ONLINE ECONOMIC CALCULATOR FOR THE APPLICATION OF TREATMENTS IN CROPS – AFRICAN VERSION

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1. INTRODUCTION

There is a wide range of treatments that a crop can receive to increase its production or quality, such as the application of fertilizers, growth regulators and stimulators, or sanitary treatments to protect the crop from damage due to competition with weeds, the occurrence of diseases or insect attacks (such as Spodoptera frugiperda, the armyworm).

A detailed evaluation of the desirability of carrying out the treatment should compare the increase in expected income (expressed in kg of product/ha or $/ha) with the total cost of the treatment (expressed in the same units as the expected income), including the cost of the product, the cost of its application and possible yield losses due to crop damage when applying is done (losses due to trampling or plant breakage). Although these calculations do not have a great algebraic difficulty, the computation would be facilitated by means of a specific program for this purpose. The objective of this article is to present an interactive web page for calculating the total cost of a wide range of treatments in a wide variety of crops.

The web page presented was developed within the framework of the agreement between INTA Balcarce (National Institute of Agricultural Technology, Agricultural Experimental Station Balcarce; Buenos Aires, Argentina; https://inta.gob.ar/balcarce) and the International Program of AAPRESID (Argentine Association of Direct Sowing Producers, Argentina; https://www.aapresid.org.ar), with the intention of promoting conservation agriculture among African producers. The page is based on a page previously developed by J.P. Edwards Molina and P.E. Abbate (https://cultivaresargentinos.com/proteccion) aimed at evaluating treatments in grain crops of Argentine producers.

2. DESCRIPTION OF THE WEB PAGE

2.1. Programmatic website design

The web page was written using the HTML 5, CSS 3 and JavaScript 5 languages. HTML is a specific language for creating web pages and acts as a link between the user and the rest of the program. CSS was the language with which the visual style was programmed (format) of the page elements and JavaScript is the language in which the calculation itself was programmed. The page does not use cookies (information sent by a website and stored in the user's browser), except for the standard cookies of the browser used.

2.2. Access to the web page

To access the web page, it is necessary to have an Internet connection during or before its use (the page can be opened in a browser with an Internet connection and can be used later without an Internet connection). The page is free and open access, it does not require a subscription or the installation of any additional application. It can be accessed from any device (computer, mobile phone, etc.) that can run any of the most popular web browsers. The page is available at the web address:

2.3. Units used

The web page uses the International System of Units, but can be used with other units taking into account the following conversions:

Monetary unit: The web page is compatible with any monetary unit ($), as long as it remains the same in all input data.

Surface unit: The surface unit chosen to enter the data on the website was the hectare (1 ha = 10000 m^2 = 2.4710 acres), but another unit could be used, as long as it remains the same in all input data.

Weight units: The weight units used by the website are the kilogram and the metric ton (1 kg = 1/1000 t = 2.2046 pounds). These units must be respected, since the website converts between them.

Yield units: The yield unit used on the website is the kilogram per hectare (kg/ha); 1 kg/ha = 0.4047 t/acre = 0.0159 bushels (bu)/acre of 56 lb/bu corn or sorghum grain = 0.0149 bu/acre of 60 lb/bu wheat or soybean grain.

Price units: The price units used on the website are the chosen monetary unit per metric ton ($/t) or per hectare ($/ha); $1/t = 453.6 $/pound (lb) = 0.2540 $/bushel (bu) of grain corn or sorghum at 56 lb/bu = 0.2722 $/bu of grain wheat or soybean at 60 lb/bu; 1 $/ha = 0.4047 $/acre.

2.3.1. General data entry section

The data to enter in this section is (Fig. 2):

Product price ($/t): expected sale price of the harvested product (grain or any other plant organ), applying the treatment being evaluated, without discounting variable expenses (expenses that vary with the yield obtained); expressed in the chosen monetary unit per ton of product.

Variable expenses (%): expenses that vary when the yield obtained varies, including the expenses of harvesting (e.g. purchase of bags), drying of the product, transporting the product, marketing, etc.; expressed as a percentage of the product price.

Expected yield (kg/ha): expected yield applying the treatment being evaluated; expressed in kilograms of product per hectare.
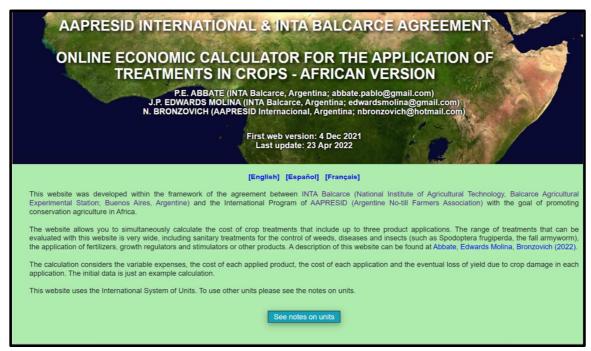
Fig. 1. Screenshot of the web page header.

