Oil Palm Nutrition
Yara Crop Nutrition

Crop Knowledge

Yara is a major provider of specialist crop nutrition advice and fertilizers to farmers throughout the world.

As part of its commitment to agriculture, Yara gathers scientific information on many crops growing around the world. Together with the practical experience of Yara's agronomists it gives Yara a comprehensive understanding of the nutritional needs of these crops.

In Malaysia, oil palm growers face problems specific to their local growing conditions. However, these crops grown with a Yara fertilizer program have shown better performance under all conditions.

Portfolio Combinations

Yara's fertilizers are known globally for consistency and quality.

The YaraMila™ range of NPK fertilizers are compounds which have balanced formulations for different growth stages and different crops. Each prill contains all the nutrients in the formulation, ensuring even distribution and better plant access of the nutrients. They are readily soluble and so fully available to the developing plant.

The YaraLiva™ range provides soluble nitrate nitrogen, calcium, and boron all which are contributing to improved development of nursery plants compared to applying just N, P & K.

The YaraVita™ range is a complete line of foliar and soil applied products, including chelated nutrients, designed to deliver specific nutrients (macro and trace elements) exactly when and where the crop needs it. Produced with high quality standards, YaraVita™ products are easy, safe and convenient to use.

Application competence

Crop nutrition is more than just buying a bag of fertilizer and applying it to your crop.

It is about understanding:
- Which nutrients does the crop need?
- When does the crop need these nutrients?
- How much nutrient does the crop need at each growth stage?
- Where should the nutrient be applied to achieve the best efficiency and effectiveness.

Yara provides fertilizer programmes proven under Malaysian production conditions.
Oil Palm Nutrition

Oil Palm responds strongly to nutrient applications. However, it is essential for quality oil production and yield that the nutrients applications are balanced and correctly timed.

The use of frond analysis (Table 1) is to determine the nutrient levels and it is the basis for checking whether the fertilizer program in use, is meeting the needs of the oil palm.

Table 1
Determines the nutrient level in the palm and optimum nutrient levels for Frond #17 in palms older than 6 years

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Optimum Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (%)</td>
<td>2.40-2.80</td>
</tr>
<tr>
<td>P (%)</td>
<td>0.15-0.18</td>
</tr>
<tr>
<td>K (%)</td>
<td>0.90-1.20</td>
</tr>
<tr>
<td>Mg (%)</td>
<td>0.25-0.40</td>
</tr>
<tr>
<td>Ca (%)</td>
<td>0.50-0.70</td>
</tr>
<tr>
<td>S (%)</td>
<td>0.25-0.35</td>
</tr>
<tr>
<td>Cl (%)</td>
<td>0.50-0.70</td>
</tr>
<tr>
<td>B (mg/kg)</td>
<td>15-25</td>
</tr>
<tr>
<td>Cu (mg/kg)</td>
<td>5-8</td>
</tr>
<tr>
<td>Mo (mg/kg)</td>
<td>0.25-0.4</td>
</tr>
<tr>
<td>Mn (mg/kg)</td>
<td>150-200</td>
</tr>
<tr>
<td>Zn (mg/kg)</td>
<td>15-20</td>
</tr>
</tbody>
</table>

Most fertilizer programs are developed to meet the nutrient uptake needs of the plant. But in designing the fertilizer program it is necessary to also consider the efficiency of nutrient in getting to the plant roots (Table 2).

Table 2
Uptake and distribution of nutrients among different palm components (148 palms/ha, 25t FFB/ha)

<table>
<thead>
<tr>
<th>Component</th>
<th>N (%)</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>MgO</th>
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<tbody>
<tr>
<td>Vegetative DM</td>
<td>277</td>
<td>48</td>
<td>374</td>
<td>46</td>
</tr>
<tr>
<td>Pruned fronds</td>
<td>453</td>
<td>137</td>
<td>595</td>
<td>87</td>
</tr>
<tr>
<td>Fruit bunches (25T)</td>
<td>493</td>
<td>179</td>
<td>630</td>
<td>83</td>
</tr>
<tr>
<td>Male inflorescence</td>
<td>74</td>
<td>34</td>
<td>102</td>
<td>27</td>
</tr>
<tr>
<td>Total Uptake</td>
<td>1297</td>
<td>401</td>
<td>1701</td>
<td>243</td>
</tr>
<tr>
<td>Removal</td>
<td>730</td>
<td>229</td>
<td>1034</td>
<td>129</td>
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</table>

YaraMila™ Palmae™ is an NPK compound fertilizer with the right nutrient balance to meet the needs of most oil palm growing situations.

