

Fertilizer Chooser

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About Fertilizer Chooser

Fertilizer Chooser helps to select the adequate and least costly combination of quality fertilizer sources to match the amounts of fertilizer nutrients specified in a fertilizer recommendation. **Fertilizer Chooser** was jointly developed by:

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Thomas Fairhurst developed the first version of Fertilizer Chooser using Microsoft Excel, which was released by Potash & Phosphate Institute/Phosphate & Phosphate Institute of Canada (PPI/PPIC). This version was later modified by Christian Witt at the International Rice Research Institute (IRRI) and programmed by Rico Pamplona in Visual Basic. Achim Dobermann led the development of the present version of Fertilizer Chooser at the University of Nebraska-Lincoln, including adding more functionality to the software. The current application was written in Java 2 by Sarathkumar Polireddy. Please send comments or suggestions to adobermann2@unl.edu.

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Installation

Fertilizer Chooser requires about 62 MB of free hard disk space for a full installation and a monitor with a graphics resolution of at least 800 x 600 pixels. As default, the program runs in a 800 x 600 pixels window.

Installation proceeds as follows:

1. Download or copy file the setup file (**Fert_USA.exe** or **Fert_Generic.exe**) to a folder of your choice.
2. Double-click on the setup file and follow the installation instructions.
3. The setup program will first install the Java™ 2 Runtime Environment (JRE) SE v1.4.1. (NOTE: Fertilizer Chooser also works with higher versions of JRE). Follow the instructions and choose Typical as your installation option.
4. Following this, the setup program installs the Fertilizer Chooser software in the default directory c:\Program Files\FertilizerChooser. This cannot be customized.
5. After setup is complete, click on the [Close] button and start using the program. Rebooting the computer is not required.
6. Go to Start → Programs → FertilizerChooser → FertilizerChooser to launch the program. Alternatively, start the program by double-clicking on the Fertilizer Chooser icon, which has been placed on the desktop during installation.

Overview

What is Fertilizer Chooser?

Fertilizer Chooser is the final step in preparing a fertilizer program. It assumes that a target fertilizer recommendation for balanced plant nutrition has been obtained by other means such as soil testing or an existing general recommendation. Fertilizer Chooser helps the user to

- Translate a nutrient recommendation into the correct amounts of different fertilizers needed to make up the right amount of nutrients
- Select a combination of meaningful fertilizer sources
- Select the least costly combination of fertilizer nutrient sources based on quoted prices for fertilizer products and the cost of application, and
- Evaluate the cost of different fertilization programs.

The program uses a linear optimization procedure to find the best combination of fertilizer materials that minimizes the cost of fertilization. Unless specified otherwise, all calculations are performed under the constraint that the calculated amounts of fertilizer required must supply the amounts of nutrients specified in the recommendations.

The user is encouraged to compare the total cost of different nutrient management recommendations and fertilizer sources to make a final choice. In choosing the right fertilization program, users must also consider other aspects that are not part of Fertilizer Chooser, including:

- *Product quality and consistency* - these are very important factors that influence crop response to fertilizers, application accuracy and time required for application. For example, a product such as ammonium bicarbonate could be the "least costly" source of N available, but it may not be the most profitable in terms of yield response, or it may cause greater environmental problems than higher-quality products. Quality fertilizers are not available in all parts of the world, for example when the nutrient composition of the fertilizer is lower than that stated on the bag. Implementation of the improved fertilizer management strategies may not be effective if farmers are purchasing fertilizer of sub-standard quality. The following strategies can be used to test for N, P and K fertilizer adulteration:
 - The most common inorganic NPK fertilizers are water soluble and should not leave any residue on the bottom of the container containing the fertilizer dissolved in water. Exceptions include rock phosphate, **other PK fertilizers?**
 - Dissolving urea in water produces heat from the hydrolysis.
 - Check the physical characteristics of granulated fertilizer. Adulterated fertilizer may be mixed with high quality fertilizer, but the adulterated material may be of different physical properties, and contain clay, sand, or other components. Good quality fertilizer will consist of granules with the same physical properties.
- *Product preference* - the user can select only specific fertilizer sources when translating a nutrient recommendation into the correct amounts of the preferred fertilizer sources. This may be the case when specific high quality products are to be used or if a fertilizer producer would like to develop a fertilizer program based on official recommendations using company products.
- *Need for other nutrients* - the need for a secondary or micronutrient may affect the choice of a suitable P or K source and lead to use of a fertilizer that costs more per unit of nutrient. Such considerations can be accounted for by specifying a minimum amount for a particular fertilizer source.
- *Available application technology and services from the dealer.* Only choose fertilizer products that you can apply properly with the equipment available. Reliable and timely support in terms of

fertilizer delivery and/or application can be critical to making the whole fertilizer program function properly.

- *Ease of handling and storage of the fertilizer.* Fertilizers that contain more nutrients require less storage space per unit nutrient than sources that contain small concentration of nutrients.
- *Fit in the cropping system* - for example, residue management goals may determine what type of fertilizer application is best, or weed control practices may influence the most appropriate source.
- *Reactivity* – Some nutrients are sparingly soluble but cost less. For example, rock phosphate and dolomite are good sources of P and Mg, respectively, but they do not dissolve well and will improve soil fertility and crop growth only over longer time periods. More soluble sources, such as triple super phosphate or kieserite may be more costly per unit nutrient but more effective as nutrient sources.

Cost of fertilization

Cost of fertilization = application cost + fertilizer cost + other charges

Fertilizer cost refers to a quoted farm gate price, which differs for different materials so that the calculation must be done on a per unit nutrient content basis to compare different sources. Application cost includes:

- Labor
- Fuel and lubricants
- Repair cost of fertilizer application equipment (power and implement)
- Depreciation of fertilizer application equipment (power and implement)

Other charges may include delivery fees and field trip charges, but those are assumed to be similar for different fertilizers and not included in Fertilizer Chooser.

Example:

Recommended amount to apply: 150 lb N per acre and 20 lb P₂O₅ per acre

Available fertilizers: Liquid starter fertilizer 10-34-0 (N, P)
Anhydrous ammonia (N)

Application: Farmer applied: planter equipped with starter fertilizer tanks;
rented company rig for anhydrous ammonia application)

Calculation of total amounts and cost of fertilization:

Step 1: Obtain the prescription:	20 lb P ₂ O ₅ and 150 lb N per acre
Step 2: Chose a P fertilizer source:	10-34-0 at \$ 237.50/short ton (= 2000 lb)
Step 3: Determine P product needed per acre:	20/0.34 = 59 lb of 10-34-0 per acre
Step 4: Determine cost of starter fertilizer:	59 x 237.5/2000 = \$ 7.01/acre
Step 5: Determine N added with 10-34-0:	59 x 0.10 = 6 lb N/acre
Step 6: Determine additional N needed:	150 - 6 = 144 lb N/acre
Step 7: Choose a N fertilizer source:	NH ₃ (82-0-0) at \$ 245.00/short ton (=2000 lb)
Step 8: Determine how much NH ₃ is needed:	144/0.82 = 176 lb NH ₃ /acre
Step 9: Determine cost of NH ₃ :	176 x 245/2000 = \$ 21.56/acre
Step 10: Determine costs of application:	Liquid starter: owned planter, \$ 0.36/acre NH ₃ : rented company rig: \$ 2.72/acre
Step 11: Determine total cost of fertilization:	7.01 + 21.56 + 0.36 + 2.72 = \$ 31.65/acre

Data requirements

To run Fertilizer Chooser, users must enter, select, or edit:

- Crop and farm information and the overall size of the area (optional)
- Local measurement units for currency, area, and fertilizer recommendations. For all those, conversion factors must be specified
- Target nutrient recommendation for N, P, K, and/or up to three other nutrients
- Names, form (e.g., solid, liquid, or gas), weight units of the fertilizers for which a price quote is entered, quoted prices, and nutrient concentrations of locally available mineral fertilizers or other nutrient sources.

What are the steps involved in the calculation?

Using Fertilizer Chooser involves the following steps:

1. Start the program and adjust screen size for running the program. As a default, Fertilizer Chooser is launched in a 800 x 600 pixels window. You can resize this window by dragging the corners or edges to the desired size, or switch to full-screen mode using the usual Windows controls. Fertilizer Chooser will adjust itself to any size chosen.
2. On the [Main] page, Select/edit local measurement units. Save settings.
3. Enter crop and farm information (optional)
4. Enter the target nutrient recommendation.
5. Click on button [Fertilizer Sources].
6. Enter/select fertilizer sources of interest. Edit weight units, prices quoted, application cost, and nutrient concentrations for each fertilizer source. If required, enter minimum amount of a fertilizer source that must be applied. Save your settings.
7. Click on button [Calculate] to find the fertilization application program with the lowest total cost that matches the target recommendation entered.
8. Review the results. Compare target (recommended rates) and result. Assess amounts of different fertilizers recommended and total cost. Assess if application of these materials is possible. If desired, change target rates in the respective boxes on the Results page or selected different [Fertilizer Sources] and re-calculate. Make adjustments in the final recommended amounts and application cost. Add other nutrients to the recommendations and re-review the results. Print results or copy them to external applications such as spreadsheet software.