2.3.1. Application data entry section

The page is ready to enter data from up to three applications. The data to be entered for each application are as follows (Fig. 2):

Cost of the applied product ($/ha): cost of the product to be applied, including adjuvants, but excluding application expenses; expressed in the monetary unit chosen per hectare.

Application cost ($/ha): cost of the application without including the product, if the application causes damage to the crop (e.g. by stepping on plants) enter the loss in the cells below; expressed in the monetary unit chosen per hectare.

Yield losses due to crop damage when applying is done (%): percentage losses due to trampling or breaking of plants; for aerial applications enter 0%; when the application damages the crop due to breakage or trampling of plants, enter the expected percentage loss; keep in mind that when the application generates damage, the damage is usually greater in the first application than in the following ones.

Finally, the "Calculate" button allows you to perform the calculation to update the result.

2.3.1. Results section

The values obtained after pressing the "Calculate" button are (Fig. 3):

Net price of the product ($/t): price of the product discounting the variable expenses; expressed in the monetary unit chosen when entering the data, per ton of product.

Yield losses due to damage to the crop when applying is done (kg/ha): yield losses considering the successive damage of the applications due to breaking or trampling of plants; expressed in kilograms of product per unit area chosen when entering the data.

Treatment cost ($/ha): cost of the treatment considering the variable expenses, cost of the applied products, application cost and yield losses due to application damage; expressed in the monetary unit chosen per hectare.
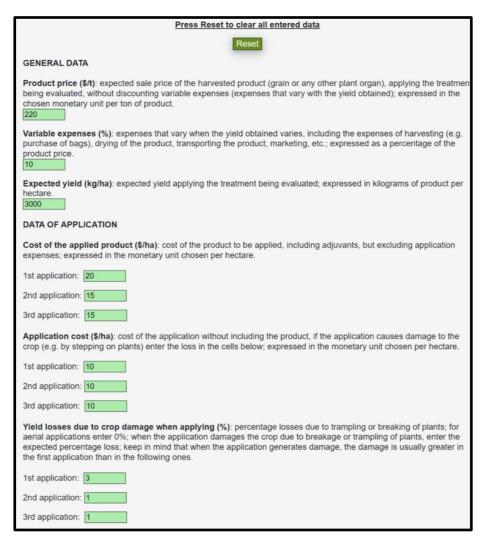

Fig. 2. Screenshot of the data entry selection and results of the web page.

Treatment cost (kg/ha): cost of the treatment considering the variable expenses, the cost of the applied products, the application cost and the yield losses due to application damage; expressed in kilograms of product per hectare.

Total cost ($/ha or kg/ha): is the sum of the costs of all applications made.

If the calculated total cost (expressed in $/ha, kg/ha or in the units chosen when entering the data) exceeds the expected increase in income (expressed in the same units as the total cost), the treatment is not economically convenient.

3. Calculation methodology

The page can be used to calculate the total cost of crop treatments with two temporal modalities: *a priori* (or *ex-ante*) and a *posteriori* (or *ex-post*), that is, before or after knowing the result of the treatment, respectively. In the first case, the precision of the data (expected performance, prices, etc.) is less than in the posterior

calculation, however, the page can be of great help in both cases since it allows evaluating several proposed scenarios. Regardless of the time mode, the algebraic calculation performed by the page is the same:

The net price of the product (PNP, $/t) is calculated from the price of the product (PP, $/t) and variable expenses (GV, %) as:

Ec.[1] $PNP = PP \cdot (1 - GV/100)$

Fig. 3. Screenshot of webpage results selection.

Yield losses due to crop damage (PRD, kg/ha) when applying i are calculated from the expected yield (RE, kg/ha), percentage yield losses (PRDP, %) and PRD of the previous application since the expected yield after the first application will be less than the RE entered as data:

Ec.[2] $PRD_i = \left(RE - \sum_{j=0}^{j=i-1} PRD_j \right) \cdot PRDP_i/100$

where $PRD_0 = 0$

The cost of the treatment of application i expressed in $/ha (CTM) is calculated from the corresponding cost of the applied product (CPA_i, $/ha), its application cost (CA_i, u$s/ha), the PRD_i and the PNP:

Ec.[3] $CTM_i = CPA_i + CA_i + PRD_i \cdot PNP/1000$

The total cost of the application expressed in $/ha ($CTMT$) is the sum of the CTM_i.

The cost of treatment of application i expressed in kg of product/ha (CTP) is calculated from the corresponding CTM_i and pnp :

Ec.[4] $CTP_i = CTM_i/PNP \cdot 1000$

Finally, the total cost of the application expressed in kg of grain/ha ($CTGT$) is the sum of the CTG_i.

If the calculated total cost (expressed in $/ha, kg/ha or the units chosen when entering the data) exceeds the expected income increase (expressed in the same units as the total cost), treatment is not economically convenient.