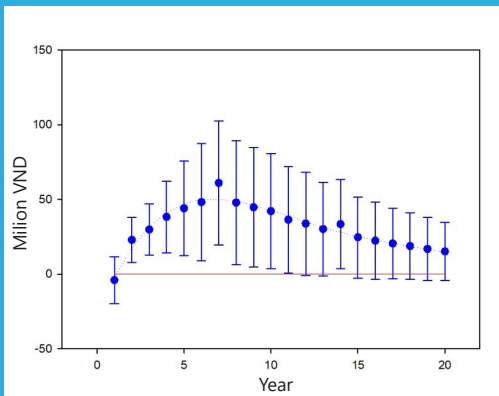
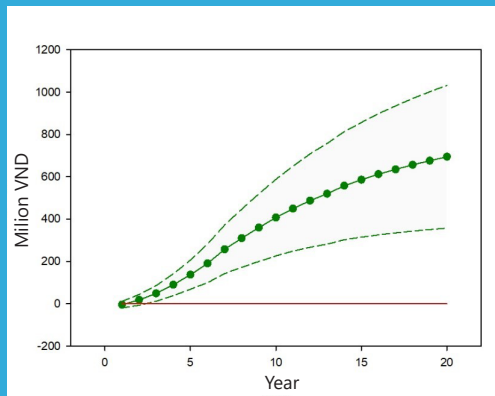


ECONOMIC EFFICIENCY

Total investment cost of the agroforestry option is 24 million VND per ha (containing materials and labor cost) and the agroforestry option could pay back of the loan/credit to farmers in the second to third year. The first 5-years of data have been used for simulations up to 20 years based on different scenarios. The results have showed that profits of the agroforestry option increase progressively and peaks in the 7th year (when harvesting acacia). From the 4th to 14th year, the agroforestry option could get profits of more than 30 million per ha per year then there is a decline to 15 million in the 20th year. Average profit from the 4th to 20th year is about 34 million per ha per year.



A profit simulation of the agroforestry option over 20 years



A cumulative profit simulation of the agroforestry option over 20 years

REFERENCE

- Mango propagation by grafting technique (Kỹ thuật nhân giống xoài bằng phương pháp ghép cành). AFLi project 2016
- Ngo, H.B., 2015. Mango in Vietnam. Agriculture Publishing House. Trang 139-140; 149-155

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PESTS AND DISEASES PREVENTION (2)

- Powdery mildew (*Oidium mangiferae* Berthet): Attack flowers and green fruit, then gradually fall down. Use pesticide with active ingredients *Benomyl* according to using instructions (for example, Benotigi 5WP). Spray when flowering or periodically once per 10-15 days when disease occurs.
- Fruit rot: Occurs heavily moisture and rainy condition. Prevention by appropriate harvesting methods to avoid crushing and rubbing; Control by 55°C warm water diluting lime.

2. MAIZE

- Black cutworm in soil (*Agrotis ipsilon*): Using pesticide with *Diazinon* active ingredients according to using instructions (for example, Vibasu 10GR containing *Diazinon* 10% w / w. Package of 1 kg for an area of 1000-1200 m², spread on soil before sowing).
- Corn borers, corn earworm (*Ostrinia nubilalis*): Using pesticide with *Dimethoate* (or *Fenobucard*) active ingredients according to using instructions (for example, Vibam 5gr contains *Dimethoate* 3% + *Fenobucarb* 2%. Using 1.5-2 kg for 1000 m², sprinkle 4 to 5 seeds into cornfield when see butterfly of the stem borers).
- Sheath blight (*Rhizoctonia solani*): Remove leaves when disease occurs.

HARVESTING

1. FORAGE GRASS

Forage grass provides income early in the agroforestry option, usually after three months of planting. Grass yield reach a peak in the second year, up to 15 ton/ha/year and reduce gently from the fifth year. In Northwest, it could be collected once in 30 days in the rainy season and 45 days in the dry season. Harvesting frequency depends on the number of cattle of each household, however, avoid late harvest to minimize nutrition losing in stem and leaves when the grass has flowered. Replanting grass after five year harvesting to maintain the agroforestry option efficiency, however, need to adjust planting distance due to mango canopy has expanded.

2. MANGO

Grafted mango usually bears fruit from the second or third year, yet, in accordance with tree growth, possible to cut flowers off and just keep fruits from the 4th year onwards. Mango harvesting time in Northwest is from mid of May to begin of July.

3. ACACIA

After about seven years, acacia wood is ready for exploitation, then replace by seedlings or alternate by other tree species that have higher value.

4. MAIZE

In Yen Bai province, maize is cultivated in two seasons, from February to March and July to August (rainy season). It is one maize season in Son La and Dien Bien province, from April to May when rain is coming.