In the nursery, the addition of calcium and boron to the fertilizer programme, using YaraLiva™ Nitrabor™ has shown major advantages in the development of oil palm seedlings. In particular, root development is advanced, leading to a more rapid turn over of palms from the nursery.

In peat soils, where some of the trace elements like copper and zinc can have limited availability, the YaraVita™ chelate range of products provide a suitable and more efficient solution.

Also the soil pH will affect the availability of nutrients to the plant (Fig. 1).

Figure 1
Soil pH affects Nutrient Availability

In the nursery, the addition of calcium and boron to the fertilizer programme, using YaraLiva™ Nitrabor™ has shown major advantages in the development of oil palm seedlings. In particular, root development is advanced, leading to a more rapid turn over of palms from the nursery.
Nutrient Requirements

Nitrogen

Nitrogen promotes growth. In oil palm this means more and bigger fronds. This larger leaf area, leads to more fruit bunches of increased weight and ultimately more oil yield (Fig. 2).

**Figure 2**
**Nitrogen increases FFB yield**

![Graph showing FFB yield increase with nitrogen application](image)

However, too much nitrogen can be detrimental to yield as it promotes excessive frond canopy growth which increases the competition for light between palms and ultimately lowers yield. Also high nitrogen will encourage the development of frond diseases and make the plant more susceptible to insect attacks. If the palm does not use the nitrogen applied, it can then be lost by leaching and therefore wasted.

**Balanced Nitrogen**

There are many different forms of nitrogen. In YaraMila™, the nitrogen is balanced with both nitrate-N and ammonium-N.

This combination has many benefits.

Nitrate-N is immediately available to the palm and is the preferred form of nitrogen which is taken into the plant.

Nitrate-N will improve the uptake into the palm of the essential cations; potassium, calcium and magnesium (Fig. 3).

**Figure 3**
**Nitrate nitrogen improves the uptake of cations**

![Diagram showing improvement of cation uptake with nitrate nitrogen](image)

Ammonium-N is converted in the soil to nitrate-N and so is slightly slower in its availability to the palm.

Palm seedlings grow better when a combination of ammonium and nitrate are applied. (Fig. 4 & 5). In strongly acid soils this conversion process is slowed down as microbial activity is limited. This means that on soils where the pH is lower than 5, urea and sulfate of ammonia applications will be very slow converting to nitrate nitrogen.

**Figure 4**
**Seedlings grow better with ammonium nitrate based NPK's compared to urea based NPK compounds**

![Graph showing growth improvement with ammonium nitrate NPK](image)
Figure 5

The root mass of oil palm seedlings grown with Urea based NPK compound on left and AN based NPK compound on right.

Nitrogen and soil acidity

Soil acidity is a measure of the hydrogen ions (H⁺) in the soil. The more H⁺ ions the greater the soil acidity i.e. the lower the soil pH.

Ammonium fertilizers are naturally converted to nitrate N in the soil. When this process occurs H⁺ ions are deposited into the soil, increasing the soil acidity.

The nitrogen fertilizer with the greatest effect on soil acidity is ammonium sulfate. It will acidify the soil at 3 times the rate of urea. Urea is the next most acidifying nitrogen fertilizer followed by CAN (Calcium ammonium nitrate).

The YaraMiia™ nitrogen combination has little effect on soil acidity. This is a major advantage over ammonium sulfate which lowers the soil pH, making it more acid.

The more acid the soil becomes, the less available nutrients become to the palm (Fig. 1). Also in highly acid soils, aluminium becomes more available. Aluminium is toxic to roots and therefore reduces the production potential of the oil palm.