Opening Screen

Units

Currency Unit **Area Unit** **Recommendation Unit**

1 US \$ = 1.0 Dollar: United States 1 ha = 2.4700 Acre 1 kg/ha = 0.8929 lb/acre

Save Delete

Crop/Farm Info

Crop: Corn Farm/FieldID: Fox Run Total Area: 100 Acre

	N	P ₂ O ₅	K ₂ O	Other	Other	Other
Target Amounts	150	50	50			
Equivalent in Element	150	22	42			
	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore

Fertilizer Sources Calculate Help About Exit

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Setting measurement units

Select or define local units for currency (CU), area (AU), and fertilizer recommendations (RU). Internally, Fertilizer Chooser performs all calculations using US\$ as currency, hectare (ha) as area unit, and kg/ha as fertilizer recommendation unit. However, users can define their own units and the program will do all conversions and display the results in the local units chosen.

Navigate to different entries using the [TAB] key or the mouse.

New units can be defined by entering a new name and conversion factor. This will not overwrite already existing units, but add a new entry to the list.

Use [DELETE] to erase any existing entries.

After completing your selection, press the [SAVE] button to make your choices active for the ongoing session. This will also make your selections program defaults for future sessions.

Currency unit (CU):

Select a pre-set currency unit from the drop-down menu or define your own one by clicking on the current entry in box CU. Changing the entry will create a new currency that will appear in addition to Dollar. Specify the exchange rate for the new CU.

Example: CU 1 US\$ = 8.2 Yuan Renminbi (China)

Area unit (AU):

Area unit defines the locally used unit for calculating production inputs such as fertilizers or measuring yields (e.g., acre in the USA, ha in Europe, Mu in China, Rai in Thailand). Select a pre-set area unit (acre or ha) or define your own one by clicking on the current entry in box AU. Changing the entry will create a new unit that will appear in addition to ha or acre. Specify the conversion factor relative to ha for the new AU.

Example: AU 1 ha = 15 Mu (China)

Recommendation unit (RU):

Recommendation unit refers to the unit typically used for prescribing fertilizer applications. Select a pre-set recommendation unit (lb/acre or kg/ha) or define your own one by clicking on the current entry in box RU. Changing the entry will create a new unit that will appear in addition to kg/ha or lb/acre. Specify the conversion factor relative to ha for the new RU.

Example: RU 1 kg/ha = 0.133 Jin/Mu (China)

Entering crop and farm information

Entries in this section are optional and only used to provide more detailed information on the results page, which can be printed or used otherwise.

Enter a name for the crop and field or farm for which a fertilizer program needs to be made.

If you also wish to display the results expressed as the whole amounts of fertilizer products needed for the entire field (farm), enter the size of the field (farm) in the area unit (AU) specified above.

Entering the target nutrient recommendation

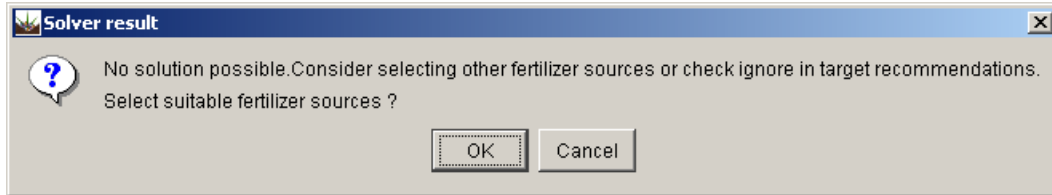
Enter your nutrient recommendations in the white boxes. Default nutrients include N, P, and K. If applicable, select up to three other nutrients from the respective drop down lists.

All amounts entered must refer to the Recommendation unit (RU) specified. For nutrients such as P, K, Ca, and Mg, enter the recommended rate using commonly used oxide forms (P_2O_5 , K_2O , CaO, MgO). For display only, all entries are also converted to elemental basis.

- You can use Fertilizer Chooser to just find out the cheapest fertilizer source for a single nutrient, i.e., it is not necessary to enter a recommendation for several nutrients.
- You can define your own nutrients or a lime recommendation by overwriting the default entries in the three **[Other]** columns. Note, however, that the program always maintains the same order of nutrients and their nutrient concentrations in the table of Fertilizer Sources, which must be taken into account for entering Fertilizer Sources. The default order is N, P_2O_5 , K_2O , S, Zn, Fe, Cu, Mn, B, CaO, MgO.
- Check the **[Ignore]** check box underneath a nutrient if you wish to ignore this nutrient in the optimization. In that case, Fertilizer Chooser will match the required amounts of all other nutrients entered based on the available fertilizers sources selected, irrespective of whether these fertilizers also contain the nutrient that is not required. Note that this is different from entering 0 for a nutrient target and can lead to a result in which the actual amount suggested for the “ignored nutrient” is less or more than what had been entered in the target recommendation. Using **[Ignore]** is sometimes necessary if one already knows in advance that a certain amount of a specific fertilizer must be applied. Irrespective of whether it represents the optimal solution or not.
- After completing all entries, click on **[Fertilizer Sources]** to proceed.

Examples for customization:

Ignore nitrogen in a fertilizer recommendation for legumes: A user needs to match a target recommendation for P and K for a legume crop such as soybean. Although no N is required for this crop, some or all of the available fertilizer sources may contain N as well. For example, the user knows already that P will be applied as a starter fertilizer, but all the available starter fertilizers contains some N. In that case, check [**Ignore**] for N and proceed with the calculation. Fertilizer Chooser will find the cheapest starter fertilizer solution for matching the P and K amounts required, but the amount of N applied with these fertilizers will also be displayed. If 0 is entered in a nutrient recommendation field (here: 0 N) and [**Ignore**] is not checked, no solution can be found and the program will return an error message:



Molybdenum recommendation. Some micronutrients are not listed in the drop-down list of other nutrients to select, but, can be calculated with some customization. For example, in any [**Other**] box, replace entry Boron (B) with Molybdenum (Mo). Enter nutrient concentrations of Mo-containing fertilizers in the column for B in the table of [**Fertilizer Sources**]. Note that the column title there (B) cannot be changed, but it now refers to Mo. For running the optimization, only select those Mo-containing fertilizers, not the original ones that contain B and may have an entry in the same B column.

Lime recommendation. In any [**Other**] box, replace entry CaO with Lime. Enter the target lime rate in CaCO₃ equivalent (CCE) in the box below. Enter lime materials and their CCE in the column for CaO% in the table of [**Fertilizer Sources**]. Note that the column title there (CaO%) cannot be changed, but the value now refers to CCE as unit, not % CaO. For running the optimization, only select those potential liming materials that contain CCE values in the CaO% column.

Fertilizer Sources

Fertilizer Sources (default_usa.mdb)

File View Help

CU = Currency Unit (Dollar: United States) AU = Area Unit (Acre) RU = Recommendation Unit (lb/acre)

U/AU = Application Cost (Dollar: United States/Acre) CU/WU = Fertilizer price quote WU = Weight Unit (for fertilizer price quote)

FERTILIZER SOURCES																	
...	Fertilizer Source	Type	Weight... (WU)	Price (CU/WU)	AppCost (CU/AU)	Min Am... (RU)	N %	P2O5 %	K2O %	S %	Zn %	Fe %	Cu %	Mn %	B %	CaO %	MgO %
<input checked="" type="checkbox"/>	Ammonium nitrate	solid	short ton	240.0	4.0	0.0	34.0										
<input checked="" type="checkbox"/>	Ammonium sulfate (21-0-0-24)	solid	short ton	200.0	4.0	0.0	21.0			24.0							
<input type="checkbox"/>	Ammonium thiosulfate (ATS)	solid	short ton	165.0	5.0	0.0	12.0			26.0							
<input type="checkbox"/>	Anhydrous ammonia	gas	short ton	300.0	5.0	0.0	82.0			0.0							
<input checked="" type="checkbox"/>	Urea (46-0-0)	solid	short ton	250.0	4.0	0.0	46.0										
<input type="checkbox"/>	Urea ammonium nitrate (28-0-...	liquid	short ton	140.0	5.0	0.0	28.0			0.0							
<input type="checkbox"/>	Urea ammonium nitrate (32-0-...	liquid	short ton	150.0	5.0	0.0	32.0										
<input type="checkbox"/>	Ammonium polyphosphate (1-...	liquid	short ton	230.0	5.0	0.0	10.0	34.0									
<input checked="" type="checkbox"/>	Diammonium phosphate (18-...	solid	short ton	230.0	4.0	0.0	18.0	46.0									
<input type="checkbox"/>	Monoammonium phosphate (...)	solid	short ton	250.0	4.0	0.0	11.0	52.0									
<input type="checkbox"/>	Superphosphate, triple	solid	short ton	230.0	4.0	0.0		45.0		1.5						18.0	
<input checked="" type="checkbox"/>	Potassium chloride (MOP,0-0-...	solid	short ton	160.0	4.0	0.0			60.0								
<input type="checkbox"/>	Potassium nitrate	solid	short ton		4.0	0.0	13.0		44.0								
<input type="checkbox"/>	Potassium sulfate	solid	short ton		4.0	0.0			50.0	18.0							
<input type="checkbox"/>	Potassium-magnesium Sulfate	solid	short ton	195.0	4.0	0.0			22.0	22.0							18.0
<input checked="" type="checkbox"/>	10-30-5-6-2	solid	short ton	270.0	4.0		10.0	30.0	5.0	6.0	2.0						
<input type="checkbox"/>	15% Nulex Liq. Zn	liquid	gallon	4.0	5.0						15.0						
<input type="checkbox"/>	20% Nulex Liq. Zn	liquid	gallon	10.0	5.0						20.0						
<input type="checkbox"/>	Borax	solid	short ton	1000.0	4.0	0.0									10.0		
<input type="checkbox"/>	Boron 15%	liquid	short ton	1150.0	4.0										15.0		
<input type="checkbox"/>	Calcium chloride	solid	short ton		4.0	0.0										50.0	
<input type="checkbox"/>	Calcium sulfate (Gypsum)	solid	short ton		4.0	0.0				18.0						32.0	
<input type="checkbox"/>	Copper sulfate	solid	short ton	2200.0	4.0	0.0							25.0				
<input type="checkbox"/>	Dolomite	solid	short ton		4.0	0.0										30.0	16.0
<input type="checkbox"/>	DTPA chelate	liquid	gallon		5.0	0.0						10.0					
<input type="checkbox"/>	EDTA chelate	liquid	gallon		5.0	0.0					10.0	10.0	10.0	9.0			
<input type="checkbox"/>	HEEDTA chelate	liquid	gallon		5.0	0.0					9.0	5.0	9.0	5.0			
<input type="checkbox"/>	Iron chelate	liquid	gallon		5.0	0.0											
<input type="checkbox"/>	Iron sulfate	solid	short ton		4.0	0.0						20.0					
<input type="checkbox"/>	Kieserite	solid	short ton		4.0	0.0					22.0						45.0
<input type="checkbox"/>	Magnesium sulfate (Epsom s...	solid	short ton		4.0	0.0					12.0						17.0

