TITHONIA GREEN MANURE

For Soil Fertility Improvement in Western Kenya Small Holder Farms
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1. Introduction

The use of commercial fertilizers for the growing of staple food crops of maize and beans in Western Kenya is generally restricted to only a few farmers who are endowed with resources, such as cattle and land and with high off-farm income. The majority of the small holder farmers, on the other hand, lack the financial resources to buy the recommended fertilizers to replace soil nutrients removed from the soil with harvested crops. As a result, soil fertility has reduced, and the yields of crops are typically low.

Organic sources of plant nutrients are often proposed as alternatives to commercial mineral fertilizers. Traditional organic materials such as crop residues and animal manure, however, cannot by themselves help to reduce soil fertility decline. This is because they are usually not available in enough quantities on most farms, they do not contain enough plant nutrients, and they require a lot of labour to prepare and apply. Furthermore, some organic materials are used for other purposes such as fodder for livestock.

Unused, nontraditional organic sources grow on or near crop fields. Some have comparatively high nutrient concentrations, but very little is known about their potential as a nutrient source to improve soil fertility and crop yields. An example of such organic source is the green biomass of Tithonia. Biomass is the total weight of the wet or dried leaves, stems, twigs and flowers of tithonia expressed in kilo grammes or tons.
Tithonia, or Mexican (wild) sunflower, is a succulent and soft shrub, which belongs to the plant family called Esteraceae. It originated from Mexico and it is now widely distributed throughout the humid and subhumid tropics in Central and South America, Asia and Africa, and is common in indigenous fallow systems in Southeast Asia. It was probably introduced into Africa as an ornamental plant either by Explorers or Missionaries several centuries ago and it is now reported growing in Kenya, Malawi, Nigeria, Zimbabwe, Rwanda, Uganda, Cameroon and Zambia.

Tithonia 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 resemble those of the sunflower plant (Helianththus annus) but are smaller. The flower disc when fully grown is about 3 cm in diameter and it bears characteristic bright yellow petals 4-6 cm long. Each mature stem may bear several flowers at the top of the branches. Flowering and seed production takes place throughout the year. The seeds are very, light and can easily be dispersed by wind, water and animals.
WHERE IT IS FOUND IN KENYA

In Kenya Tithonia is found in Western and Central provinces as well as in coastal regions and parts of the Rift Valley where it grows wild in hedges along roadsides and on wasteland.

Some local names of tithonia are:
1) 'Maua malulu' (Luhya),
2) 'Maua makech' (Luo),
3) 'Amaua amaroro' (Kigusii) and
4) 'Maruru' (Kikuyu),
all of which imply that the plant tastes bitter.

TRADITIONAL USES OF TITHONIA

Among the various traditional uses of tithonia its medicinal value is one that people in western Kenya frequently report. An infusion made of the leaves and buds is used as a cure for constipation, stomach pains, indigestion, and sore throat and liver pains. It is also one of the popular shrubs used to establish live fencing around homesteads and to demarcate boundaries between plots and farms.

Occasionally tithonia is used for composting, and during the dry season when fodder is scarce, cattle and goats may browse on it. On sloping land tithonia hedges are planted along contours to act as soil erosion control structures. This makes tithonia biomass to be available near crop land therefore less labour is required to transport it. Field observations have indicated that farmers are using tithonia biomass by placing it into the planting holes for banana suckers. This could be a good practice as the biomass contains potassium, which is so important for good growth of bananas. Tithonia may also be used for fuel during time of scarcity although the quality of the fuel wood is poor.
HOW TO GROW TITHONIA

One way of growing new tithonia plants is by using seeds, which can be directly sown into the soil. However, the seeds do not germinate well when planted deep, but on the other hand are easily washed away if they are sown shallowly. The best method to achieve good germination 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 also to retain soil moisture required for germination.

Make a shallow furrow  
Plant the seeds  
Tithonia Seeds  
Cover with sandy soil  
Apply a mulch

Fig. 3. Sowing seeds of tithonia in seedbed
CONSTRAINTS TO THE USE OF TITONIA

Availability
The production of tithonia biomass even in small landholdings with internal and external boundaries for tithonia hedges will not be sufficient to meet the nutrient requirements for crop production on all the remaining area of the landholding. The production of tithonia biomass, however, can be adequate to meet the nutrient requirements for crop production in comparatively small plots within the landholding. Tithonia biomass can, therefore, be particularly well suited for high-valued crops that generate income, which can then be used to buy fertilizers for use in growing other food crops.

Little awareness by farmers
There is still little awareness by farmers that tithonia biomass can directly be applied to soil rather than composting first. Also, some farmers waste tithonia by cutting it and either throwing it away or leaving it where it was cut.

Labour
Considerable labour is required for cutting, transporting and preparing the biomass, especially if the tithonia is far from the crop field. Even though tithonia biomass is relatively easy to handle owing to the absence of thorns, the handling may be unpleasant to some people because it is sticky and produces a pungent smell.

Export of nutrients
The continual transfer of tithonia biomass from hedges results into nutrient export, and this will eventually lead to drastic reduction of tithonia biomass unless there are other ways of maintaining the soil fertility under the hedges. The application of fertilizer to tithonia hedges could ensure sustained production of biomass, but this is unlikely to be practised by resource-poor farmers.