In tropical conditions, the loss of nitrogen through ammonia volatilization can be quite significant. Losses of over 50% of the nitrogen applied have been measured. Urea, urea blends, urea based compounds, and sulfate of ammonia based compounds can all lose significant amounts of nitrogen through volatilization (Fig. 6). This applies particularly to fertilizer placed on fronds or any unweeded areas.

Figure 6

When urea converts to nitrate-N there is a risk of volatilization

Ammonia from sulfate of ammonia based compounds or blends is more likely to volatilize if it is formulated with Di-ammonium phosphate (DAP). This is because when the DAP dissolves in the soil, it causes the soil to become more alkaline which encourages the conversion of ammonium to ammonia gas. Also the high levels of sulfur added when using ammonium sulfate may cause the leaching of magnesium. (See Mg section below).

However, losses of nitrogen through volatilization from YaraMiia™ products are negligible. (Fig. 7)

Figure 7

Volatilization of ammonia from fertilizers placed on soil

The yellow tubes are sensitive to ammonia. Fertilizer is placed on soil in the container and sealed with the ammonia sensitive tube in the top. As ammonia is released from the fertilizer it causes the yellow to change to blue. Once the blue reaches the top of the tube, approximately 15% of the nitrogen in the fertilizer has been lost as ammonia.

The photo shows the ammonia losses 3 days after applying the fertilizers. Note: there is no ammonia loss from YaraMiia™ Palmae™.
Phosphorus

Phosphorus is essential for root development, new shoot growth, flower development and for providing the energy within the plant for processes such as nutrient uptake and transport to occur.

Phosphorus has a direct effect on yield.

In oil palm, phosphorus has been shown to increase frond weight and production, bunch number, bunch weight and hence bunch yield.

It is important to keep a constant supply of phosphorus available to the palm to achieve these yield increases (Fig. 8).

Figure 8
Phosphorus improves yield in oil palm

![Graph showing FFB yield (t/ha/year) over years after planting with different phosphorus applications.]

The phosphorus in the YaraMila™ range is fully available to the palm. The combination of water soluble and neutral ammonium citrate soluble phosphorus means the palm has phosphorus available for immediate uptake, as well as for some sustained uptake.

Additionally part of the water soluble phosphorus in YaraMila™ Palmae™ is in the form of polyphosphates. This means that the phosphorus remains available to the palm for a longer period of time and will penetrate deeper into the soil.

Potassium

One of the major roles of potassium in the palm is regulation of water within the plant. Adequate potassium is therefore important to help the plant survive dry conditions.

Potassium is also important for bunch size and yield. (Fig 9).

![Graph showing FFB yield (t/ha/year) over years after planting with different potassium applications.]

Potassium is one of the nutrients involved in strengthening the plant cells, and therefore adequate levels of potassium in the palm will improve its tolerance to diseases and insect pests.

YaraMila™ Palmae™ provides potassium in the form of potassium chloride. Some chloride in palm nutrition is useful in the plant, It promotes yield. It is involved with the regulation of the stomata and this results in improved vegetative growth. Chloride will improve the uptake of Mg, especially on volcanic soils with high Ca content.
Magnesium

Oil palm responds strongly to magnesium, however the palm is not efficient in taking up magnesium, therefore deficiencies are commonly seen.

Magnesium promotes leaf development and improves bunch number, bunch weight and yield. (Fig 10).

Figure 10
Magnesium increases FFB yield

![Graph showing FFB yield increase with magnesium application](image)

Most importantly magnesium increases the oil content of the fruit.

Care needs to be taken with potassium applications as high levels of potassium in the palm can reduce the oil content of the bunch if no magnesium is applied. (Fig 11). YaraMila™ Palmae™ balances potassium and magnesium in the one fertilizer.

Figure 11
Potassium and Magnesium must be balanced to achieve high oil yields

![Graph showing oil content increase with balanced potassium and magnesium](image)

The leaching of magnesium can be accelerated by excessive amounts of sulfur coming from ammonium sulfate. The sulfur is excessive as the palm does not take it all up into the plant. Experiments have shown that the Mg losses are 3 times higher when comparing ammonium sulfate to YaraMila™ (Fig 12).

