Sweet Lupin
(Cultivars, Kieve mutant and 28324)
Seed Production Manual

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Lupinus albus (cv Kieve mutant)  Lupinus angustifolius (cv 28324)

Lupinus albus beans  Lupinus angustifolius beans
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Acknowledgement

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We are also grateful to the contributors of this manual who include KALRO scientists and extension agents.
Preface

Sweet lupin has great potential in improving livestock productivity in Kenya. However, reduced access to seed limits the growing of the legume. Development of alternative forage seed distribution system is key in upscaling of the legume among dairy farmers. This manual provides information on how to strengthen cooperatives and other farmer groups to produce clean planting material for sale and utilization of lupins to improve livestock nutrition. Broad leaved lupins (Kieve Mutant) and narrow leaved lupins (28324) are among the developed varieties of lupins in Kenya.

Sweet Lupin can produce 6 tons dry matter/Ha (2.4 tons/Acre) of green forage when harvested at 4 months. Grain yield is approximately 0.8-1.0 Ton per acre (2.0 - 2.5Tons/Ha) at 5 months. The green forage has Crude Protein (CP) of 15-20%. Grain CP is 30-36%. Cost of producing one Kilo of lupin seed is Kes. 136.95.

The two varieties are being promoted by Kenya Agricultural and Livestock Research Organisation (KALRO) under KCSAP Common Interest Group (CIGs), Vulnerable and Marginalized Groups (VMGs) and Producer Organizations (POs) for seed production as a business. This work is being piloted in KCSAP Counties of Nyeri, Kericho, Bomet and Kakamega.
1.0 INTRODUCTION

Lupins have widely been used as a source of protein and energy in livestock feeds in most parts of the world. However, their potential as livestock feed in Kenya has been under-utilized due to limited availability of information, low seed access and adoption by farmers. The Lupin varieties available in the country are *Lupinus angustifolius* cvs - 26974, 28137, 28324, *Lupinus albus* cvs Ultra and Kieve mutant, *Lupinus luteus* and *Lupinus mutabullis*. As leguminous plants, they have ability to fix atmospheric nitrogen.

Their high protein content makes them a suitable feed resource for goats, sheep and cattle. Generally, they have low level of starch but are rich in fermentable carbohydrates and hence ideal for ruminant feeding. Sweet Lupin green forage can be mixed with maize/Napier and conserved as silage. For making homemade dairy feed supplement, mix 25% Lupins and 75% maize meal or 17% of sweet Lupin grains, 60% of maize meal, 20% maize/wheat bran and 3% minerals. Feed the mixture at a supplementation rate of 1:2 (1kg Lupin mixture:2 kg milk produced above 7 kg of milk per cow per day).

Sweet Lupin can produce 6 tons dry matter/Ha. (2.4 tons per acre) of green forage when harvested at 4 months. Grain yield is approximately 0.8-1.0 ton per acre (2.0 - 2.5 tons/Ha) at 5 months. The green forage and grain have 15-20% and 30-36%Crude Protein (CP) respectively. Price of Lupin seed is approximately Kes. 400 per Kilo.
1.1 General Agro-ecological requirements for Lupins

**Altitude:** Medium to high altitude areas > 1000m ASL

**Rainfall:** Minimum of 700 mm but well distributed

**Temperature:** Average 18° C.

**Soil:** Well drained deep and fertile light acidic to neutral.

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2.0 FIELD ESTABLISHMENT

2.1 Land preparation

Lupins requires well drained deep fertile soils but can tolerate soils with low phosphate. Lupin requires a well-prepared seed bed. Seed bed is ploughed and harrowed once to break and loosen the top soil for better aeration and water percolation for good seed germination. Lupin does not do well on water logged soil.

![Primary and secondary land preparation](image)  

2.2 Inoculation of Lupin seed

Seed inoculation with Rhizobium bacteria, is required when Lupin is grown for the first time in a new field, or where similar legumes have not been grown before. Mix Lupin seed with legume inoculant to introduce rhizobium bacteria in the soil. In the absence of commercial inoculant, mix Lupin seed with soil acquired from an old plot/field of Lupins or any other bean had been grown. Inoculation enhances fixing of nitrogen into the soil by the bacteria.

**Inoculation procedure**

- Add 30g of Gum Arabic (or 2 table spoonful of sugar) to 300ml of clean lukewarm water in a soda bottle and shake well to dissolve
- Weigh 15 kg of lupin seed and in a container that will accommodate the seeds
- Pour Gum Arabic/sugar solution onto the lupin seed in the container
• Mix the lupin seed with the Gum Arabic/sugar solution until all the seeds are soaked
• Use the relevant inoculant such as BIOFIX®, pour the contents of the packet onto the wet seeds in the container
• Mix the legume seeds and the inoculant thoroughly until all the seeds are uniformly covered with the inoculant
• Cover the basin containing the inoculated seeds with paper, cloth or gunny bag and keep under shade until all the seed are planted
• Plant the inoculated seeds as soon as possible in well prepared moist bed

2.3 Fertilizer and manure application
Use 5-10 tons of well cured manure/Ha. (2 - 4 tons per acre) and TSP fertilizer at 200 kg/Ha. (80 kgs per acre) and mix thoroughly with soil.