PESTS AND DISEASES PREVENTION (1)

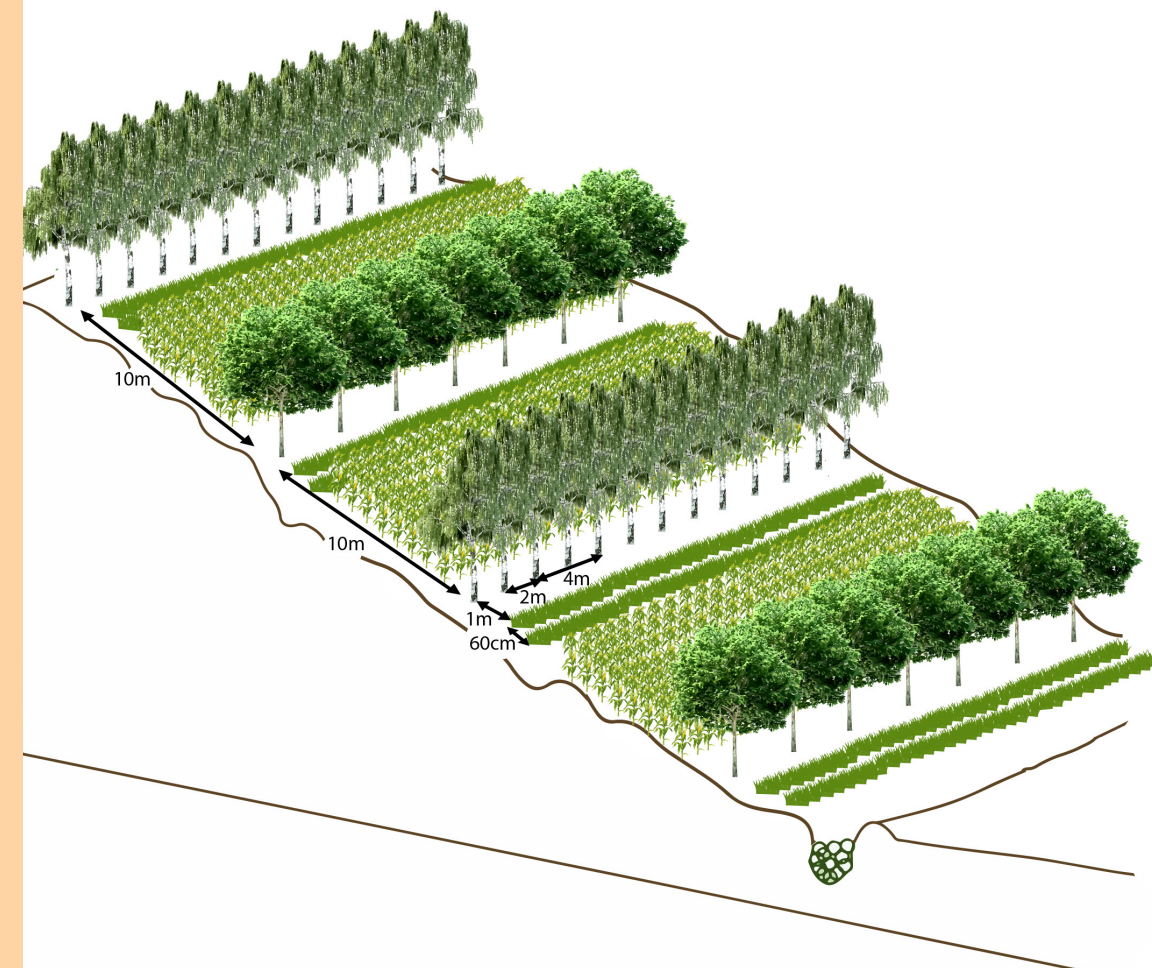
1. MANGO

As some research findings, mango is affected heavily by pests and diseases in the North from December to April. Hence, need to do pruning frequently and apply fertilizer adequately. Some common pests and diseases of mango tree are:

