Using the wild sunflower, tithonia, in Kenya
for soil fertility and crop yield improvement
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One of the most popular agroforestry practices in the highlands of Kenya is to use traditional hedges to demarcate both external and internal boundaries of farms and compounds. These hedges also protect soil and crops as well as producing fodder, green manure and mulch. Among the most common species found in them are *Tithonia diversifolia, Lantana camara, Thevetia peruviana* and *Croton megalocarpus*. Some species, such as tithonia and lantana, produce large quantities of biomass, which farmers do not fully utilize as green manure. Yet the major constraint to high crop productivity in Kenya is declining soil fertility. In particular, the soils are deficient in nitrogen and phosphorus.

Researchers evaluated mulch from different hedge species, both on station and on farm, to see if it improved soil fertility and the crop
yield of different crops. Experiment results consistently indicate that *Tithonia diversifolia* can improve soil fertility and increase crop yield when it is used either as green manure alone or, more particularly, in combination with inorganic phosphorus.

**What tithonia looks like**

*Tithonia*, or the wild sunflower, is a succulent and soft shrub belonging to the family *Asteraceae = Compositae*. It grows to a height of 1–3 metres and bears alternately positioned leaves along most of the stem. Each leaf has 3–5 lobes with toothed margins, a pointed apex and a long petiole. The leaves have many hairs on the lower side, giving them a grey appearance. The leaf veins are parallel. The flowers are similar to the well-known sunflower plant *Helianthus* but are smaller. The flower disc of tithonia is about 3 cm in diameter and has yellow petals 4–6 cm long. The plant flowers and produces seeds throughout the year. Each mature stem may bear several flowers at the top of the branches. The lightweight seeds can easily be dispersed by wind, water and animals.

**Where it is found**

*Tithonia* is found in Western and Central Provinces of Kenya as well as in coastal regions and parts of the Rift Valley. Initially introduced into Kenya from Central America as an ornamental plant, it escaped from cultivation and now grows wild in hedges, along roadsides and on wasteland.
Traditional uses

People in Kenya use tithonia for live fencing around homesteads and to demarcate boundaries between plots and farms. Occasionally they use it for composting, and during the dry season cattle and goats may browse on it. An infusion made of tithonia leaves and buds is used as a medicine for constipation, stomach pains, indigestion, sore throat and liver pains. The leaves should be ground into small pieces, mixed with water, and then the infusion is drunk. The local names of tithonia are ‘maua amalulu’ (Luhya), ‘maua makech’ (Luo), ‘amaua amaroro’ (Kisii) and ‘maruru’ (Kikuyu), all of which imply that the plant is bitter to the taste.

Agronomic values

Before the plant flowers, tithonia leaves (dry matter) on average contain the following nutrients:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (N)</td>
<td>3.17%</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>0.3%</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>3.22%</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>2.0%</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

The moisture content of tithonia leaves is estimated to be 84%. Crops respond well when the leaves and cuttings are applied at the rate of 1 tonne of dry matter per hectare. However, the best results are obtained with higher quantities of biomass, such as 5 tonnes of leafy dry matter per hectare. This is equivalent to about 159 kg ha$^{-1}$ N, 15 kg ha$^{-1}$ P, 161 kg ha$^{-1}$ K, 100 kg ha$^{-1}$ Ca and 15 kg ha$^{-1}$ Mg. This quantity of nutrients significantly exceeds the amount of inorganic fertilizer recommended for the area, which is 60 kg N ha$^{-1}$. 

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How to propagate Tithonia seeds

You can easily propagate Tithonia by direct seeding. However, the seeds do not germinate when planted deep, but on the other hand are washed away if they are sown superficially. The best method is to make a furrow for the seeds and cover them lightly with sandy soil. Then apply mulch to prevent the seeds from being washed away and to retain the soil moisture.

1. Make a shallow furrow.
2. Plant the seeds.
3. Cover with sandy soil.
4. Apply a mulch.
You can also establish tithonia from cuttings. For successful propagation, make cuttings 20–30 cm long from mature wood and place them in the soil the right way up. Avoid split cuttings, as they do not sprout. Plant the cuttings with 1 or 2 nodes below ground level and 2 or more nodes above. Place the cuttings in the ground slanting at an angle of 45–60 degrees. You can also use bare-root seedlings from farmers’ nurseries or wildlings.

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Select a mature stem.

Cut a piece with 4 or 5 nodes.

Plant at an angle of 45°–60°.

Water the cuttings.