Figure 12
More magnesium is lost to leaching when ammonium sulfate is used

![Graph showing higher magnesium leaching with ammonium sulfate](image)
Boron

Boron is important in palm growth for root development, pollen viability and therefore fruit set, and for giving strength and elasticity to cell walls within the plant.

Along with potassium and calcium, boron is necessary for improving the plant's tolerance to pests and diseases.

However, care must be taken as high potassium applications may decrease the amount of boron in the palm (Fig. 13). YaraMila™ Palmae™, has the right proportion of potassium and boron to avoid this problem and provide a highly efficient way of spreading boron evenly and frequently to the whole root system. It is important to have frequent applications of boron because it is very mobile in the soil and therefore easily leached when applied only once per year.

Copper

Copper is rapidly adsorbed in peat soils, making it unavailable to the palm. In sandy soils, copper can often be deficient.

In peat soils, high rates of copper sulfate are often used to try and overcome deficiency. The most effective form of copper to apply is a copper chelate, as it is less affected by adsorption to the soil and stays readily available in the soil for the palm to take up.

Field trials have shown that the use of EDTA chelates like YaraVita™ Rexolin™ B Cu15 are highly effective in getting copper to the oil palm on these acidic peat soils. Applications at 10% of the traditional rate of copper sulfate have given good results (Fig. 14).

This has been confirmed in glasshouse trials applying copper to different Malaysian peat soils and comparing the amount of copper remaining in the soil solution and hence available to the palm (Fig 15). The results shown are the average response from 4 tropical peat soils.

Figure 15
Chelated copper is more available in peat soil than copper sulfate

Figure 13
High potassium may depress the boron levels in the palm

![Graph showing leaf B content (ppm) for different K supplies and boron levels]

![Graph showing relative yield increase (%) for control, sulphates, and chelates]

REF: RAMATANAM, 1972

REF: AKO NOBEL 2005
Zinc

Zinc reacts similarly to copper in peat soils, but not to the same extent. It can also be deficient on sandy soils.

Glasshouse trials have again confirmed that chelates such as YaraVita™ Rexolin® Zn15 are more effective than using a zinc sulfate (Fig. 16). The results shown are the average response from 4 tropical peat soils.

Figure 16
Zinc chelates remain in the soil solution better than zinc sulfate

Balanced Nutrition

All nutrients have an impact on oil palm growth and production, however it is important to ensure these nutrient applications are balanced. As can be seen above high levels of potassium can influence the uptake of magnesium (page 7) and boron (page 8).

There are advantages in having all nutrients applied at the same time to ensure even growth and production of the palm. This applies with nitrogen and potassium (Fig. 17) and phosphorus and potassium (Fig. 18).

Figure 17
Balanced nitrogen and potassium applications achieve the greatest yields

Figure 18
Balanced phosphorus & potassium applications achieve the greatest yields

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Oil Palm Nutrient Deficiency Symptoms

Nitrogen
Small, pale green or yellow palms. Occurs in poorly drained or waterlogged soils.

Phosphorus
Palms have a stunted appearance, small bunch size with a pyramid shaped trunk.

Potassium
Bright orange spots or flecks on the older fronds, common on peat soils.
**Magnesium**
Also known as sun-scorch and orange frond, pinnae turn yellow and dessicate. Common on sandy soils with high rainfall.

**Boron**
Wrinkled or misshapen leaves with death of root tips. Symptoms described as hooked, crinkled or blind leaf.

**Copper**
Small fruit bunches and premature frond dessication which leads to palm death. Common on peat soils.

**Iron**
Colorosis of the youngest 3-4 fronds. Older fronds turn yellow and snap in mid-upper crown.

**Nitrogen-Potassium Imbalance**
Known as white stripe and occurs where the K:N ratio is wide.
A balanced fertilizer designed to meet the needs of the oil palm plant and to make the job of fertilizing more accurate, reliable and convenient.

Quality assured

Yara is a global fertilizer company with high standards of quality control. Our main production plants in Porsgrunn, Norway and Uusikaupunki, Finland are ISO certified. This means that the product will arrive in the field with the highest quality and all granules having the same analysis.