- Mango leafhoppers (*Idioscopus clypealis*): Occur from October to June, attack tree buds, young leaves and flower stalks result to stunned plants and slow growth. Prevention by using trap lamp; spray pesticide when flowering. Using pesticides with active ingredients *Carbosulfan*, *Etofenprox* or *Fenoburcarb* according to using instructions (for example, Marshal 0.2%, Trebon 10EC, Bassa 50EC; Spray 2-3 times, each time 5-7 days).
- Mango fruit flies (*Ceratitis cosyra*): Prevention by harvesting at the right time, using trap or wrap mango fruit by specialized bags.
- Stem borers (belong to *Cerambycidae* family) often lay eggs in wounds on main stem and big branches, the larvae attack inside trunk's bark and soft wood, then deeper. Prevention by applying dense lime water mixture on tree base, using light to trap mature beetle, if detect a hole on stem, inject limewater, or pesticide with strong active ingredient *Methyl parathion* or *Diazinon* according to instructions for use, then cover the hole by clay. Branch borers lay eggs on the tops of young branches that will be wilted and died by. Heavy damage occurs in rainy season (May-September). Mature worms need to be detected early, and destruct damaged branches. Possible to use pesticide containing *Fipronil* according to using instructions (for example Regen 0.3RG), spraying when detect any harmful phenomenon.
- Mango anthracnose (*Glomerella cingulate*): The most devastating effects occurs from November to April. Attaches young leaves, young shoots, inflorescences and fruits. Causes heavy damage when the weather is murky with high humidity, temperature ranges from 25-30°C. Controlling by fungicide containing active ingredient *Copper oxychloride* or *Copper hydroxide* according to using instructions (for example Champion 37.5 SC, Viben C 50 WP, spray on entire tree, once per 1.5 months, stop spraying when flowering and pre-harvest 20 days); Do proper pruning and fruit pruning; Possible to use Ridomil Gold 68WG (containing *Mancozeb* 640 g/kg + *Metalaxyl-M* 40 g/kg), spray after flowering.
- Black sooty mold (*Meliola mangiferae*, *Capnodium mangiferae*, *C. ramosum*, *Trichospermumacerinium*, *Microxyphium columnatum*...): Caused by fungi, the leaves become black and reduce photosynthesis of leaves. Using fungicide contains active ingredient *Etofenprox* according to using instructions (for example Trebon 0.2%).



Mango for fruits in Acacia - Mango - Maize - Forage grass option at Yen Bai province



OPTION: ACACIA - MANGO - MAIZE - FORAGE GRASS

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INTRODUCTION

Mango (*Mangifera indica* L.) belongs to the cashew family. Mango trees prefer an average temperature about 24-26°C, with minimum annual rainfall is 1000 - 1200 mm. They flourish in intense light conditions. Mango tree are adapted to various soil types including sandy soil or gravel soil, with pH ranging from 5.5 to 6.5. In Viet Nam, there are about 100 mango varieties distributed along country, some popular mango name as Hoa Loc, Thanh Ca, Canh Nong, Yen Chau, Tuong, GL1, GL2, GL6 that are suitable for natural condition in the North recognized by the Fruits and Vegetables Research Institute (FAVRI) and Ministry of Agriculture and Rural Development (MARD). In some provinces, currently, farmers are tending to plant a mango cultivar imported from Australia as R2E2, due to big fruit and high weigh (1.5 kg per fruit), attractive colors and small seeds.

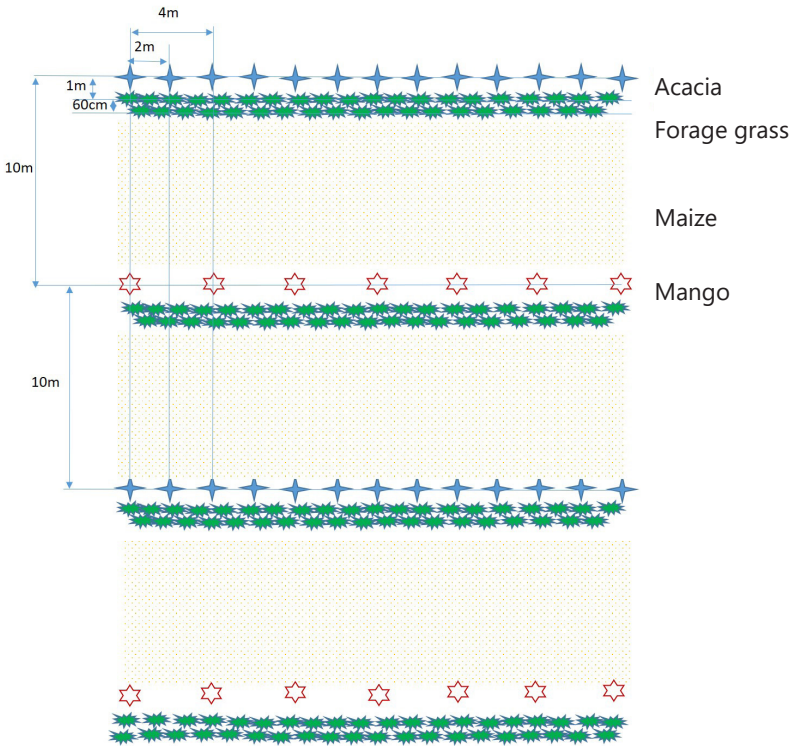
Acacia mangium and *Acacia auriculiformis* are imported into Vietnam, along with other hybrid Acacia that is later widely used for purpose of afforestation to improve ecological environment, produce wood and materials for the pulp and wood chip processing industry. This tree adapts widely and grows well on medium thickness soil which has good drainage, near-neutral pH, slightly acidic. Due to growing fast characteristic and nitrogen fixing ability, the acacia can be introduced into new establishment period to generate shadow, contribute to land improvement and support other crops in agroforestry option.