2.4 Seed rate and spacing
The seed rate is 30-50 kg per hectare (12kg/acre) depending on the variety. Two seeds per hole are sown at a spacing of 50 X 30 cm between and within rows at a soil depth of 3-5cm, cover and compact the soil. In clay soils shallow depth is recommended while on loose sandy soils deep depth is required. Seed germination takes 5-7 days. Lupins exhibits slow growth in the first two months.

2.5 Weeding
Weed such as couch grass, datura, pigweed, can affect germination of lupin and are difficult to eradicate. Timely hand weeding is essential for control of the weeds. Two weedings are adequate depending on the weed invasion. Alternatively, selective herbicides can be used to control the weeds.
3.0 PESTS AND DISEASES

3.1 Common pests

Most field pests occur at different stages of growth and show different symptoms on the plant.

<table>
<thead>
<tr>
<th>Common Pest</th>
<th>Symptoms</th>
<th>Control</th>
</tr>
</thead>
</table>
| Red legged earth mites               | Signs of cutting at the ground level of the plant or withering on tender lupin plants from emergence to 3 weeks after planting. Check for webs under leaf. | • Good agricultural practice  
• Use of recommended pesticides  
• Integrated pest management |
| Thrips                               | Check for aphids and thrips at flowering stage.  
Where signs of withering flowers are observed it indicates the attack by the pest | • Good agricultural practice  
• Use of recommended pesticides  
• Integrated pest management |
| Ladybird beetle feeding on aphids    |                                                                            |                                                            |
| Cut worm                             | Signs of cutting at the ground level of the plant or withering on tender Lupin plants from emergence to 3 weeks after planting. Check for cut worm in the soil | • Good agricultural practice  
• Use of recommended pesticides  
• Integrated pest management |
3.2 Common diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Symptom</th>
<th>Control</th>
</tr>
</thead>
</table>
| Anthracnose on plant and seed | Symptoms of lupin anthracnose can be seen on all above ground parts of the host plant. If infection occurs early in the season lesions can be found on seedlings | • Plant clean seeds  
• Seed dressing with fungicides  
• Use resistant varieties                                                                                                           |
| Brown Spot on plant           | Dark brown spots on the leaves become yellow and drop off. Pods develop large brown lesions especially those close to the ground                                                                        | • Long period of Crop rotation  
• Use seed dressing with fungicides                                                                                                          |
| Brown Spot on pods            |                                                                                                                                                                                                        |                                                                                                   |
Cucumber mosaic virus (CMV)

| Plants grown from infected seed are stunted with pale, bunched, down-curved leaves. Pod set and seed size are both reduced in infected plants | • Sowing healthy uninfected seed  
• Virus spread can be reduced by narrow spacing and high seeding rates  
• Varieties with low seed transmission rates are recommended for high rainfall environments. *Albus lupins* are not hosts of CMV. |
4.0 HARVESTING OF LUPIN FOR SEED PRODUCTION

Lupins take 4 - 5 months (120 -150 days) to mature. Sweet Lupin can produce 6 tons dry matter/Ha.(2.4 tons per acre) of green forage when harvested at 4 months. Grain yield is approximately 0.8 -1.0 ton per acre (2.0 - 2.5 tons/Ha) at 5 months. Mature pods can be harvested manually by hand or mechanically with a combine harvester. The use of a harvester is recommended if seed production is done in large scale.

4.1 Postharvest management

This is aimed at minimizing losses attributed to the following ;

- Improper handling, biological spoilage, rodents, insects damage e.g. weevils
- Deterioration of seed quality from mould infestation from high moisture levels
- Improper storage leading to aflatoxin infestation which is harmful to livestock and can affect humans through milk and meat

Recommended practices to minimize storage losses are:

- Seed-dress to increase shelf life. Seed dusting and dressing with appropriate insecticides is highly recommended to prevent losses arising from insect infestation and damage. Insecticides that can be used include actelic dust® and supa skana® for grain storage and Fanasan-D®, Furaha® for seed dressing
- Store seeds in treated gunny bags placed on pallets, not directly on the floor
5.0 COMMERCIALIZATION OF SWEET LUPIN SEED PRODUCTION

Growing of Lupins for seed production can be profitable to the grower due to the high demand for seeds. Presently, the sterilized seeds are being milled and incorporated in feed formulation for ruminants (cattle, sheep and goats) hence the need to increase production for the milling industry.

Lupin seed is currently sold at Kes. 400 per kg and gross margin computations indicate that the cost of producing one Kilo of lupin seed is Kes. 136.95 resulting in a gross profit margin of 65.8%.

