		Kg/Application				ml	
Week	**Growth Face**	**Phenology**	**Hours**	**Minutes**	**Urea**	**TSP**	**MOP**	**MgSO4**	**Phosphoric Acid (ml)**	**Micronutrients**
1	Vegetative	Germination	0	29	0.304	1.35	0.85	3.91		Foliar
2		Germination	0	29	0.304	1.35	0.85	3.91	101	Foliar
3		Vegetative Growth	0	29	0.761	1.35	0.85	3.91		Foliar
4		Vegetative Growth	0	29	0.761	1.35	0.85	3.91	101	Foliar
5		Vegetative Growth	0	29	0.761	1.35	0.85	3.91		Foliar
6		Vegetative Growth	0	29	0.761	1.35	0.85	3.91	101	Foliar
7	Flowering	Flowering	0	45	0.913	0.93	0.59	2.68		Foliar
8		Flowering	0	45	0.913	0.93	0.59	2.68	101	Foliar
9		Flowering	0	45	0.913	0.93	0.59	2.68		Foliar
10		Flowering	0	45	0.913	0.93	0.59	2.68	101	Foliar
11	Pod Development	Pod Development	0	52	0.761	0.90	0.57	2.61		Foliar
12		Pod Development	0	52	0.761	0.90	0.57	2.61	101	Foliar
13		Pod Development	0	52	0.761	0.90	0.57	2.61		Foliar
14		Pod Development	0	52	0.761	0.90	0.57	2.61	101	Foliar
15		Maturation	0	52	0.304	0.90	0.57	2.61		Foliar
16		Maturation	0	52	0.304	0.90	0.57	2.61	101	Foliar

Two Applications per Week Except Phosphoric Acid Every Two Weeks

Jumbo Peanuts Ampara
Report No: CIC/0081/22-23
Cluster: Komari Dry chili Cluster areas in Ampara District.

Samle Code & Village	Lab No.	pH	OM	EC	Ca	Mg	K	NH4 -N	P	S	Cu	Fe	Mn	Zn	CEC	Ca/Mg	Ca/K	Mg/K	Ca+MG/K	Ca Sat
		1:2.5, H_2O	%	µS/cm	Exchangeable (meq/100g)			Available (ppm)							cmol/Kg	Cation Ratios				
S-03 Kanchikudichiaru	R2 460	7.65	0.94	105.8	4.26	2.32	0.22	14.4	17	13	3.1	224	72.0	1.6	6.80	1.8	19.4	10.5	29.9	62.6
S-04 Kanchikudichiaru	R3 460	7.92	2.02	37.0	6.01	3.34	0.62	16.2	40	24	2.8	496	88.0	2.5	9.97	1.8	9.7	5.4	15.1	60.3
S-05 Kanchikudichiaru	R4 460	7.26	1.08	53.1	2.20	1.12	0.46	13.3	37	18	3.8	213.4	33.9	1.9	3.78	2.0	4.8	2.4	7.2	58.2
S-06 Kanchikudichiaru	R5 460	7.11	1.34	52.6	1.74	0.92	0.55	16.2	29	36	1.9	268	94.0	1.8	3.21	1.9	3.2	1.7	4.8	54.2
S-07 Kanchikudichiaru	R6 460	7.05	0.81	41.6	1.66	0.87	0.42	23.3	16	26	3.1	131.5	39.3	1.4	2.95	1.9	4.0	2.1	6.0	56.3
S-08 Manalchenai	R7 460	7.00	1.75	40.1	2.74	1.40	0.73	19.7	25	22	3.4	346	190.0	2.7	4.87	2.0	3.8	1.9	5.7	56.3
S-09 Manalchenai	R8 460	6.79	2.15	101.9	2.34	0.77	0.5	19.5	95	26	1.4	347.3	18.5	1.3	3.61	3.0	4.7	1.5	6.2	64.8
S-10 Manalchenai	R9 460	7.28	0.40	81.2	3.10	0.95	0.25	19.4	75	29	1.7	264	37.0	1.6	4.30	3.3	12.4	3.8	16.2	72.1
S-11 Manalchenai	R10 460	7.24	0.81	204.0	3.65	1.09	0.29	36.4	116	28	1.9	307.6	83.3	5.4	5.03	3.3	12.6	3.8	16.3	72.6
S-12 Manalchenai	W1 460	7.14	0.81	47.2	1.68	0.87	0.18	26.5	19	31	2.6	81.9	17.4	3.2	2.73	1.9	9.3	4.8	14.2	61.5
S-13 Manalchenai	W2 460	7.08	0.54	34.8	1.77	0.91	0.22	16.9	22	15	1.4	253.2	30.2	3.4	2.90	1.9	8.0	4.1	12.2	61.0
S-14 Manalchenai	W3 460	7.05	1.08	86.4	3.15	1.04	0.18	12.2	41	27	1.5	296	43.1	2.8	4.37	3.0	17.5	5.8	23.3	72.1
S-15 Manalchenai	W4 460	7.27	0.67	54.8	2.36	0.95	0.27	16.4	34	20	1.3	314.4	27.2	2.7	3.58	2.5	8.7	3.5	12.3	65.9
S-21 Thangavelayauthapuram	W10 460	6.97	0.40	157.6	4.71	2.04	0.74	34.8	17	65	2.8	121.3	49.2	1.3	7.49	2.3	6.4	2.8	9.1	62.9
S-22 Thangavelayauthapuram	B1 460	6.30	2.55	68.7	7.74	2.81	1.02	16.6	137	41	5.1	748	130.0	4.6	11.57	2.8	7.6	2.8	10.3	66.9
S-23 Thangavelayauthapuram	B2 460	6.31	0.67	49.6	5.24	1.81	0.31	25.7	107	21	5.8	194.9	139.2	2.6	7.36	2.9	16.9	5.8	22.7	71.2
S-24 Thangavelayauthapuram	B3 460	6.36	1.08	78.6	6.85	2.50	0.56	15.2	27	27	3.0	314.4	88.0	16.1	9.91	2.7	12.2	4.5	16.7	69.1