Select All Deselect All Insert Row Delete Row Help Home Calculate

Enter, select, or delete available fertilizer sources. Edit weight units, prices quoted for each product, application cost, and nutrient concentrations for each fertilizer source. If desired, enter minimum amounts of a fertilizer product that need to be applied, irrespective of whether this represents the most cost-efficient solution or not.

Entering and editing fertilizer sources

Fertilizer Chooser contains two default tables of common fertilizer sources, and other amendments, including their typical nutrient concentrations, which can be loaded by clicking on **File – Open** and selecting:

- **default_generic.mdb** generic database for worldwide use, with no weight units and prices entered; this is the default database when Fertilizer Chooser is launched for the first time.
- **default_USA.mdb** generic database for the USA, with some weight units, typical prices, and application costs entered; load this database [File – Open, browse to ... \Program Files\FertilizerChooser and select file **default_USA.mdb**] if you work in the USA.

Users can edit these tables and create and save custom tables for different projects (**File – Save As**). Any changes made will become program defaults, i.e., they will appear upon next restart of the program. Perform the following operations:

- Delete fertilizer sources that are not locally available or not part of your normal management. This will make the table shorter and further selection easier. Select a fertilizer row (a selected row will appear highlighted in blue) and click [**Delete Row**] to delete it from the list.
- Add additional locally available nutrient sources by either:
 - Overwriting and existing entry with new values for each cell in a row.
 - Adding a new fertilizer in a particular group with different color-coding. Click on a fertilizer to highlight the entire row. Then click [**Insert Row**]. This inserts an empty row at the top of this group of fertilizers. Enter all details for the new fertilizer.
- Click on the check boxes left to each product to select those fertilizers that should be considered as possible choices in the fertilization program. Alternatively, click [**Select All**] to choose the entire list of fertilizers.
- For each selected fertilizer, verify or and enter name, type, weight unit (WU), price (CU/WU), application cost (CU/AU), minimum amount to apply, and nutrient concentrations.

Fertilizer Source

Enter a clearly recognizable name for the product

Type

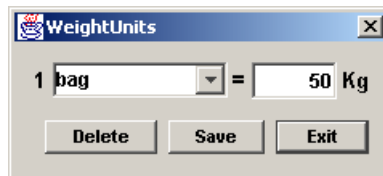
General fertilizer type (dry-granular, liquid, gas). Choose from the drop-down list shown when you click on this cell. Alternatively, entering the first letter will automatically enter the full specification (**s** – solid [granular/dry], **l** – liquid, **g** – gas)

Weight Unit (WU)

Product weight unit for which the price is quoted. Because prices for different fertilizer sources may be quoted in different weights units (ton, kg, gallon, bag, etc.), a specific WU must be selected **for each fertilizer source** selected. Click on the WU cell for each fertilizer and select any of the pre-set choices (gallon, kg, lb, metric ton, short ton) from the drop-down list:

<input checked="" type="checkbox"/>	Urea (46-0-0)	solid	short...
<input type="checkbox"/>	Urea ammonium nitrate (28-0...	liquid	gallon
<input type="checkbox"/>	Urea ammonium nitrate (32-0...	liquid	kg
<input type="checkbox"/>	Ammonium polyphosphate (1...	liquid	lb
<input checked="" type="checkbox"/>	Diammonium phosphate (18-...	solid	metric ton
<input type="checkbox"/>	Monoammonium phosphate (...)	solid	short ton

To define a new WU, click on **View → Weight Units** in the menu bar at the top of the screen. A dialog box will pop up with all pre-set choices. Enter a name for a new unit you wish to define and the correct conversion factor to relate this unit to kg as the standard unit used in program-internal calculations. Click [**Save**] to add the new unit to the list, and make it available for any fertilizer source:



Price (CU/WU)

Fertilizer price quoted per specified weight unit (WU). Enter the price in the same currency unit as defined on the opening screen (CU). The currently selected CU is also displayed at the top of the [**Fertilizer Sources**] screen

Application Cost (CU/AU)

Estimate of total application cost, expressed on an area basis (CU/AU) using the currency (CU) and area units (AU) defined under [Home]. Application cost includes:

- Labor
- Fuel and lube
- Repair cost of fertilizer spreader (power and implement)
- Depreciation of fertilizer spreader (power and implement)

Note that application costs vary depending on the type of fertilizer, available equipment and services, and the amount of labor needed. Application costs are often expressed on a per area basis (e.g., \$ per acre), but, occasionally, also on a per unit fertilizer basis (e.g., \$ per ton applied). NOTE: in Fertilizer Chooser, application costs must be entered on a **per area basis**.

If no estimate of application cost is available or desired, set all values to zero and proceed running the calculation without it.

If several fertilizers will be blended and applied with the same application pass, specify the application cost only once or divide it among those fertilizers that are applied together.

Where applicable, average application cost numbers such as those shown below can be used.

Example: Typical application costs for farmers in Nebraska, USA

Anhydrous ammonia	company rig (rental)	\$2.50/acre
Anhydrous ammonia	owned rig	\$5.30/acre
Anhydrous ammonia	custom applied	\$6.20/acre
Dry fertilizer	company spreader (rental)	\$1.20/acre
Dry fertilizer	custom spinner	\$4.00/acre
Dry fertilizer	custom air flow	\$5.50/acre
Liquid fertilizer	company sidedress (rental)	\$2.35/acre
Liquid fertilizer	custom injection	\$6.00/acre
Liquid fertilizer	custom floater	\$5.50/acre
Liquid starter	add-on planter	\$0.35/acre

Minimum Amount (RU)

Enter the minimum amount of a particular fertilizer, **expressed in the recommendation unit (RU)** selected. This is useful under certain conditions. For example, you know already that you will apply a certain amount of a specific fertilizer with your planter as starter fertilizer, but wish to find out how to match the total target recommendation with other nutrient sources at the lowest cost. A minimum amount may also be the smallest feasible rate that can be reliably applied with a particular fertilizer spreader. Set all minimum amounts to zero if no such constraints exist.

Nutrient concentrations (%)

For each fertilizer source to be included, enter/edit the respective nutrient concentrations as indicated.

BEFORE PROCEEDING WITH THE CALCULATION, ALWAYS MAKE SURE THAT ALL FERTILIZERS SELECTED HAVE COMPLETE INFORMATION ON WU, PRICE, AND NUTRIENT CONCENTRATIONS. EMPTY FIELDS IN ANY OF THOSE MAY LEAD TO ERRONEOUS RESULTS.

- Click [Calculate] to find the optimal solution for the fertilization program.