Potential to become a weed
Tithonia produces very many seeds which are easily blown away by wind. This means that other nearby crop fields can easily be colonized and thereby increase labour for weeding. To ensure that this does not happen, it is advisable to harvest and use the biomass before the plants flower and produce mature seeds.
ECONOMIC BENEFITS

Research results from field studies have demonstrated that the use of tithonia green manure is economically more attractive with high-valued crops such as tomatoes, kales (*Brassica oleracea cv acephala*), and French beans that low-valued crops such as maize and other cereals. This can be explained by the fact that the use of tithonia biomass on high-valued crops readily offsets the increased labour costs of collecting, transporting and applying it due to the higher price they fetch on the local market.

Plots, which have received tithonia green manure when growing vegetables, have soils with a substantial increase in fertility, which can last several seasons. It is therefore recommended to grow maize and other cereal crops in rotation with vegetables, which can then benefit from the residual soil fertility.

OTHER BENEFITS OF TITHONIA GREEN MANURE

When tithonia green manure is applied and incorporated into the soil, the population of the saprophytic nematodes (microscopic worms) is increased and this helps to decompose the biomass so that the nutrients are released into the soil. Also, the increased soil fertility as a result of applying tithonia green manure leads to better growth and yield of cereal crops even if the soil is heavily infested with striga weed. Field observations also suggest that application of tithonia to beans can reduce yield loss due to bean root rot, a fungal disease of beans commonly found in western Kenya. Farmers have also reported less incidence of termite damage to crops growing in plots where tithonia biomass was applied.
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As most soils in western Kenya are deficient in phosphorus, it is advisable to apply tithonia green manure or its compost together with phosphatic fertilizers such as triple super phosphate (TSP), diammonium phosphate (DAP) and Minjingu phosphate rock during planting.
AGRICULTURAL VALUE OF TITHONIA

Compared to other non-leguminous shrubs, tithonia is uniquely rich in plant nutrients especially in the leaves and green wood, which decompose readily, and they can therefore be used as green manure or in making compost. The dried leaves and green wood contain on average 3.5% nitrogen, 0.37% phosphorus and 4.1% potassium. It is also rich in calcium (1.8%) and magnesium (0.4%). The average moisture content of tithonia leaves is 84%. The nutrient concentration in a given quantity of tithonia may be slightly higher or lower than what is indicated above depending on other factors such as age of the plant, plant part used and its position within the canopy, fertility of the soil and the geographical locality where the plant grows. The concentration of the nutrients is highest in younger parts and before the plant forms flowers.

USING TITHONIA GREEN MANURE AS FERTILIZER

When leaves and twigs of tithonia are placed in the planting hole, put in the compost pit, or, broadcast on the soil surface, they decompose rapidly and the nutrients become readily available to crops. To apply the green manure, cut the leaves and small twigs from the hedges, chop them into small pieces and place them into the planting holes or spread them evenly over the surface and then mix them into the soil and let them decompose for at least one week before planting crops. You can continue applying the green manure throughout the active growing period of the crops. This practice gradually increases soil fertility over time. An example of good yield response was observed in West Bunyore location on 46 farms where the yield of green pods of French beans was increased 3-fold when tithonia biomass was applied as compared to the pod yield where no biomass was applied. Similarly in Central Bunyore location, the bean green pod yield from tithonia-treated plots was 746 kg per hectare per season as compared to 285 kg where no tithonia green manure was applied as shown in fig. 5.
Another way of establishing tithonia is to use cuttings from suitable mother plants. For successful establishment, make cuttings 20-30 cm long from mature stems and push them into the soil the right way up, i.e. they should be planted the way they were growing on the mother plant.

The end of the stick to be pushed into the soil should not be split and it should have an angled clean cut to facilitate easy penetration into the soil and rooting.

To avoid cuttings peeling back as they are pushed into the ground, one may use a pointed dry stick of equal thickness to prepare the hole.

Plant the cuttings with 1 or 2 nodes below the ground level and 2 or more nodes above. Push the sticks into the ground at an angle of 45-60 degrees. Using bare-root seedlings from the nursery or as wildlings is yet another way of establishing tithonia. Out of the three methods of growing tithonia mentioned here, the use of cutting is probably the easiest and cheapest. Note that it may be necessary to water planted cuttings and seedlings during dry periods.

Fig. 4. Planting tithonia from stem cuttings
RECOMMENDATIONS

- Plant tithonia as near as possible to places where crops will be planted in order to reduce labour for carrying the biomass.
- Suitable places to grow tithonia on the farm include external and internal boundaries and along soil erosion control structures.
- Use tithonia green manure on high-valued crops because it is more economical.
- Use tithonia green manure in combination with phosphatic fertilizers in order to ensure adequate supplies of phosphorous to crops.
- A better option to reduce the labour and the required quantities of tithonia biomass is by spot application in the planting holes.
- Occasionally make compost manure and use part of it to apply to tithonia hedges in order to maintain soil fertility and sustain production of biomass.

For more information on the use of tithonia, please contact the Agro Forestry Research Centre at Maseno using the information given below:

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Or read further from the following current sources:

- Miti Ni Maendeleo Newsletter No.8 p. 10-11.

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