PYRETHRUM AGRONOMIC PRACTICES

KALRO
Kenya Agricultural & Livestock Research Organization

NAVCDP
NATIONAL AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT

Introduction

The agronomic practices refer to techniques and methods applied in pyrethrum production to optimize crop growth, productivity and health. The agronomic practices include; principles and practices of soil, water and crop management starting from crop establishment to harvesting.

Pyrethrum splits (left), spraying pyrethrum field (centre) and healthy pyrethrum field (right)- (Source: KALRO and KENTEGRA)

Site selection and land preparation

Proper site selection is very critical in ensuring maximum crop productivity. When selecting the site it is advisable to consider the following factors:

Soil composition

1. The land should not have been used for pyrethrum cultivation in the last 3-6 years.
2. The soil should be deep, and well-drained, free from waterlogging, good texture and structure to

ensure proper water infiltration and prevent soil erosion.

3. The soil should be rich in Calcium, Phosphorus, and Magnesium, with a pH ranging from 5.0 to 6.0. Soil testing is recommended to guide on the nutrition status of soil.

Soil collection for testing before pyrethrum establishment (Source: Robert L.K., KALRO)

Rainfall and water requirement

- Grow pyrethrum in areas where it thrives well with a minimum of 750 mm (30 inches) of well-distributed rainfall throughout the season. In warmer regions with high evaporation rates, a precipitation range of 1000 to 1125 mm (40 to 45 inches).
- Adequate rainfall at the start of the season triggers immediate flower growth, but excess rains can lead to issues like root rot and bud diseases, reducing yields. Persistent droughts exceeding four months significantly decrease yields, while short dry spells enhance flower production.

Altitude and temperature

- The selected site should be situated within an altitude range of 1700 to 3000 m above sea level, with cool temperatures of less than 18°C for at least 6 weeks to initiate flowering.
- Different clones and varieties are recommended based on altitude, with specific preferences for low, medium, and high altitudes in Kenya.

Land preparation

This is the clearing and tilling of fallow fields or stubble from previous harvest in good time, in readiness for planting.

Proper land preparation ensures;

1. Good crop establishment at the appropriate time for the realization of high yields.
2. Efficient control of perennial weeds such as couch grass, sedge grass, star grass, Kikuyu grass, Oxalis and portulaca that are difficult to eradicate later within the season when the crop is established,
3. Deep root growth and establishment, facilitating water infiltration.

Methods such as the use of herbicides

against perennial weeds can be applied two weeks before planting, or ploughing the land during dry months to destroy stubborn weeds. Farmer can till the land by the use of hoes/ jembes in small-scale farming and a tractor or animal-drawn equipment, for large-scale farming. Harrowing is recommended to attain the desired soil tilth and recommended depth.

Tractor-drawn plough used for land Preparation (Source Collins and Micah. KENTEGRA)

Ridging and drainage

Pyrethrum cannot tolerate water-logging. In areas with poor drainage, plant pyrethrum on ridges of 2.5 to 3 feet (approximately 0.75 to 0.9 meters) wide. The use of ridges promotes higher flower yields than on a flat field.

Field establishment of pyrethrum

Timely establishment of the pyrethrum, at the start of the long rain season following recommended establishment practices will ensure maximum utilization of the rainfall and soil nutrient (nitrogen flush). Planting should be done early in the rainy season preferably within the first two 2 weeks of continuous rain. This allows quick development of young roots and tillers. High flower yields depend on good plant establishment at 1st planting.

Establish the crop using, splits of mature plants or seedlings from tissue culture or seed nurseries.

Pyrethrum variety seedling (source: Collins and Micah KENTEGRA)

Propagation through seedlings is easy but takes a long time (1 year) for the first harvest to be realized while propagation through splits takes 6 months giving a uniform population although it is expensive in terms of transport and is highly weather dependent. Rapid multiplication through tissues is fast and efficient but requires heavy initial capital investment.

Planting Clonal Material (Splits)

A pyrethrum clone is a plant produced from the parent through vegetative methods. This results in a genetically identical population with the same growth characteristics. In pyrethrum the vegetative materials are splits. A split is a shoot that arises from the base of a plant.

The preparation of splits from mature plants is a critical operation for the successful establishment of clonal material. Follow the following steps to prepare a good split.

1. Identify healthy mature pyrethrum bushes as the parent plant. Avoid:
   - Blind plants. Plants that do not produce flowers.
   - Small and weak plants which are partially dead
   - Diseased plants that have signs of wilting or yellowing of leaves.

2. Carefully uproot/dig out the whole plant, preferably using a fork jembe ensuring that the plant remains intact without breaking off the roots.
3. Using a sharp object/knife trim old stems at the level of the topmost leaves, trim excessively long roots to 15 cm in length.
4. When splitting ensure that each split retains most of the original root system
5. On average the number obtained from one plant can be 5 to 10 splits depending on;
   - o The parent plant size
   - o The size of splits
   - o The genetic characteristic of the clone.
6. Plant splits at a spacing of 60 cm between rows and 30 cm within rows and 15cm deep. For uniformity and proper spacing use string during planting.
7. Apply Triple superphosphate fertilizer (46% P_2O_5) at a rate of one teaspoonful per planting hole. The fertilizer should be mixed well with soil before planting.
8. At planting if there are signs and symptoms of a fungal disease or nematode infestation, the splits should be dipped in a fungicide or nematicide solution.
9. Plant the split vertically covering the root crown not the leaves.
10. Fill the soil firmly around the roots ensuring cannot be pulled from the soil with a gentle pull. This ensures moisture retention.
11. In cases where rainfall is unreliable, irrigate the splits to avoid wilting and drying.