Results

Fertilizer Reports

File View Help

Crop/Farm Info

Crop Name Field Total Area Acre

	N	P2O5	K2O	Other	Other	Other
Target (lb/acre)	<input type="text" value="150"/>	<input type="text" value="50"/>	<input type="text" value="50"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Result (lb/acre)	<input type="text" value="150"/>	<input type="text" value="50"/>	<input type="text" value="50"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

Nutrients supplied with each fertilizer

Recommended Fertilizers	N	P2O5	K2O	Other	Other	Other
Urea (46-0-0)	130	0	0	0	0	0
Diammonium phosphate (18-46-0)	20	50	0	0	0	0
Potassium chloride (MOP,0-0-60)	0	0	50	0	0	0

Recommended amounts and cost of fertilization

Recommended Fertilizers	Price	(CU/AU)	App.Cost(CU/AU)	Amount(RU)	Cost(CU/AU)	Total Amount(lb)	Total Cost(CU)
Urea (46-0-0)	250.0	Dollar/short ton	4.0	263.6	39.4	26,360	3,940
Diammonium phosphate (18-46-0)	230.0	Dollar/short ton	4.0	108.8	16.5	10,880.1	1,650
Potassium chloride (MOP,0-0-60)	160.0	Dollar/short ton	4.0	83.3	10.7	8,330	1,070
Total			12.0	475.7	66.6	47,570.1	6,660

CU - Currency Unit (Dollar: United States) AU - Area Unit (Acre) RU - Recommendation Unit (lb/acre) Total amount Unit

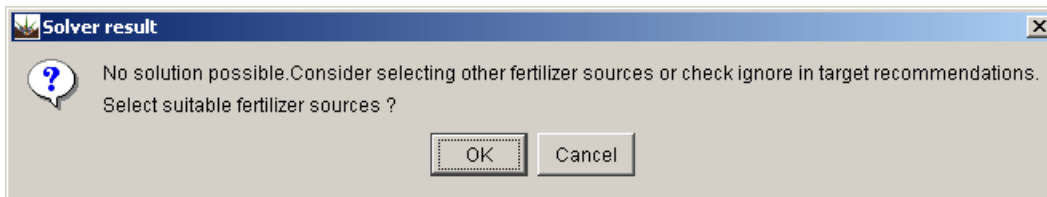
FertilizerSources Home Help Save As Copy to Clipboard Print Exit

Verify that the resulting nutrient recommendation matches the target amounts entered. Review what fertilizer sources have been chosen how much each of them contributes to the different nutrients amounts in the target recommendation. Assess the amount and cost of recommended materials as well as the total cost of the entire fertilization program. Prices of fertilizers displayed here refer to the Weight Units specified for each fertilizer source, which may differ among different products. Final costs of each product and of the entire fertilization program are expressed in the currency unit per area unit selected (CU/AU) and include the fertilizer amounts needed as well as the application cost. The total amount of fertilizers needed as well as the total costs for the entire field (farm) are displayed in the last two columns.

Possible actions include:

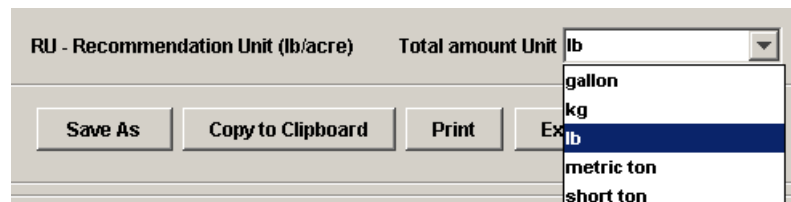
- Manually **adjust the recommended amounts** of fertilizers. This may make sense if the program suggests applying a very small amount of a fertilizer source or if you simply want to round the numbers. Double-click on a cell in column "Amount" to perform such changes. Observe effects of your adjustments on the total cost and the amount of recommended nutrients (compare target and actual nutrient content). NOTE: prices of fertilizers can only be changed by going back to **[Fertilizer Sources]**.
- Manually **adjust the application cost** of different fertilizers. This may make sense if the program suggests applying several granular (dry) fertilizers, which could be made into a custom blend so that the application cost applies only once.

- Re-run the calculation with **different target amounts** to evaluate alternatives and how they affect the cost. Change the target amount directly on the **[Results]** screen and the program will automatically update the results displayed. Study repeatedly how changing amounts of one or more nutrients affects the total cost to decide on the best compromise between minimizing cost and sustaining soil fertility and yield.
- Re-run the calculation with **different fertilizer sources** to evaluate alternatives and how they affect the cost. Click on **[Fertilizer Sources]** to change those selections.
- Re-run the calculation with **other nutrients added** to evaluate alternatives and how they affect the cost. Select other nutrients and their target amounts directly on the **[Results]** screen and the program will automatically update the results displayed. Study repeatedly how changing amounts of one or more nutrients affects the total cost to decide on the best compromise between minimizing cost and sustaining soil fertility and yield. NOTE: if a nutrient is selected for which no suitable fertilizer sources has been selected before, an error message will be displayed:



Click **[OK]** to select suitable fertilizer sources. Click **[Cancel]** to cancel the nutrient selected.

- Change the unit in which the total fertilizer amount for the entire field (farm) is displayed:



- Copy the result to an external application for further processing. Click on **[Copy to Clipboard]** and paste results in any application of your choice. Alternatively, click **[Save As]** to save the entire result page in spreadsheet format (*.csv file).
- Print a hardcopy of the final result page by clicking **[Print]**

Suggestions:

- Small changes in target amounts have little effect on the overall cost of fertilization, but they may decrease or increase yield potential and yield stability (risk). If uncertain, do not reduce the actual rate applied much below recommended levels.
- On a per unit nutrient basis, compound fertilizers may be more expensive than single nutrient fertilizers. Explore if this is true for your location, but also take into account differences in application cost. A compound fertilizer may still be a good choice if convenience of application is a key decision criterion. Otherwise, explore whether application of custom blends made from single nutrient sources would be a more cost-efficient solution.
- Explore how application cost affects the total cost and decide whether buying or renting equipment is a better option than custom application.
- Evaluate your final choice with regard to all other factors to consider:
 - *Product quality and consistency* - these are very important factors that influence crop response to fertilizers, application accuracy and time required for application. For example, a product such as

ammonium bicarbonate could be the "least costly" source of N available, but it may not be the most profitable in terms of yield response, or it may cause greater environmental problems than higher-quality products.

- *Need for other nutrients* - the need for a secondary or micronutrient may affect the choice of a suitable P or K source and lead to use of a fertilizer that costs more per unit of nutrient. Such considerations can be accounted for by specifying a minimum amount for a particular fertilizer source.
- *Available application technology and services from the dealer.* Only choose fertilizer products that you can apply properly with the equipment available. Reliable and timely support in terms of fertilizer delivery and/or application can be critical to making the whole fertilizer program function properly.
- *Ease of handling and storage of the fertilizer.* Fertilizers that contain more nutrients require less storage space per unit nutrient than sources that contain small concentration of nutrients.
- *Fit in the cropping system* - for example, residue management goals may determine what type of fertilizer application is best, or weed control practices may influence the most appropriate source.
- *Reactivity* – Some nutrients are sparingly soluble but cost less. For example, rock phosphate and dolomite are good sources of P and Mg, respectively, but they do not dissolve well and will improve soil fertility and crop growth only over longer time periods. More soluble sources, such as triple super phosphate or kieserite may be more costly per unit nutrient but more effective as nutrient sources.

Example 1: Irrigated corn in Nebraska, USA

1. Enter and save the measurement units for this region. Select US Dollar as Currency Unit, Acre as Area Unit and lb/acre as Recommendation Unit. Verify that the conversion factors are correct. Click [Save] to make your selection active.

2. Enter the Crop/Field information: We assume a 100-acre field to be planted with irrigated corn:

3. Enter the target amounts of nutrients to apply: irrigated corn is grown on a sandy soil with low organic matter content, low available P and K. Soil testing was done and the existing recommendation algorithms suggest to apply the following to meet crop needs for a 200 bu/acre yield goal:

	N	P ₂ O ₅	K ₂ O	S	Other	Other
Target Amounts	185	40	40	10		
Equivalent in Element	185	17	33	10		
	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore

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4. Select and edit locally available fertilizer sources. Choices to consider are:
 - Nitrogen sources: Anhydrous NH₃, \$300/short ton, \$5/acre application cost (owned rig)
UAN 32%, \$150/short ton, \$6/acre application cost (custom floater)
Urea, \$250/short ton, \$4/acre application cost (custom spinner)
 - Phosphorus sources: DAP, \$230/short ton, \$4/acre application cost (custom spinner)
MAP, \$250/short ton, \$4/acre application cost (custom spinner)
10-34-0 (liquid), \$230/short ton, \$6/acre application cost (custom floater)
 - Potassium sources: KCl (muriate of potash – MOP), \$160/short ton, \$4/acre application cost (custom spinner)
 - Sulfur sources: Sulfur, \$300/short ton, \$4/acre application cost (custom spinner)
Potassium-Magnesium-Sulfate, \$195/short ton, \$4/acre application cost
Ammonium sulfate, \$230/short ton, \$4/acre application cost (custom spinner)
 - Other sources: Starter 8-20-5-5, \$200/short ton, \$0.3/acre application cost (planter)

Fertilizer Sources (default_ usa.mdb)

File View Help

CU = Currency Unit (Dollar: United States) AU = Area Unit (Acre) RU = Recommendation Unit (lb/acre)
 U/AU = Application Cost (Dollar: United States/Acre) CU/WU = Fertilizer price quote WU = Weight Unit (for fertilizer price quote)