All nutrients in one granule

YaraMila™ Palmae™ contains the common nutrient requirements of oil palms (nitrogen, phosphorus, potassium, magnesium and boron) all in one granule. The proportion of each nutrient is matched to the oil palm's basic nutritional requirements.

All nutrients fully available

The nitrogen is a combination of nitrate-N and ammonium-N and fully available to the palm. This means the plant is given both rapid and a sustained delivery of nitrogen and this is more efficient than using straight urea or ammonium sulphate as the nitrogen source.

Nitrogen losses from YaraMila™ Palmae™ are minimal as there is low risk of volatilization and when following the rates suggested, the nitrogen application does not exceed the palm's demand for nitrogen.

Because the phosphorus is a combination of water soluble phosphorus and citrate soluble phosphorus the palm has easy access to this nutrient. Its availability is not dependent on acidity of the soil to make it plant available.

Additionally, part of the water soluble phosphorus in YaraMila™ Palmae™ is in the form of polyphosphate. This P form remains available for a longer period and penetrates deeper into the soil, enhancing the phosphorus availability to the palm.

The potassium, magnesium and boron in YaraMila™ Palmae™ are all water soluble and so fully available to the palm.

Superior handling

YaraMila™ Palmae™ has minimal dust and a particle size between 2 to 4 mm.

It spreads easily and evenly whether applied by machine or by hand. Because all nutrients are in each fertilizer particle there is an even spread of nutrients on the ground. This is a major advantage over using straight fertilizer products and it reduces the spreading costs.

With YaraMila™ Palmae™ it is easier to ensure that each palm receives the correct amount of nutrient, more frequently. And there is less rounds made using YaraMila™ Palmae™ than with conventional fertilizer applications.

All nutrients in the product are highly soluble and so when applied to moist soil, the nutrients are released for immediate uptake by the plants.

Overall, YaraMila™ Palmae™ improves nutrient use efficiency and reduces labour costs.
Low risk product

With its balanced combination of ammonium and nitrate nitrogen, YaraMila™ Palmae™ has little effect on soil pH, thus reducing the need for constant lime applications.

Also volatilization risks are very low, so there is no need to use higher rates to allow for losses which may occur.

Suitable for all soil types

YaraMila™ Palmae™ has the nutrient combination that is right for oil palm production. This means it is suited to all soil types. Should there be specific nutrient needs, for example additional copper on peat soil, Yara has a full range of products to meet these needs.

Benefits of YaraMila™ Palmae™

- Balanced formula which is right for oil palm
- All nutrients in each prill
- All nutrients fully plant available
- No risk of volatilization
- Dissolves fast, therefore lowering the risk of surface runoff losses
- Low risk of increasing soil acidity
- Easy to handle
- Spreads evenly
- Quality assured
- European origin
In peat soils, nutrients such as Copper and Zinc have limited availability as they are readily adsorbed by organic matter, making them unavailable for plant uptake.

Chelates as used in the YaraVita™ Rexolin® product range help to overcome this tie up in the soil, by selectively protecting the ion, ensuring that this reaction, leading to precipitation does not occur. This process is called chelation (Fig. 19).

**Figure 19**
The chelating agent wraps the metal ion protecting it from being adsorbed in peat soils

In effect this reaction changes the Cu or Zn ion into a form which largely prevents adsorption by organic matter. This allows Cu and Zn to move freely around in the soil until it comes into contact with the root hairs where it is immediately available for uptake.

Applying YaraVita™ Rexolin® during chemical weeding saves additional application costs and gives excellent soil coverage.

YaraVita™ Rexolin® Cu15 and YaraVita™ Rexolin® Zn15 are products developed for use in Cu and Zn deficient soils, including peat soils. Both products are formulated to allow maximum availability of Cu and Zn to the plant when applied to the soil. Both products can be applied during chemical weeding and are compatible with the common herbicides glyphosate, paraquat, and glufosinate ammonium.

**YaraVita™ Rexolin® Cu15**
YaraVita™ Rexolin® Cu15 is a product developed for use on copper deficient soils, including peat soils.