Pyrethrum splits ready for planting (Source: Obanyi J., KALRO MOLO)

Fertilizer application during split planting (Source: Collins and Micah, KENTEGRA)

Spacing and plant population

Recommended planting density varies based on moisture availability. Spacing recommendations are as follows:

- The spacing of 30 cm intra-row (between plants) and 60 cm inter-row (between lines) should be used, but in drier places, spacing of 30cm between plants and 90 cm between lines is recommended.
- 30 x 60 cm spacing results in approximately 22,000 plants per acre (55,000 plants per hectare)
- 30 x 90 cm spacing results in approximately 14,000 plants per acre (36,000 plants per hectare)
- Approximately 4,000 mature plants are required to raise enough splits to plant an acre or 10,000 plants for a hectare.
- In drier places with a spacing of 30 x 90 cm, 3,000 plants are required to split into approximately 14,000 splits to plant an acre or 7,000 plants for a hectare.

Irrigation of clonal splits after planting (source: Micah and Collins, KENTEGRA)

Planting Seed Material

Pyrethrum seedlings can be propagated from varietal seed or tissue culture clonal material.

A pyrethrum variety is obtained from seeds produced through hybridization of two or more clones consecutively. Varietal populations are different in all growth aspects since each plant is distinctly different.

Variety seed-Left (source: Obanyi, J., KALRO Molo) and pyrethrum seedling ready for planting-Right (Source: Collins KENTEGRA)

After establishing seeds in a nursery, under good management seedlings should ready for transplanting after 4 - 5 months. Mature seedlings should be about 10-15 cm tall with a well-established root system before transplanting.

Plant Seedlings within 24 hours after uprooting from the nurseries. Plant seedlings in;

1. Holes of 10 cm wide and 15 cm deep, with a spacing of 30 cm x 60 cm.
2. Apply Triple Super Phosphate fertilizer (46% $P_2O_5$0 at 125-150 kg/ha (5 grams/planting hole) and mix it with the soil thoroughly.
3. In poor soils add well decomposed manure at 4 tons/ acre.
4. Each seedling is an individual plant hence do not split.
5. Plant seedlings vertically into the holes, and cover them up to the root crown firming soils around the plant.
6. In the absence of adequate rain, irrigate seedlings to prevent drying.
7. Top-dress with Calcium Ammonium Nitrate (CAN) 400 kg/ha 3 months after germination.

Mechanized Planting

Pyrethrum planting in Kenya is usually manual and often labour-intensive. In the last few years, large-scale farmers have also started producing pyrethrum. The biggest constraint in large-scale production has been challenges in the planting process. It requires intensive labor which is very costly. This has led to adopting the use of tractor-drawn seedling planters which are efficient and in terms of cost of planting and also increased acreage planted per day.

Mechanization is required for increased productivity, precision planting, giving the right plant population.

Mechanized planting of pyrethrum seedlings (Source Micah and Collins, KENTEGRA)

Management Practices

Fertilizer and manure application

The decline in soil fertility in smallholder systems is a major factor limiting pyrethrum crop yields. The decline in soil fertility is compounded by leaching of applied nutrients, soil erosion and continuous cultivation and crop harvest without adequate nutrient replenishment. Balanced nutrition fertilizers rich in Phosphate are recommended for use in pyrethrum growing. Triple superphosphate (T.S.P) (46% $P_2 0_5$) or slow-release technology N.P.K (10.26.10 + Te) should be applied in each planting hole at the rate of 125 -150 kg/ha or 2.5 -3 bags of 50 kg/ha. To avoid seedling scorching, the fertilizer should be thoroughly mixed with soil in the hole before planting.

Triple superphosphate fertilizer (source Infonet)

Farmyard Manure (FYM) can be obtained from different animals (poultry, cow, goat,) or composed; should be applied on the farm, or purchased from other farmers or at the market. When managed properly, it provides plant nutrients, builds soil organic matter, and improves soil physical properties.

The recommended rate of applications is 4 tonnes per acre or 10 tonnes per hectare on poor soils. The FYM should be applied three months before planting of the crop and worked in the soil to allow adequate decomposition, however, if the manure is well decomposed it can be applied at planting time.

Weed Control

Weeds are unwanted/ undesired plants in the field and can lead to more than 50%, reduction in flower yield from the competition for moisture and nutrients and from the introduction of pests and diseases. Weeding should be carried out frequently every 4 weeks using small forked Jembe to avoid root damage.