FERTILIZER SOURCES

...	Fertilizer Source	Type	Weight... (WU)	Price (CU/WU)	AppCost (CU/AU)	Min Am... (RU)	N %	P2O5 %	K2O %	S %	Zn %	Fe %	Cu %	Mn %	B %	CaO %	MgO %
<input checked="" type="checkbox"/>	Ammonium sulfate (21-0-0-24)	solid	short ton	230.0	4.0	0.0	21.0			24.0							
<input checked="" type="checkbox"/>	Anhydrous ammonia	solid	short ton	300.0	5.0	0.0	82.0			0.0							
<input checked="" type="checkbox"/>	Urea (46-0-0)	solid	short ton	250.0	4.0	0	46.0										
<input checked="" type="checkbox"/>	Urea ammonium nitrate (32-0-...	liquid	short ton	150.0	6	0.0	32.0										
<input checked="" type="checkbox"/>	10-34-0	liquid	short ton	230.0	6	0.0	10.0	34.0									
<input checked="" type="checkbox"/>	Diammonium phosphate (18-...	solid	short ton	230.0	4.0	0.0	18.0	46.0									
<input checked="" type="checkbox"/>	Monoammonium phosphate (...)	solid	short ton	250.0	4.0	0.0	11.0	52.0									
<input type="checkbox"/>	Superphosphate, triple	solid	short ton	230.0	4.0	0.0		45.0		1.5						18.0	
<input checked="" type="checkbox"/>	Potassium chloride (MOP,0-0-...	solid	short ton	160.0	4.0	0.0			60.0								
<input checked="" type="checkbox"/>	Potassium-magnesium Sulfate	solid	short ton	195.0	4.0	0.0				22.0	22.0						18.0
<input checked="" type="checkbox"/>	Starter 8-20-5-5-0.5	liquid	short ton	195.0	0.3	0.0	8.0	20.0	5.0	5.0	0.5						
<input checked="" type="checkbox"/>	Sulfur	solid	short ton	300.0	4.0	0.0				90.0							

Select All Deselect All Insert Row Delete Row Help Home Calculate

- Save those choices in a custom table by clicking on **File → Save As**
5. Click [**Calculate**] and review the result:

Fertilizer Reports

File View Help

Crop/Farm Info

Crop Name: Field: Total Area: Acre

N: P2O5: K2O: S: Other: Other:

Target (lb/acre):

Result (lb/acre):

Nutrients supplied with each fertilizer

Recommended Fertilizers	N	P2O5	K2O	S	Other	Other
Anhydrous ammonia	169	0	0	0	0	0
Diammonium phosphate (18-46-0)	16	40	0	0	0	0
Potassium chloride (MOP,0-0-60)	0	0	40	0	0	0
Sulfur	0	0	0	10	0	0

Recommended amounts and cost of fertilization

Recommended Fertilizers	Price	(CU/WU)	App.Cost(CU/AU)	Amount(RU)	Cost(CU/AU)	Total Amount(lb)	Total Cost(CU)
Anhydrous ammonia	300.0	Dollar/short ton	5.0	206.5	36	20,649.9	3,600
Diammonium phosphate (18-4...	230.0	Dollar/short ton	4.0	86.9	14	8,690	1,400
Potassium chloride (MOP,0-0-...	160.0	Dollar/short ton	4.0	66.6	9.3	6,660.1	930
Sulfur	300.0	Dollar/short ton	4.0	11.1	5.7	1,110	570
Total			17.0	371.1	65	37,110	6,500

CU - Currency Unit (Dollar: United States) AU - Area Unit (Acre) RU - Recommendation Unit (lb/acre) Total amount Unit:

FertilizerSources Home Help Save As Copy to Clipboard Print Exit

- The total cost of this fertilizer program is \$65/acre. Anhydrous ammonia is the most cost-effective N source available and supplies most of the recommended N dose. DAP, MOP, and sulfur are the other least-costly nutrient sources to match the target recommendation. However, because the soil at this site is of sandy texture injecting 207 lb/acre anhydrous ammonia as one pre-plant dose may cause significant N losses, resulting in lower yield than expected. Therefore, we make the following change:

Under [**Fertilizer Sources**], specify a minimum amount of 300 lbs 32-0-0 (urea-ammonium-nitrate solution; 300 lbs x 0.32 = 96 lbs N/acre) to be applied as three fertigations through the center-pivot irrigation system at different growth stages. This will provide better congruence of N supply with crop N demand and perhaps results in higher yield than a single anhydrous application. The application cost associated with this is small and we assume \$1/acre:

...	Fertilizer Source	Type	Weight... (WU)	Price (CU/WU)	AppCost (CU/AU)	Min Am... (RU)	N %	P2O5 %	K2O %	S %	Zn %	Fe %	Cu %	Mn %	B %	CaO %	MgO %
<input checked="" type="checkbox"/>	Ammonium sulfate (21-0-0-24)	solid	short ton	230.0	4.0	0.0	21.0			24.0							
<input checked="" type="checkbox"/>	Anhydrous ammonia	solid	short ton	300.0	5.0	0.0	82.0			0.0							
<input checked="" type="checkbox"/>	Urea (46-0-0)	solid	short ton	250.0	4.0	0.0	46.0										
<input checked="" type="checkbox"/>	Urea ammonium nitrate (32-0-0-0)	liquid	short ton	150.0	1.0	300.0	32.0										
<input checked="" type="checkbox"/>	10-34-0	liquid	short ton	230.0	6.0	0.0	10.0	34.0									

- Clicking on [**Calculate**] results in the revised solution, now including anhydrous ammonia (pre-plant), 32-0-0 (fertigations), DAP, MOP, and sulfur (all pre-plant). The total cost of the modified fertilizer program is \$68.8/acre. This is only \$3.8/acre more than the original solution and a yield increase of just 2 bu corn/acre would easily make up for that extra cost.
- As a next step, we need to consider that DAP, MOP, and sulfur could probably be applied as a custom blend in one pre-plant pass. Consequently, the application cost of \$4/acre should only be applied once to the cost calculation. Therefore, we make the following change:
- Under [**Fertilizer Sources**] or directly on the [**Results**] page, we set the values for application cost to \$4/acre for DAP, but \$0/acre for MOP and Sulfur, assuming that those would be blended with the DAP. Recalculate.

Fertilizer Reports

File View Help

Crop/Farm Info

Crop Name: Field: Total Area: Acre

N: P2O5: K2O: S: Other: Other:

Target (lb/acre)

Result (lb/acre)

Nutrients supplied with each fertilizer

Recommended Fertilizers	N	P2O5	K2O	S	Other	Other
Anhydrous ammonia	62	0	0	0	0	0
Urea ammonium nitrate (32-0-0)	96	0	0	0	0	0
Diammonium phosphate (18-46-0)	16	40	0	0	0	0
Potassium chloride (MOP,0-0-60)	0	0	40	0	0	0
Sulfur	0	0	0	10	0	0

Recommended amounts and cost of fertilization

Recommended Fertilizers	Price	(CU/WU)	App.Cost(CU/AU)	Amount(RU)	Cost(CU/AU)	Total Amount(lb)	Total Cost(CU)
Anhydrous ammonia	300.0	Dollar/short ton	5.0	75.4	16.3	7,539.9	1,630
Urea ammonium nitrate (32-0-0)	150.0	Dollar/short ton	1.0	300	23.5	30,000	2,350
Diammonium phosphate (18-4-...	230.0	Dollar/short ton	4.0	86.9	14	8,690	1,400
Potassium chloride (MOP,0-0-...	160.0	Dollar/short ton	0.0	66.6	5.3	6,660.1	530
Sulfur	300.0	Dollar/short ton	0.0	11.1	1.7	1,110	170
Total			10.0	540	60.8	54,000	6,080

CU - Currency Unit (Dollar: United States) AU - Area Unit (Acre) RU - Recommendation Unit (lb/acre) Total amount Unit

FertilizerSources Home Help Save As Copy to Clipboard Print Exit

- Our final result is now \$60.8/acre or \$6080 for the entire field. This program can be implemented well and it ensures high N use efficiency and profit.

- We may also evaluate the cost of a fertilizer program that includes a starter fertilizer since our planter is equipped for this. For example, a fixed amount of 60 lb/acre 8-20-5-5 starter could be applied during planting to boost emergence and early vegetative growth of corn on this sandy soil.
- Under **[Fertilizer Sources]**, enter 60 lbs/acre as minimum amount for this starter fertilizer and review the result:

Fertilizer Reports

File View Help

Crop/Farm Info

Crop Name: Field: Total Area: Acre

	N	P2O5	K2O	S	Other	Other
Target (lb/acre)	<input type="text" value="185"/>	<input type="text" value="40"/>	<input type="text" value="40"/>	<input type="text" value="10"/>	<input type="text"/>	<input type="text"/>
Result (lb/acre)	<input type="text" value="173"/>	<input type="text" value="39"/>	<input type="text" value="40"/>	<input type="text" value="10"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

Nutrients supplied with each fertilizer

Recommended Fertilizers	N	P2O5	K2O	S	Other	Other
Anhydrous ammonia	62	0	0	0	0	0
Urea ammonium nitrate (32-0-0)	96	0	0	0	0	0
Diammonium phosphate (18-46-0)	10	27	0	0	0	0
Potassium chloride (MOP,0-0-60)	0	0	37	0	0	0
Starter 8-20-5-5-0.5	5	12	3	3	0	0
Sulfur	0	0	0	7	0	0

Recommended amounts and cost of fertilization

Recommended Fertilizers	Price	(CU/WU)	App.Cost(CU/AU)	Amount(RU)	Cost(CU/AU)	Total Amount(lb)	Total Cost(CU)
Anhydrous ammonia	300.0	Dollar/short ton	5.0	75.3	16.3	7,530	1,630
Urea ammonium nitrate (32-0-0)	150.0	Dollar/short ton	1.0	300	23.5	30,000	2,350
Diammonium phosphate (18-46-0)	230.0	Dollar/short ton	4.0	57.8	10.6	5,780	1,060
Potassium chloride (MOP,0-0-60)	160.0	Dollar/short ton	0.0	61	4.9	6,100.1	490
Starter 8-20-5-5-0.5	195.0	Dollar/short ton	0.3	60	6.1	6,000	610
Sulfur	300.0	Dollar/short ton	0.0	7.4	1.1	740.1	110
Total			10.3	561.5	62.5	56,150.2	6,250

CU - Currency Unit (Dollar: United States) AU - Area Unit (Acre) RU - Recommendation Unit (lb/acre) Total amount Unit

- The additional cost of the starter fertilizer is \$1.7/acre, which is less than 1bu/acre yield. It may be well worth spending that extra money. Also note how the amounts of DAP, MOP, and Sulfur have been adjusted downwards to account for the nutrient amounts provided by the starter fertilizer.
- Proceed to **[Save As]** or **[Print]** the result.
- Try various other options to identify the fertilizer program that best fits your needs. You may also evaluate how much extra money you would have to invest to apply larger amounts of one or more nutrients, including micronutrients. For example, you may wish to invest in building up soil P levels. Evaluate what it would cost to apply 100 lb P₂O₅/acre as compared to just 40 lb P₂O₅/acre. Change the target recommendation for P on the results page to 100 and re-calculate. The increased P amount adds \$11/acre to the total cost of the fertilizer program.