YaraVita™ Rexolin® Cu15 is water soluble, containing 148 grams of copper per kg of product as Cu-disodium-EDTA

**YaraVita™ Rexolin® Zn15**
YaraVita™ Rexolin® Zn15 is a product developed for use on zinc deficient soils, including peat soils.

YaraVita™ Rexolin® Zn15 is water soluble and non dusting zinc chelate, containing 148 grams of zinc per kg of product chelated by EDTA.

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Yara delivers solutions for sustainable agriculture and the environment. Our fertilizers and crop nutrition programs help produce the food required for the growing world population. Our industrial products and solutions reduce emissions, improve air quality and support safe and efficient operations. Founded in Norway in 1905, Yara has a worldwide presence with sales to 150 countries. Safety is always our top priority.
YaraVita™ Rexolin®

Formulated Copper and Zinc for Oil Palms grown on Peat Soils
Copper and Zinc are two nutrients which are required for healthy palm growth and production. Both these nutrients have limited availability in peat soils as they are readily adsorbed by clay or organic matter, making them unavailable for plant uptake. Copper applied using non-formulated products like copper sulphate is also intensively adsorbed to organic matter making it unavailable. To compensate for this, often excessive rates are applied so that some copper is available for plant uptake.

Chelates - as used in YaraVita™ Rexolin® product range help overcome this by selectively protecting the ion, ensuring that this reaction, leading to precipitation, does not occur. This process is called chelation. In effect, this reaction changes the Cu or Zn ion into a form which largely prevents adsorption by organic matter. This allows Cu and Zn to move freely around in the soil until it comes into contact with the root hairs where it is immediately available for uptake.

Chelating Mechanism

YaraVita™ Rexolin® Cu15 and YaraVita™ Rexolin® Zn15 are products developed for use in copper and zinc deficient soils, including peat soils.

YaraVita™ Rexolin® Cu15 is water soluble, containing 148 grams copper per kg of product as Cu-disodium-EDTA, whereas YaraVita™ Rexolin® Zn15 is water soluble and non-dusting zinc chelate containing 148 grams zinc per kg of product, chelated by EDTA.

Both products are formulated to allow maximum availability of Cu and Zn to the palm when applied to the soil. Both products can be applied during chemical weeding and are compatible with the common herbicides glyphosate, paraquat and glufosinate ammonium. Applying YaraVita Rexolin during chemical weeding saves additional application costs and gives excellent soil coverage.

Recovery of Copper after interaction with soil

Recovery of Zinc after interaction with soil

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Recommendation Rates

<table>
<thead>
<tr>
<th></th>
<th>Copper Sulfate</th>
<th>YaraVita™ Rexolin® Cu15</th>
<th>Zinc Sulfate</th>
<th>YaraVita™ Rexolin® Zn15</th>
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</thead>
<tbody>
<tr>
<td>Rate per year</td>
<td>200 g/palm/yr</td>
<td>40 g/palm/yr</td>
<td>200 g/palm/yr</td>
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<td>Rate per application</td>
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<td>Water rate</td>
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<tr>
<td>Application rate</td>
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<td>20 g/L per palm</td>
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<td>Rate for a standard 16L knapsack sprayer</td>
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<td>320 g/knapsack for 16 palms</td>
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<tr>
<td>Rate per hectare*</td>
<td>27.2 kg/ha/yr</td>
<td>5.44 kg/ha/yr</td>
<td>27.2 kg/ha/yr</td>
<td>5.44 kg/ha/yr</td>
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*Note: Standard planting density of 130 palms/ha is used. Total palms per hectare varies due to plantation management.

Mixing Procedure
- Add water to backpack sprayer
- Add herbicide
- Add YaraVita™ Rexolin® Cu15 and YaraVita™ Rexolin® Zn15

Precautions
- Store in original container, keep tightly closed and store in cool dry place
- Store away from children, pets, livestock and foodstuff
- Wash hands after application and before meals
- WARNING: Harmful if swallowed. Do not breathe dust. Wear suitable protective clothing.
- No health hazards are involved in normal handling of YaraVita™ Rexolin® product range but it is advisable to follow the above precautions.