Interpretation:

Low Organic Matter
Low Mg in half the samples
Low K
Low Micronutrients specially S, Cu and Zn
Low CEC and Cation Ratios
Ca Saturation Low in a few samples

Fertilizers Required:

Urea
MOP
MgSO4 as a source of S
Micronutrients

Irrigation and Fertigation Farmer's Guide

Per Plot Per Application

			Irrigation		Kg/Application			ml	
Week	**Growth Face**	**Phenology**	**Hours**	**Minutes**	**Urea**	**MOP**	**MgSO4**	**Phosphoric Acid (ml)**	**Micronutrients**
1	Vegetative	Germination	0	29	0.123	0.85	3.91		Foliar
2		Germination	0	29	0.123	0.85	3.91	101	Foliar
3		Vegetative Growth	0	29	0.308	0.85	3.91		Foliar
4		Vegetative Growth	0	29	0.308	0.85	3.91	101	Foliar
5		Vegetative Growth	0	29	0.308	0.85	3.91		Foliar
6		Vegetative Growth	0	29	0.308	0.85	3.91	101	Foliar
7	Flowering	Flowering	0	45	0.370	0.59	2.68		Foliar
8		Flowering	0	45	0.370	0.59	2.68	101	Foliar
9		Flowering	0	45	0.370	0.59	2.68		Foliar
10		Flowering	0	45	0.370	0.59	2.68	101	Foliar
11	Pod Dvlmt	Pod Development	0	52	0.308	0.57	2.61		Foliar
12		Pod Development	0	52	0.308	0.57	2.61	101	Foliar
13		Pod Development	0	52	0.308	0.57	2.61		Foliar
14		Pod Development	0	52	0.308	0.57	2.61	101	Foliar
15		Maturation	0	52	0.123	0.57	2.61		Foliar
16		Maturation	0	52	0.123	0.57	2.61	101	Foliar

Two Applications per Week Except Phosphoric Acid Every Two Weeks

ANNEX 2: FERTIGATION PROTOCOL

Management of the Irrigation System

1. Turn irrigation pump on and allow the operating pressure of the system to become stable at the correct operating pressure (1 Bar to 2 Bar).
2. When pressure is stable, make sure venturi system is working correctly using only water in the fertigation tank or container.
3. Once venturi system is checked, proceed to fertigate with the fertilizer solution.
4. After fertigation, allow the system to continue to apply irrigation water to the plot for at least 10 minutes in order to flush out any fertilizer solution residue remaining in the system.
5. Make sure to apply Phosphoric acid every two weeks as recommended to make sure system remains unclogged by deposits of calcium salts.

Using Fertigation Solutions

1. Carefully follow "*Irrigation and Fertigation Recommendations"* issued by the ISP to make sure the right amounts and types of fertilizer materials are used for fertigation.
2. To prepare the fertigation solution, accurately weigh the correct amounts of fertilizer materials using a portable weighing scale.
3. Mix the weighed fertilizer material with water in an appropriate container such as a 20-litre plastic bucket using a clean wooden stick to stir the fertilizer material into the water to make sure all the fertilizer material is dissolved.
4. In case there is a fertilizer material that is not 100% soluble in water such as TSP, mix for at least 5 minutes to dissolve as much material as possible.
5. Filter the fertigation solution into the fertigation container to be used with the venturi system (fertigation tank or container) using a cloth filter such as an old t-shirt or similar.
6. After filtering, the fertilizer material left on the cloth filter when using a partially soluble fertilizer material such as TSP must be saved into a container to be used in the next fertigation with the same material.
7. Close the main valve of the irrigation system and open the valves of the venturi system to force the irrigation water to flow through the venturi system. This will create the necessary vacuum to suck the fertigation solution into the irrigation system to be distributed throughout the plot and applied to the crop.
8. After the fertigation solution is applied, add clean water to the fertigation container and allow this water to flow though the venturi system to clean it.

9. Open the main valve and close the venturi system valves to allow for normal irrigation to resume.