Example 2: Irrigated rice, Philippines

1. Select Philippine Peso (PhP) and enter the exchange rate to the US\$, then select Hectare as Area Unit and kg/ha as Recommendation Unit used in the Philippines. Verify that the conversion factors are correct. Click **[Save]** to make your selection active.

2. Enter the Crop/Field information: We assume a 2.5 ha farm to be planted with irrigated rice in the dry season:

3. Enter the target amounts of nutrients to apply: irrigated rice is grown on Vertisols and Inceptisols with medium to heavy texture (clay loam to clay), moderate organic matter content, low extractable Olsen-P, and low exchangeable soil K level. Omission plots were installed to estimate the indigenous soil nutrient supplies of N, P and K, and fertilizer recommendations were worked out according to the site-specific nutrient management approach for rice (www.knowledgebank.irri.org/ssnm). The following rates of N, P, and K are recommended to achieve target yields of 6.0 to 6.5 t ha⁻¹ in the dry season (DS) and 5.0 to 5.5 t ha⁻¹ in the wet season (WS):

Nutrient	Nutrient addition (kg/ha)		
	Dry season		Wet season
	Transplanted rice	Broadcast seeded rice	Transplanted rice
N	130*	130*	80*
P ₂ O ₅	35	35	20
K ₂ O	65	65	20

* The fertilizer N requirement varies from season to season and adjustments will be made during the season.

In our example, we focus on the DS recommendation and enter:

4. Select and edit locally available fertilizer sources. First, we need to define “bag” as a new fertilizer weight unit. On page **[Fertilizer Sources]**, go to **View → Weight Unit** and define “Bag” as the new unit:

Fertilizer Choices to consider are:

- Nitrogen sources: Ammoniumsulfate (21-0-0): 278 PhP per 50 kg bag
Urea (46-0-0): 530 PhP per 50 kg bag,
- Phosphorus sources: Solophos (0-18-0): 303 PhP per 50 kg bag
- Potassium sources: KCl (muriate of potash - MOP): 454 PhP per 50 kg bag
- Combined fertilizers 14-14-14 465 PhP per 50 kg bag
17-7-17 475 PhP per 50 kg bag
17-0-17 485 PhP per 50 kg bag
16-20-0 419 PhP per 50 kg bag
20-10-0 400 PhP per 50 kg bag

Edit/enter all those fertilizers, prices, and nutrient concentrations. No application costs are specified. Save your customized fertilizer table (**File → Save As**):

Fertilizer Sources (rice_Philippines.mdb)
 File View Help
 CU = Currency Unit (Peso: Philippine) AU = Area Unit (Hectare) RU = Recommendation Unit (kg/ha)
 CU/AU = Application Cost (Peso: Philippine/Hectare) CU/WU = Fertilizer price quote WU = Weight Unit (for fertilizer price quote)

FERTILIZER SOURCES																	
S.	Fertilizer Source	Type	WeightU... (WU)	Price (CU/WU)	AppCost (CU/AU)	Min Amo... (RU)	N %	P205 %	K2O %	S %	Zn %	Fe %	Cu %	Mn %	B %	CaO %	MgO %
<input checked="" type="checkbox"/>	Ammonium sulfate	solid	bag	278.0	0.0	0.0	21.0			24.0							
<input checked="" type="checkbox"/>	Urea	solid	bag	530.0	0.0	0.0	46.0										
<input type="checkbox"/>	Diammonium phosphate (DAP)	solid			0.0	0.0	18.0	46.0									
<input checked="" type="checkbox"/>	Solophos (0-18-0)	solid	bag	303.0	0.0	0.0		18.0									48.0
<input type="checkbox"/>	Superphosphate, triple	solid			0.0	0.0		45.0		1.5							18.0
<input checked="" type="checkbox"/>	Potassium chloride (MOP)	solid	bag	454.0	0.0	0.0			60.0								
<input type="checkbox"/>	Potassium nitrate	solid			0.0	0.0	13.0		44.0								
<input checked="" type="checkbox"/>	14-14-14	solid	bag	465.0	0.0	0.0	14.0	14.0	14.0								
<input checked="" type="checkbox"/>	16-20-0	solid	bag	419.0	0.0	0.0	16.0	20.0									
<input checked="" type="checkbox"/>	17-0-17	solid	bag	485.0	0.0	0.0	17.0		17.0								
<input checked="" type="checkbox"/>	17-7-17	solid	bag	475.0	0.0	0.0	17.0	7.0	17.0								
<input checked="" type="checkbox"/>	20-10-0	solid	bag	400.0													
<input type="checkbox"/>	Zinc sulfate	solid			0.0	0.0					36.0						

Select All Deselect All Insert Row Delete Row Help Home Calculate

5. Click [Calculate] and review the result:

Fertilizer Reports
 File View Help

Crop-Farm Info
 Crop Name: Rice Field: Lazo Total Area: 2.5 Hectare

	N	P205	K2O	Other	Other	Other
Target (kg/ha)	130	35	65			
Result (kg/ha)	130	35	65	0	0	0

Nutrients supplied with each fertilizer

Recommended Fertilizers	N	P205	K2O	Other	Other	Other
Urea	102	0	0	0	0	0
Potassium chloride (MOP)	0	0	65	0	0	0
16-20-0	28	35	0	0	0	0

Recommended amounts and cost of fertilization

Recommended Fertilizers	Price	(CU/WU)	App.Cost(CU/AU)	Amount(RU)	Cost(CU/AU)	Total Amount(kg)	Total Cost(CU)
Urea	530.0	Peso/bag	0.0	221.7	2,350	554.3	5,875
Potassium chloride (MOP)	454.0	Peso/bag	0.0	108.3	983.4	270.8	2,458.5
16-20-0	419.0	Peso/bag	0.0	175	1,466.5	437.5	3,666.3
Total			0.0	505	4,799.9	1,262.6	11,999.8

CU - Currency Unit (Peso: Philippine) AU - Area Unit (Hectare) RU - Recommendation Unit (kg/ha) Total amount Unit kg

FertilizerSources Home Help Save As Copy to Clipboard Print Exit

The result matches the target and the least costly combination of fertilizers includes urea, MOP and 16-20-0 as nutrient sources, resulting in a cost of 4800 Pesos per hectare. However, since all fertilizer P should be applied shortly before or after crop establishment, applying 175 kg of 16-20-0 would not only supply all targeted fertilizer P, but also 28 kg N/ha. A smaller N dose of 20 kg N/ha would be desirable early in the season when plants are still small and fertilizer N requirement is low. Therefore, in a second run, we evaluate how the result would change if only single-nutrient fertilizers were chosen. De-select all compound fertilizers under **[Fertilizer Sources]** and re-run the calculation:

Fertilizer Reports

File View Help

Crop/Farm Info

Crop Name: Rice Field: Lazo Total Area: 2.5 Hectare

N: P205: K20: Other: Other: Other:

Target (kg/ha): 130 35 65

Result (kg/ha): 130 35 65 0 0 0

Nutrients supplied with each fertilizer

Recommended Fertilizers	N	P205	K20	Other	Other	Other
Urea	130	0	0	0	0	0
Solophos (0-18-0)	0	35	0	0	0	0
Potassium chloride (MOP)	0	0	65	0	0	0

Recommended amounts and cost of fertilization

Recommended Fertilizers	Price	(CU/WU)	App.Cost(CU/AU)	Amount(RU)	Cost(CU/AU)	Total Amount(kg)	Total Cost(CU)
Urea	530.0	Peso/bag	0.0	262.6	2,995.6	706.5	7,489.3
Solophos (0-18-0)	303.0	Peso/bag	0.0	194.4	1,178.1	486	2,945.3
Potassium chloride (MOP)	454.0	Peso/bag	0.0	108.3	983.4	270.8	2,458.5
Total			0.0	585.3	5,157.1	1,463.3	12,892.8