Tank Mixtures/ Compatibility
Apply with application of herbicide to the weeded circle. Both YaraVita™ Rexolin® Cu15 and YaraVita™ Rexolin® Zn15 can be tank mixed with the commonly used compatible herbicides:

Compatible Herbicides
- Glyphosate
- Paraquat
- Glufosinate ammonium
- Metsulfuron methyl
- Fluroxypyr
- Triclopyr
- 2,4 D amine

For herbicides which are not listed in table, kindly consult local Yara agronomist to check the mixability of the products with YaraVita™ Rexolin® Cu15 and YaraVita™ Rexolin® Zn15.

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Yara’s global presence makes a world of difference

Timing is everything
Yara works closely with researchers and farmers all over the world gaining invaluable experience on how best to use our fertilizers. We know that rate and timing of product application - taking into account nutrient availability from the soil, crop residues and manures - is essential to ensure growth and crop quality is not compromised. As a result, you can be sure that the advice you will be given will provide you with high yields of highly-marketable, premium grade produce.
Oil Palm - Nursery

0 - 3 Months
Apply every 2 weeks

- YaraMila™
  12-11:18:3MgO+8S+TE
  7 grams / palm

- YaraLiva™ NITRADOR™
  3 grams / palm

3 - 6 Months
Apply every 3 weeks

- YaraMila™
  12-11:18:3MgO+8S+TE
  10 grams / palm

- YaraLiva™ NITRADOR™
  5 grams / palm

7 - 9 Months
Apply every month

- YaraMila™
  12-11:18:3MgO+8S+TE
  10 grams / palm

Over 9 Months
Apply every month

- YaraMila™
  12-11:18:3MgO+8S+TE
  25 grams / palm

Month 2
YaraVita™
BORTAC ISO™
1 litre / ha

Month 4 & Month 6
YaraVita™
BORTAC ISO™
1 litre / ha

Month 8
YaraVita™
BORTAC ISO™
1 litre / ha

Month 10 & Month 12
YaraVita™
BORTAC ISO™
1 litre / ha

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Where additional micronutrients (Mg, B, Cu, Zn) are required, please consult your local sales agronomists for the YaraVita™ range. This Crop Nutrient Programme is meant as a general guide and should be adapted according to local conditions, such as soil, climate, cultivar and growing methods. Above pictures are to show the growth stages of oil palm and not to illustrate soil types.
**Oil Palm - Immature - Inland Soil**

Assuming 143 palms / ha

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</tr>
<tr>
<td>0.1 kg / palm</td>
<td>0.8 kg / palm</td>
<td>1.5 kg / palm</td>
</tr>
<tr>
<td>Month 4</td>
<td>Month 4.5</td>
<td>Month 5</td>
</tr>
<tr>
<td>0.2 kg / palm</td>
<td>1.0 kg / palm</td>
<td>1.5 kg / palm</td>
</tr>
<tr>
<td>Month 6</td>
<td>Month 7</td>
<td>Month 8</td>
</tr>
<tr>
<td>0.3 kg / palm</td>
<td>1.2 kg / palm</td>
<td>2.0 kg / palm</td>
</tr>
<tr>
<td>Month 8</td>
<td>Month 9.5</td>
<td>Month 11</td>
</tr>
<tr>
<td>0.4 kg / palm</td>
<td>1.5 kg / palm</td>
<td>2.0 kg / palm</td>
</tr>
<tr>
<td>Month 10</td>
<td>Month 11</td>
<td></td>
</tr>
<tr>
<td>0.6 kg / palm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Month 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.7 kg / palm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**YaraMila™**

**PALMAE™**

<table>
<thead>
<tr>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>MgO</th>
<th>B</th>
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<tbody>
<tr>
<td>43</td>
<td>36</td>
<td>69</td>
<td>7</td>
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<tr>
<td>112</td>
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<td>130</td>
<td>110</td>
<td>210</td>
<td>20</td>
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</tbody>
</table>

**Yara International (M) Sdn Bhd** (30344-T)
Lot 3 O2, Level 3, 1 First Avenue, Bandar Utama, 47800 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +603-7726 4181  Fax: +603-7722 2479  E-mail:yaramalaysia@yara.com  Website: www.yara.com