5.1 Gross margin of Lupin seed production

<table>
<thead>
<tr>
<th>Sweet Lupin (1 Acre)</th>
<th>Unit</th>
<th>No. of Units</th>
<th>Cost of Unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land hire</td>
<td>Acre</td>
<td>1</td>
<td>10,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Non-selective herbicide</td>
<td>lts</td>
<td>2</td>
<td>1,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Ploughing tractor hire</td>
<td>acre</td>
<td>1</td>
<td>4,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Heavy Harrowing tractor hire</td>
<td>acre</td>
<td>1</td>
<td>3,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Light Harrowing tractor hire</td>
<td>acre</td>
<td>1</td>
<td>1,500</td>
<td>1,500</td>
</tr>
<tr>
<td>TSP Fertilizer</td>
<td>bags</td>
<td>1</td>
<td>6,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Lupin seeds</td>
<td>kgs</td>
<td>12</td>
<td>400</td>
<td>4,800</td>
</tr>
<tr>
<td>Insecticide</td>
<td>lts</td>
<td>3</td>
<td>2,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Fungicide</td>
<td>45g sachet</td>
<td>13</td>
<td>520</td>
<td>6,760</td>
</tr>
<tr>
<td>Planting labour</td>
<td>m/days</td>
<td>10</td>
<td>400</td>
<td>4,000</td>
</tr>
<tr>
<td>1st weeding labour</td>
<td>m/days</td>
<td>15</td>
<td>400</td>
<td>6,000</td>
</tr>
<tr>
<td>2nd weeding labour</td>
<td>m/days</td>
<td>15</td>
<td>400</td>
<td>6,000</td>
</tr>
<tr>
<td>Chemical application labour</td>
<td>m/days</td>
<td>20</td>
<td>400</td>
<td>8,000</td>
</tr>
<tr>
<td>Harvesting labour</td>
<td>m/days</td>
<td>20</td>
<td>400</td>
<td>8,000</td>
</tr>
<tr>
<td>Cleaning and processing labour</td>
<td>m/days</td>
<td>20</td>
<td>400</td>
<td>8,000</td>
</tr>
<tr>
<td>Dressing chemical</td>
<td>lts</td>
<td>4</td>
<td>1,500</td>
<td>6,000</td>
</tr>
<tr>
<td>Dressing labour</td>
<td>m/days</td>
<td>10</td>
<td>400</td>
<td>4,000</td>
</tr>
<tr>
<td>Packaging labour</td>
<td>m/days</td>
<td>20</td>
<td>400</td>
<td>8,000</td>
</tr>
<tr>
<td>Packages</td>
<td>pcs</td>
<td>500</td>
<td>15</td>
<td>7,500</td>
</tr>
<tr>
<td><strong>Sub total</strong></td>
<td></td>
<td></td>
<td><strong>109,560</strong></td>
<td></td>
</tr>
</tbody>
</table>
Gross margin analysis for 1 acre of sweet lupin seed

<table>
<thead>
<tr>
<th></th>
<th>kgs/acre</th>
<th>cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected output (TR)</td>
<td>800</td>
<td>400</td>
<td>320,000</td>
</tr>
<tr>
<td>Cost of production (TC)</td>
<td></td>
<td>109,560</td>
<td></td>
</tr>
<tr>
<td><strong>Gross profit (GP= TR-TC)</strong></td>
<td></td>
<td><strong>210,440</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Gross profit margin % (GPM = GP/TR*100)</strong></td>
<td></td>
<td><strong>65.8%</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Cost of production/Kg (Kes.)</strong></td>
<td></td>
<td><strong>136.95</strong></td>
<td></td>
</tr>
</tbody>
</table>

Other costs such as salaries, levies, insurance, marketing and promotion are not factored. It further assumes that harvesting is done once in a year and establishment is done as per the production recommendations. All other risk factors such as vulgaries of weather, theft, crop destruction, pests and diseases are held constant.

5.2 Promotion and Marketing of Lupin seed

For successful marketing of lupin seed, farmers and farmer groups need to focus on some basic marketing principles which include Product, price, place and promotion. This helps farmers decide on the product and its characteristics, set the price, and decide how to distribute and promote it.

**Product:** what to produce? Lupin seed

**Price:** at what price to sell? Ksh 400 per Kg which is determined mainly by the cost of production and demand.

**Place:** where to sell it? Farmers can sell the rooted splits amongst themselves, other CIGs, VMGs, POs and other institutions.

**Promotion:** how to promote the product? This can be achieved using avenues such as farmer to farmer interactions, churches, schools, shows, milk collection centres and use of printed materials.
5.3 Lupin Seed business analysis

6.0 FURTHER READING

1. Lupin grow notes, Grains Research and Development Corporation, April 2018
2. The biology of *Lupinus* L. (Lupin and lupine) Australian Government, April 2013 version 1