CU - Currency Unit (Peso: Philippine) AU - Area Unit (Hectare) RU - Recommendation Unit (kg/ha) Total amount Unit kg

FertilizerSources Home Help Save As Copy to Clipboard Print Exit

- This combination of fertilizer sources is about 360 PhP/ha or 7 US\$/ha more expensive than the previous solution, but would allow splitting N as desired. However, farmers in the Philippines often prefer to use combined fertilizers because of greater convenience. Therefore, in addition to the previously selected single-nutrient fertilizers, we also select 14-14-14 under **[Fertilizer Sources]** and review the result again:

Fertilizer Reports

File View Help

Crop/Farm Info

Crop Name: Rice Field: Lazo Total Area: 2.5 Hectare

N: P205: K20: Other: Other: Other:

Target (kg/ha): 130 35 65

Result (kg/ha): 130 35 65 0 0 0

Nutrients supplied with each fertilizer

Recommended Fertilizers	N	P205	K20	Other	Other	Other
Urea	95	0	0	0	0	0
Potassium chloride (MOP)	0	0	30	0	0	0
14-14-14	35	35	35	0	0	0

Recommended amounts and cost of fertilization

Recommended Fertilizers	Price	(CU/WU)	App.Cost(CU/AU)	Amount(RU)	Cost(CU/AU)	Total Amount(kg)	Total Cost(CU)
Urea	530.0	Peso/bag	0.0	206.5	2,188.9	516.3	5,472.3
Potassium chloride (MOP)	454.0	Peso/bag	0.0	50	454	125	1,135
14-14-14	465.0	Peso/bag	0.0	250	2,325	625	5,812.5
Total			0.0	506.5	4,967.9	1,266.3	12,419.8

CU - Currency Unit (Peso: Philippine) AU - Area Unit (Hectare) RU - Recommendation Unit (kg/ha) Total amount Unit kg

FertilizerSources Home Help Save As Copy to Clipboard Print Exit

- This selection suggests to apply 250 kg 14-14-14 as the only P source early in the season. This would, however, also provide 35 kg N/ha of pre-plant N. To avoid this problem, we set the constraint to use at least two bags of Solophos/ha. Under **[Fertilizer Sources]**, we specify 100 kg/ha as minimum amount for Solophos and recalculate:

Crop Farm Info

Crop Name: Rice Field: Lazo Total Area: 2.5 Hectare

	N	P205	K20	Other	Other	Other
Target (kg/ha)	130	35	65			
Result (kg/ha)	130	35	65	0	0	0

Nutrients supplied with each fertilizer

Recommended Fertilizers	N	P205	K20	Other	Other	Other
Urea	113	0	0	0	0	0
Solophos (0-18-0)	0	18	0	0	0	0
Potassium chloride (MOP)	0	0	48	0	0	0
14-14-14	17	17	17	0	0	0

Recommended amounts and cost of fertilization

Recommended Fertilizers	Price	(CU/WU)	App.Cost(CU/AU)	Amount(RU)	Cost(CU/AU)	Total Amount(kg)	Total Cost(CU)
Urea	530.0	Peso/bag	0.0	245.7	2,604.4	614.3	6,511.1
Solophos (0-18-0)	303.0	Peso/bag	0.0	100	606	250	1,515
Potassium chloride (MOP)	454.0	Peso/bag	0.0	80	726.4	200	1,816
14-14-14	465.0	Peso/bag	0.0	121.4	1,129	303.5	2,822.5
Total			0.0	547.1	5,065.8	1,367.8	12,664.5

CU - Currency Unit (Peso; Philippine) AU - Area Unit (Hectare) RU - Recommendation Unit (kg/ha) Total amount Unit: kg

Buttons: FertilizerSources, Home, Help, Save As, Copy to Clipboard, Print, Exit

- This solution satisfies all needs. Phosphorus is all applied early as Solophos and 14-14-14, some K is applied with the 14-14-14, more K can be applied later during the growing season, and the amount of pre-plant N is kept small (17 kg N/ha). All remaining N can be applied as urea in various splits throughout the growing season and using diagnostic tools such as a Leaf Color Chart (LCC).
6. For the final recommendation, we round the application amounts to ½ bag (25 kg) amounts:

Crop Farm Info

Crop Name: Rice Field: Lazo Total Area: 2.5 Hectare

	N	P205	K20	Other	Other	Other
Target (kg/ha)	130	35	65			
Result (kg/ha)	133	36	63	0	0	0

Nutrients supplied with each fertilizer

Recommended Fertilizers	N	P205	K20	Other	Other	Other
Urea	113	0	0	0	0	0
Solophos (0-18-0)	0	18	0	0	0	0
Potassium chloride (MOP)	0	0	48	0	0	0
14-14-14	17	17	17	0	0	0

Recommended amounts and cost of fertilization

Recommended Fertilizers	Price	(CU/WU)	App.Cost(CU/AU)	Amount(RU)	Cost(CU/AU)	Total Amount(kg)	Total Cost(CU)
Urea	530.0	Peso/bag	0.0	250	2650.0	625.0	6650.0
Solophos (0-18-0)	303.0	Peso/bag	0.0	100	606	250	1,515
Potassium chloride (MOP)	454.0	Peso/bag	0.0	75	681.0	187.5	1,727.5
14-14-14	465.0	Peso/bag	0.0	125	1162.5	312.5	2,931.3
Total			0.0	450.0	5099.5	187.5	17958.8

CU - Currency Unit (Peso; Philippine) AU - Area Unit (Hectare) RU - Recommendation Unit (kg/ha) Total amount Unit: kg

Buttons: FertilizerSources, Home, Help, Save As, Copy to Clipboard, Print, Exit

Example 3: Oilpalm, Indonesia

1. Select Rupiah: Indonesia and enter the exchange rate to the US\$, then select Hectare as Area Unit and kg/ha as Recommendation Unit used in Indonesia. Verify that the conversion factors are correct. Click [**Save**] to make your selection active.

2. Enter the Crop/Field information: A fertilization program needs to be developed for a 750-ha oilpalm plantation.

3. Enter the target amounts of nutrients to apply: Oilpalm is grown on tropical soils with low to medium nutrient status and the fertilizer program must supply the following nutrient amounts, none of those is to be ignored:

	N	P ₂ O ₅	K ₂ O	MgO	S	B
Target Amounts	180	60	250	20	25	5
Equivalent in Element	180	26	208	12	25	5
	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore	<input type="checkbox"/> Ignore

4. Select and edit locally available fertilizer sources. Choices to consider are:

Nitrogen sources:

Urea, Rp. 1,500/kg
Ammonium sulfate, Rp. 1,300/kg

Phosphorus sources:

Rock phosphate, fine, Rp. 625/kg
Triple superphosphate, Rp. 1,900/kg
SP-36, Rp. 1,400/kg
DAP, Rp. 3,250/kg

Potassium sources:

KCl (muriate of potash – MOP), Rp. 2,000/kg
Potassium sulfate, Rp. 2,800/kg

Magnesium, sulfur, boron:

Kieserite, Rp. 1,200/kg
Dolomite, Rp. 290/kg
Magnesium sulfate (Epsom salt), Rp. 1450/kg
Na borate (48% B), Rp. 6,000/kg

- Save those choices in a custom table by clicking on **File → Save As**

Fertilizer Sources (oilpalm_Indonesia.mdb)

File View Help

CU = Currency Unit (Rupiah: Indonesian) AU = Area Unit (Hectare) RU = Recommendation Unit (kg/ha)
 CU/AU = Application Cost (Rupiah: Indonesian/Hectare) CU/WU = Fertilizer price quote WU = Weight Unit (for fertilizer price quote)

FERTILIZER SOURCES

...	Fertilizer Source	Ty...	Weigh... (WU)	Price (CU/W...)	AppC... (CU/AU)	MinA... (RU)	N %	P2... %	K2O %	S %	Zn %	Fe %	Cu %	Mn %	B %	CaO %	MgO %
<input checked="" type="checkbox"/>	Ammonium sulfate (21-...	solid	kg	1300.0	0.0	0.0	21.0			24.0							
<input checked="" type="checkbox"/>	Urea (46-0-0)	solid	kg	1500.0	0.0	0.0	46.0										
<input checked="" type="checkbox"/>	Diammonium phosphat...	solid	kg	3250.0	0.0	0.0	18.0	46.0									
<input checked="" type="checkbox"/>	Rock phosphate, fine	solid	kg	625.0	0.0	0.0	11.0	32.0									
<input checked="" type="checkbox"/>	SP-36	solid	kg	1400.0	0.0	0.0	36.0										
<input checked="" type="checkbox"/>	Superphosphate, triple	solid	kg	1900.0	0.0	0.0		45.0		1.5						18.0	
<input checked="" type="checkbox"/>	Potassium chloride (MO...	solid	kg	2000.0	0.0	0.0			60.0								
<input checked="" type="checkbox"/>	Potassium sulfate	solid	kg	2800.0	0.0	0.0			50.0	18.0							
<input checked="" type="checkbox"/>	Dolomite	solid	kg	290.0	0.0	0.0										30.0	16.0
<input checked="" type="checkbox"/>	Kieserite	solid	kg	1200.0	0.0	0.0				22.0							45.0
<input checked="" type="checkbox"/>	Magnesium sulfate (Ep...	solid	kg	1450.0	0.0	0.0				13.0							17.0
<input checked="" type="checkbox"/>	Na-Borate	solid	kg	6000.0	0.0	0.0									48.0		

Select All Deselect All Insert Row Delete Row Help Home Calculate

All application costs are set to zero because they are included in the prices quoted for fertilizers. Manual spreading is US\$15 per ton of fertilizer; mechanical spreading is US\$5 per ton.