Reasons for timely weed control in the pyrethrum field

- Pyrethrum growth rate is very slow compared with most weeds.
- Weeds compete with pyrethrum for space, nutrients, light and space.
- Weeds are alternative hosts for pests and diseases.
- Ecological zones of pyrethrum favor the growth of many weeds, are constant hazards.

Example of Pyrethrum field free of weeds (source Micah and Collins, KENTEGRA)

Pest and disease control

Several pests and diseases cause significant losses in pyrethrum crop (quantity and quality). Pyrethrum fields are prone to fungal diseases affecting the plants and flowers. They include; bud diseases, ray blights, fusarium wilts and root rots. Several approaches have been adopted to enhance control of the pests and diseases, which include; cultural, biological and chemical controls.

Pyrethrum flowers picking

The pyrethrin content is highly influenced by the flower development stage. At harvest the mature flowers should contain 92% pyrethrin content,

hence picking should be done at the right stage to get maximum pyrethrin content.

Pyrethrum flower and a farmer picking flowers at his Molo Farm (Source Muriithi, I., KALRO MOLO)

Pyrethrin content is at its maximum when the ray florets are horizontal and 3-4 rows of disc florets are open. Young or overblown flowers contain low pyrethrins and if picked in high quantities will lower the average pyrethrin content.

The correct picking interval is every 2 weeks, this will reduce the number of overblown flowers left on the plant as they reduce the number of newly initiated buds.

How to pick flowers

1. Hold the flower between first and second fingers.
2. Twist and Jerk the flower head with the thumb.
3. Place the flowers into well aerated baskets to reduce fermentation

How to harvest pyrethrum flowers (source: Muriithi I. KALRO)

Avoid flower harvesting under rainy conditions to prevent fermentation resulting in losses of pyrethrins. The flowers should be dried immediately after harvesting. Drying is necessary not only to prevent fermentation and the associated loss of pyrethrins but it enhances flower processing.

Cutting back

Pyrethrum plants economically produce open flowers for 9 months in a year after which they are cut back to rejuvenate for next year cycle. Cutting back ensures;

1. Promotion of fresh and vigorous growth encouraging vegetative growth needed for photosynthesis.
2. Eliminates diseases like bud rot.
3. Eases the weeding process.

Steps to cutting back

1. Use a sickle, (never a panga) to remove all stalks but not the leaf.
2. Make slanted cuts to facilitate water drainage.
3. Burn all cut off stalks. If left in the field they can harbor pests and diseases.
4. Weed and earth up the plants immediately after cutting back.

Sickle is used for cutting back and a comparison of before and after cutting back.

Intercropping

Intercropping is a type of multiple-cropping system that includes cultivating two or more crops in close proximity or at the same time, on the same piece of land.

In Kenya, there has been a decrease in arable land size per household due to increasing population density, leading to low food crop production, an increase in food insecurity and a decrease in farm incomes.

Benefits of Intercropping

1. Increases land productivity.
2. Intensive land use.
3. Increased household income from the intercrop.
4. Adequate ground cover for soil conservation.
5. Decreased weed incidence.

Pyrethrum field after Cutting back with new tillers developing (Source KALRO MOLO)

Sickle used for cutting back and a comparison of before and after cutting back

6. Reduced pest and disease incidence.
7. Reduction in field maintenance cost.

When the crop is cut back, the field remains with no economic yield for three consecutive months.

An intercrop can only be introduced during the following stages of pyrethrum production

- During the earlier growth stages after planting of pyrethrum before flower production begins. (month 2 to month 4)
- The period after cut back.

Food legumes are recommended for pyrethrum intercrops because of their high economic and nutritional importance. The combined benefit of pyrethrum and legume intercrops in monetary terms is high compared to where pyrethrum was grown alone thus increasing productivity per unit area

Pyrethrum and bean intercrop (Source: Lusikwe Wasilwa)

Advantages of Legumes as intercrops with Pyrethrum

1. They are high in protein content and hence contribute to food security.
2. They have fast growth, they mature and are ready for harvest in four months.
3. Their ability to fix nitrogen (N2) symbiotically with rhizobium making nitrogen available for use by pyrethrum.
4. They lower nematode infestation when intercropped with pyrethrum.

Examples of recommended legumes; Common beans, green peas and chick peas.

Avoid intercropping with crops that are climbers, or tall, as they cast a shade onto the pyrethrum crops leading to low production or total loss of the whole plant.

Crop rotation

This is a practice of growing different types of crops (or none at all) in the same area over a sequence of seasons. Crop rotation aims to replenish soil fertility, breakdown life cycles of weeds, diseases and pests.

Pyrethrum is a perennial crop that has a growth period of 3-4 years. It is uneconomical to maintain the crop in the field after 4 years. After the 4th year of production, clonal plants should be uprooted and re-planted in clean fields where pyrethrum had not been planted between 3-6 years prior. For varietal plant material, the crop should be uprooted and discarded.

For rotation purposes, a cereal crop such as maize, wheat, barley or oats can be planted after pyrethrum. Do not rotate with plants from Solanaceae family like tomato, potato and eggplant as they are hosts to the same pest and diseases as pyrethrum. Other methods of rejuvenating include leaving the field fallow.

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