Where additional micronutrients (Mg, B, Cu, Zn) are required, please consult your local sales agronomists for the **YaraVita™** range. This Crop Nutrient Programme is meant as a general guide and should be adapted according to local conditions, such as soil, climate, cultivar and growing methods. Above pictures are to show the growth stages of oil palm and not to illustrate soil types.
## Oil Palm - Immature - Coastal Soil

### Year 1
- **Month 2**: 0.1 kg / palm
- **Month 4**: 0.2 kg / palm
- **Month 6**: 0.3 kg / palm
- **Month 8**: 0.4 kg / palm
- **Month 10**: 0.5 kg / palm
- **Month 12**: 0.6 kg / palm

### Year 2
- **Month 2**: 0.8 kg / palm
- **Month 4.5**: 0.8 kg / palm
- **Month 7**: 1.0 kg / palm
- **Month 9.5**: 1.2 kg / palm
- **Month 11**: 1.2 kg / palm

### Year 3
- **Month 2**: 1.5 kg / palm
- **Month 5**: 1.5 kg / palm
- **Month 8**: 1.5 kg / palm
- **Month 11**: 2.0 kg / palm

### YaraMila PALMAE™

**Assuming 143 palms / ha**

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Fertilizer (kg / palm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>9.5</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>1.2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>5</td>
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<td></td>
<td>8</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>2.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Fertilizer (kg / ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>N 39     P₂O₅ 33   K₂O 63   MgO 6   B 0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N 93     P₂O₅ 79   K₂O 150  MgO 14  B 1.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N 121    P₂O₅ 102  K₂O 195  MgO 19  B 1.9</td>
</tr>
</tbody>
</table>

---

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Oil Palm - Immature - Peat Soil

Assuming 143 palms / ha

<table>
<thead>
<tr>
<th>Year 1</th>
<th></th>
<th>Year 2</th>
<th></th>
<th>Year 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Month 2</td>
<td>0.1</td>
<td>Month 3</td>
<td>1.0</td>
<td>Month 3</td>
<td>2.0</td>
</tr>
<tr>
<td>Month 4</td>
<td>0.2</td>
<td>Month 6</td>
<td>1.0</td>
<td>Month 8</td>
<td>2.0</td>
</tr>
<tr>
<td>Month 6</td>
<td>0.4</td>
<td>Month 9</td>
<td>1.0</td>
<td>Month 12</td>
<td>2.0</td>
</tr>
<tr>
<td>Month 9</td>
<td>0.5</td>
<td>Month 12</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Month 12</td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>MgO</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>25</td>
<td>48</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>84</td>
<td>71</td>
<td>135</td>
<td>13</td>
<td>1.3</td>
</tr>
<tr>
<td>112</td>
<td>94</td>
<td>180</td>
<td>17</td>
<td>1.7</td>
</tr>
</tbody>
</table>

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Oil Palm - Mature

3 applications per year should be made using the rates suggested

<table>
<thead>
<tr>
<th>Year 4 - 7</th>
<th>Year 8 - 15</th>
<th>Over 16 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal Soil</td>
<td>Coastal Soil</td>
<td>Coastal Soil</td>
</tr>
<tr>
<td>2.0-2.5 kg / palm / application</td>
<td>2.5-3.5 kg / palm / application</td>
<td>2.5-3.0 kg / palm / application</td>
</tr>
<tr>
<td>Inland Soil</td>
<td>Inland Soil</td>
<td>Inland Soil</td>
</tr>
<tr>
<td>2.5-3.0 kg / palm / application</td>
<td>3.0-4.0 kg / palm / application</td>
<td>3.0-3.5 kg / palm / application</td>
</tr>
<tr>
<td>Peat Soil</td>
<td>Peat Soil</td>
<td>Peat Soil</td>
</tr>
<tr>
<td>2.0-2.5 kg / palm / application</td>
<td>2.5-3.5 kg / palm / application</td>
<td>2.5-3.0 kg / palm / application</td>
</tr>
</tbody>
</table>

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