DESIGN

Contour planting is designed in the agroforestry option to minimize soil erosion. A mango row alternates with a acacia row in a distance of 10 m. Distance between mango tree is 4 m and acacia tree is 2 m. Hence, about 125 mango trees and 300 acacia trees could be planted in one ha.

Two rows of forage grass (mulato or guinea) are planted closely and 1 m apart to each mango/ acacia row. Spacing between a double grass rows is 60 cm. In a row, grass cuttings are planted 40 cm apart (about 1.5-2 tons of grass per ha). Grass could be grown by seed, however, to reach a high performance, it should be sown as rice then plant on field as designed above.

Maize is sown on the remaining areas. The required amount of maize seed equals to 65-70 percent of mono-maize cultivation (12 kg seed/ha/season). Maize rows need to be kept at least 1 m away from mango rows to avoid affecting mango trees when they are in newly established periods.



Distance and layout of trees and crops in Acacia - Mango - Maize - Forage grass option

PLANTING TECHNIQUES AND FERTILIZING (1)

1. MANGO

Planting hole: The size of a hole is 60 cm x 60 cm x 60 cm or 80 cm x 80 cm x 80 cm.

Basal fertilizer application: Apply 10-15 kg manure, 1 kg Superphosphate or NPK in the ration of 5:10:3 (or equivalent), 0.5-1 kg lime powder per hole before planting a month and cover the hole by soil.

Top dressing fertilizer application:

- From the first to the third year: apply 0.6 kg NPK in the ration of 13:5:10 (or equivalent); 0.4 kg Urea per tree.
- From the fourth year onwards: Considering each tree condition and its yield, it is possible to apply about 0.7-1.7 kg Urea, 1.6-4 kg Superphosphate, 0.3-0.8 kg Potassium chloride, 20-30 kg manure per tree.
- How to apply: (the 1st) apply all manure amount and half of fertilizers in September-October before flowering; (the 2nd) apply the remaining amount of fertilizers in beginning of rainy season in March-April. Or apply 2-5 kg NPK in the ration of 16:16:8 (or equivalent) per tree divided twice as above.

2. ACACIA

Planting hole: The size of a hole is 40 cm x 40 cm x 40 cm.

Basal fertilizer application: Apply 0.6 kg NPK per hole.

Top dressing fertilizer application: Annually 0.2 kg NKP per tree.



Mango for fruits in Acacia - Mango - Maize - Forage grass option

PLANTING TECHNIQUES AND FERTILIZING (1)

3. FORAGE GRASS

- Dig a grassy trench 20-25 cm deep on the contour lines, which is below acacia and mango rows. The forage grass grow very fast, it therefore will be prevented the nutrients and fertilizers run following along the slope.
- The forage grass can utilize nutrients and fertilizers from runoff; it is unnecessary to apply fertilizer for grass.

4. MAIZE

- Basal fertilizer application: Maize is sown in the remaining areas: 6-10 tons manure and 300 kg Superphosphate per ha.
- Top dressing fertilizer application: total of 180-240 kg Urea, 300 kg Superphosphate and 75-100 kg Potassium chloride (per ha) are divided into two to three times:
 - The 1st time: When maize has 3-4 leaves, apply one third of Urea amount and half of Potassium;
 - The 2nd time: When maize has 9-10 leaves, apply one third of Urea amount and half of Potassium;
 - The 3rd time: Before flowering 5-7 days, apply the remaining amount of Urea fertilizer. Fertilizing is done after weeding, grubbing soil; then hill up plant. Usually, there are two times of weeding.

PRUNING AND CANOPY FORMATION

1. MANGO

Pruning and canopy forming when tree is young is to build a strong frame and produce a desirable shape and height.

- Prune off the top of the tree at 60-70 cm from the graft union to promote branching.
- When those branches develop well, keep 3-4 strong branches grow equally in all directions, called primary branches.
- Again, cut the top of those primary branches when they reach about 60 cm to boost secondary branches. Keep two to three those branches turning to distinct directions.
- Similarly, repeat with secondary branches to create the third level branches. Yet, those are not limited in number and length, only thin away the dense interior branches.
- Remove any suckers at ground level and any shoots on the trunk below the graft union.

Continue pruning annually after harvesting (in October-November) and before flowering (from February to March). Remove dead, damaged, broken and diseased/ weak twigs, crossing branches, twigs growing downward, stubs, waters-sprouts and suckers, or thinning if necessary.

2. ACACIA

- From the third year onwards, pruning branches at ground level under one second height of tree, remove broken and diseased branches.



Acacia - Mango - Maize - Forage grass option in Van Chan district, Yen Bai province