How to propagate tithonia by cuttings
Cut leaves and twigs from the hedge. Chop them into small pieces.

Place in planting holes and along rows. Spread the green manure over the soil.

Preparing and using the green manure

How to apply the green manure

To apply the green manure, cut leaves and soft twigs of tithonia from the hedges, chop them into small pieces, and either place them in each planting hole or spread them evenly over the surface and then incorporate them into the soil. You can continue applying this green manure throughout the active growing period of the crop either by placing it along the rows of plants or by incorporating it into the soil. After you apply the leaves, they must be mixed well with the soil or left to decompose for at least 1 week before you plant. The maize and other seeds may not germinate well if they are planted immediately.
Effect on crops

Maize

A wide range of experiments has shown that tithonia can increase maize yields from the depleted soils of western Kenya. These experiments were carried out both on station and on farm, using tithonia alone or in combination with an inorganic fertilizer such as triple super phosphate (TSP), diammonium phosphate (DAP) or Minjingu rock phosphate (RP). In West and Central Bunyore locations of Vihiga District, 63 farmers in on farm experiments showed that they could easily double their maize yields by using tithonia leaves as green manure.

Farmers can obtain a maize yield from an application of 5 tonnes of tithonia (dry matter) per hectare that is comparable to the yield obtained from applying the recommended rate of inorganic fertilizer—50 kg ha\(^{-1}\) of P\(_2\)O\(_5\) and 60 kg ha\(^{-1}\) of nitrogen. The best results are obtained when tithonia is complemented with phosphorus from DAP at the combination rate of 50\% of the recommended rate of DAP with either 5 t ha\(^{-1}\) or 2.5 t ha\(^{-1}\) of dry tithonia biomass.
Application of the same quantities of phosphorus from inorganic sources (TSP) or from an organic source (tithonia leaves) on maize have shown that maize yields obtained from treatment with organic fertilizer are higher than those obtained from inorganic fertilizers. This is probably because of the large amounts of other nutrients such as potassium that are contained in the organic fertilizer and also the physical effects of the mulch. These high maize yields are noticeable for as long as 3 seasons after the application of the biomass, which shows that the fertility remains in the soil for a significant period of time.

Maize yields were 4 times higher than the yield obtained from the urea treatment when rock phosphate (RP) (Minjingu), which contains 28% $P_2O_5$, was combined with tithonia leaves. These maize yields were twice as much as when tithonia was used alone or when rock phosphate was used with urea. The maize yield from the tithonia treatment was twice what the yield was when urea was used alone.
Effects of tithonia, with or without rock phosphate, on maize grain yield

**Kale (sukuma wiki vegetable)**

Farmers who applied tithonia leaves as green manure on kale made a substantial increase in both their gross and their net profits. The net increase ranged from USD 91 to USD 1,665 ha$^{-1}$. This suggests that using tithonia on high-value crops can offset the increased labour costs of collecting and applying it.

**Other crops**

Other high-value crops are french beans, tomatoes and napier grass. Tithonia green manure treatment was found to increase the yield of beans 3-fold on 46 farms in West Bunyore location, which produced an average of 734 kg ha$^{-1}$ season$^{-1}$. This can be compared
with 260 kg ha\(^{-1}\) season\(^{-1}\) for controls with no tithonia. Similarly in Central Bunyore location, the bean yield with tithonia treatment produced 746 kg ha\(^{-1}\) season\(^{-1}\), while the control without tithonia produced 285 kg ha\(^{-1}\) season\(^{-1}\).
Constraints
Although tithonia is often found growing along roadsides and on fallow land, it takes a lot of labour to collect and carry it. It takes about 4 minutes to collect 1 kg of fresh tithonia biomass, which means a person could harvest 83–120 kg of tithonia a day. To reduce the labour demand, it is better to plant tithonia on internal and external borders and boundaries of farms as well as along contour lines. This will ensure a constant supply and also reduce the cost of labour to carry it.

Recommendations
- *Tithonia diversifolia* can be applied as green manure to maize, sorghum, cowpeas, kale, tomatoes and beans as well as to high-value crops such as french beans and pineapples.
- For efficient use of labour, it is recommended that farmers should plant tithonia in different niches on their farm by direct seeding or by using cuttings or bare-root seedlings. This will make tithonia available within the farm.
- Farmers can be encouraged to use a combination of tithonia with inorganic sources of P (TSP or DAP or rock phosphate) or other organic sources such as animal manure.
Tithonia — a versatile plant for farmers in Kenya

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