5. Click [Calculate] and review the result:

Fertilizer Reports

File View Help

Crop/Farm Info

Crop Name Field Total Area Hectare

N P205 K2O MgO S B

Target (kg/ha)

Result (kg/ha)

Nutrients supplied with each fertilizer

Recommended Fertilizers	N	P205	K2O	MgO	S	B
Ammonium sulfate (21-0-0-24)	13	0	0	0	15	0
Urea (46-0-0)	146	0	0	0	0	0
Rock phosphate, fine	21	60	0	0	0	0
Potassium chloride (MOP,0-0-60)	0	0	250	0	0	0
Kieserite	0	0	0	20	10	0
Na-Borate	0	0	0	0	0	5

Recommended amounts and cost of fertilization

Recommended Fertilizers	Price	(CU/WU)	App.Cost(CU/AU)	Amount(RU)	Cost(CU/AU)	T.Amount(kg)	T.Cost(CU)
Ammonium sulfate (21-0-0-24)	1300.0	Rupiah/kg	0.0	63.4	82,420	47,550	61,815,000
Urea (46-0-0)	1500.0	Rupiah/kg	0.0	317.5	476,250	238,125	357,187,500
Rock phosphate, fine	625.0	Rupiah/kg	0.0	187.5	117,187.5	140,625	87,890,625
Potassium chloride (MOP,0-...	2000.0	Rupiah/kg	0.0	416.7	833,400	312,525	625,050,000
Kieserite	1200.0	Rupiah/kg	0.0	44.4	53,280	33,300	39,960,000
Na-Borate	6000.0	Rupiah/kg	0.0	10.4	62,400	7,800	46,800,000
Total			0.0	1,039.9	1,624,937.5	779,925	1,218,703,1...

CU - Currency Unit (Rupiah: Indonesian) AU - Area Unit (Hecta... RU - Recommendation Unit (... Total amount Unit

FertilizerSources Home Help Save As Copy to Clipboard Print Exit

- The total cost of this fertilizer program is Rs. 1.625 million/ha or US\$191/ha. Urea is the most cost-effective N source available and supplies most of the recommended N dose. Finely ground rock phosphate is the least costly P source. Because the soil is acid (pH 4.5), this is a viable option. For comparison, if rock phosphate is not available or not desirable, the next best solution would be one with triple superphosphate, which increases the total cost by 11% to Rs. 1.823 million/ha (US\$214.5/ha):

Fertilizer Reports

File View Help

Crop/Farm Info

Crop Name Field Total Area Hectare

N P2O5 K2O MgO S B

Target (kg/ha)

Result (kg/ha)

Nutrients supplied with each fertilizer

Recommended Fertilizers	N	P2O5	K2O	MgO	S	B
Ammonium sulfate (21-0-0-24)	12	0	0	0	13	0
Urea (46-0-0)	168	0	0	0	0	0
Superphosphate, triple	0	60	0	0	2	0
Potassium chloride (MOP,0-0-60)	0	0	250	0	0	0
Kieserite	0	0	0	20	10	0
Na-Borate	0	0	0	0	0	5

Recommended amounts and cost of fertilization

Recommended Fertilizers	Price	(CU/AU)	App.Cost(CU/...	Amount(RU)	Cost(CU/AU)	T.Amount(kg)	T.Cost(CU)
Ammonium sulfate (21-0-0-24) 1300...	Rupiah/kg	0.0	55.1	71,630	41,325	53,722,500	
Urea (46-0-0) 1500...	Rupiah/kg	0.0	366.2	549,300	274,650	411,975,000	
Superphosphate, triple 1900...	Rupiah/kg	0.0	133.3	253,270	99,975	189,952,500	
Potassium chloride (MOP,0... 2000...	Rupiah/kg	0.0	416.7	833,400	312,525	625,050,000	
Kieserite 1200...	Rupiah/kg	0.0	44.4	53,280	33,300	39,960,000	
Na-Borate 6000...	Rupiah/kg	0.0	10.4	62,400	7,800	46,800,000	
Total		0.0	1,026.1	1,823,280	769,575	1,367,460,...	

CU - Currency Unit (Rupiah: Indonesian) AU - Area Unit (Hecta... RU - Recommendation Unit (... Total amount Unit

FertilizerSources Home Help Save As Copy to Clipboard Print Exit

- Kieserite provides all of the magnesium and nearly half of sulfur required. We may explore, however, how much difference it would make to use Dolomite as the primary Mg source, assuming that it is available as finely ground material and would also be of benefit for raising the pH of this acid soil. Thus, we modify the original choice of available fertilizers by de-selecting Kieserite under **[Fertilizer Sources]**:

Fertilizer Sources (oilpalm_Indonesia.mdb)

File View Help

CU = Currency Unit (Rupiah: Indonesian) AU = Area Unit (Hectare) RU = Recommendation Unit (kg/ha)
 CU/AU = Application Cost (Rupiah: Indonesian/Hectare) CU/WU = Fertilizer price quote WU = Weight Unit (for fertilizer price quote)

FERTILIZER SOURCES

Fertilizer Source	Ty...	Weigh... (WU)	Price (CU/W...)	AppC... (CU/AU)	MinA... (RU)	N %	P2... %	K2O %	S %	Zn %	Fe %	Cu %	Mn %	B %	CaO %	MgO %
<input checked="" type="checkbox"/> Ammonium sulfate (21-0-0)	solid	kg	1300.0	0.0	0.0	21.0			24.0							
<input checked="" type="checkbox"/> Urea (46-0-0)	solid	kg	1500.0	0.0	0.0	46.0										
<input checked="" type="checkbox"/> Diammonium phosphat...	solid	kg	3250.0	0.0	0.0	18.0	46.0									
<input checked="" type="checkbox"/> Rock phosphate, fine	solid	kg	625.0	0.0	0.0	11.0	32.0									
<input checked="" type="checkbox"/> SP-36	solid	kg	1400.0	0.0	0.0	36.0										
<input checked="" type="checkbox"/> Superphosphate, triple	solid	kg	1900.0	0.0	0.0		45.0		1.5						18.0	
<input checked="" type="checkbox"/> Potassium chloride (MO...	solid	kg	2000.0	0.0	0.0			60.0								
<input checked="" type="checkbox"/> Potassium sulfate	solid	kg	2800.0	0.0	0.0			50.0	18.0							
<input checked="" type="checkbox"/> Dolomite	solid	kg	290.0	0.0	0.0										30.0	16.0
<input type="checkbox"/> Kieserite	solid	kg	1200.0	0.0	0.0				22.0							45.0
<input checked="" type="checkbox"/> Magnesium sulfate (Ep...	solid	kg	1450.0	0.0	0.0				13.0							17.0
<input checked="" type="checkbox"/> Na-Borate	solid	kg	6000.0	0.0	0.0										48.0	

Select All Deselect All Insert Row Delete Row Help Home Calculate

- Recalculation results in a solution that has nearly the same cost as the original solution, costing about Rs. 1.633 million/ha or US\$192/ha. In this case all sulfur is provided by ammonium sulfate and we may choose this program or the first solution, depending on our own priorities for soil management.

Fertilizer Reports

File View Help

Crop/Farm Info

Crop Name Field Total Area Hectare

N P205 K2O MgO S B

Target (kg/ha)

Result (kg/ha)

Nutrients supplied with each fertilizer

Recommended Fertilizers	N	P205	K2O	MgO	S	B
Ammonium sulfate (21-0-0-24)	22	0	0	0	25	0
Urea (46-0-0)	137	0	0	0	0	0
Rock phosphate, fine	21	60	0	0	0	0
Potassium chloride (MOP,0-0-60)	0	0	250	0	0	0
Dolomite	0	0	0	20	0	0
Na-Borate	0	0	0	0	0	5

Recommended amounts and cost of fertilization

Recommended Fertilizers	Price	(CU/WU)	App.Cost(CU/AU)	Amount(RU)	Cost(CU/AU)	T.Amount(kg)	T.Cost(CU)
Ammonium sulfate (21-0-0-24)	1300...	Rupiah/kg	0.0	104.2	135,460	78,150	101,595,000
Urea (46-0-0)	1500...	Rupiah/kg	0.0	298.9	448,350	224,175	336,262,500
Rock phosphate, fine	625.0	Rupiah/kg	0.0	187.5	117,187.5	140,625	87,890,625
Potassium chloride (MOP,0-...	2000...	Rupiah/kg	0.0	416.7	833,400	312,525	625,050,000
Dolomite	290.0	Rupiah/kg	0.0	125	36,250	93,750	27,187,500
Na-Borate	6000...	Rupiah/kg	0.0	10.4	62,400	7,800	46,800,000
Total			0.0	1,142.7	1,633,047.5	857,025	1,224,785,6...

CU - Currency Unit (Rupiah: Indonesian) AU - Area Unit (Hecta... RU - Recommendation Unit (... Total amount Unit

FertilizerSources Home Help Save As Copy to Clipboard Print Exit