

REGULA: AN APP FOR PLANT GROWTH REGULATOR MANAGEMENT IN COTTON**F.R. Echer****São Paulo Western University – Unoeste
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Presidente Prudente, SP****Brazil****Abstract**

Plant growth regulators (PGR) are largely adopted by cotton growers in a wide range of growing conditions around the world. In large cotton fields, the timing between plant monitoring and decision-making must be short and a smartphone application (app) could help growers in the management of their fields. The purpose of this work was to present step by step the use of a smartphone application (REGULA) for PGR management in cotton fields. REGULA was built in Android Studio development platform, and the database used was SQLite, native of Android and for a better function's use API's fragments, Navigation Drawer and Swipe View Tabs were implemented. In the main menu the user is able to register the farm's name and size, field's name and size, crop year, PGR type, tank of spraying, plant sampling, rate calculation and re-applying and growth report. For plant sampling, the user must select the farm, field and crop year to start the measurement of plant height, node number and the length of the top five internodes. Collected samples can be accessed in the Consult tab by clicking the Refresh button. All samples available for each field can be viewed in this screen. For PGR rate calculation, the user has to select the farm, crop year, field, PGR type, tank, the sample and finally the cultivar maturity group. The rate will be displayed in the same screen, as well as the total amount of PGR needed for that field. Also, it is possible to consult the complete information about, PGR type, PGR rate and amount per field used in each application. REGULA also provides an option for reapplying PGR rates in cases of losses by rainfall, by just inserting the time without rain if it was used adjuvant. Additionally, it is possible to monitor plant growth, using a growth parameter to compare. Finally, a report for PGR rates applied and reapplied shows the number of collected samples, number of applications and the total amount of PGR applied in the field.

Introduction

Plant growth regulators (PGR) are largely adopted by cotton growers in a wide range of growing conditions around the world. Cultivar's characteristics and the environment drive the plant growth and the excessive amount of rain on the first months of the crop alternated with sunny, warm days may result in plant rank growth. Differences between cultivars, i.e., daily growth rates, and climate variability during the growing season and from year to year make it difficult to anticipate growth regulator rates and time of application. Additionally, the timing between plant monitoring and decision-making must be short and a smartphone application (app) could help growers in the management of their fields. The purpose of this work was to present step by step the use of a smartphone app (REGULA) for PGR management in cotton fields.

Materials and Methods

REGULA was developed based on a method for PGR management suggested by Echer and Rosolem (2015). REGULA was built in Android Studio development platform, and the database used was SQLite, native of Android and for a better function's use API's fragments, Navigation Drawer and Swipe View Tabs were implemented.

Results and Discussion

Registering Farm, Field, Crop Year, PGR and Tank

In the main menu the user is able to register the farm's name and size, field's name and size, crop year, PGR type, tank of spraying, plant sampling, rate calculation and re-applying and growth report (Figure 1). To register a new farm, the user must inform the farm's name and size (hectares) and then save (Figure 2). It is possible to edit an already registered farm. The next step is register the field. First, select the farm of that field belongs to and inform the field name and area and then save (Figure 3). After that, inform the crop year in the selected farm already registered (Figure 4). To register a new plant growth regulator (PGR), just provide the name and the mepiquat chloride/chlormequat chloride active ingredient concentration (Figure 5). It is also possible to edit or delete a PGR already registered. In the tank tab the user can register the tank's name, tank capacity (liters) and also the spray volume that will be used for the PGR application (Figure 6).

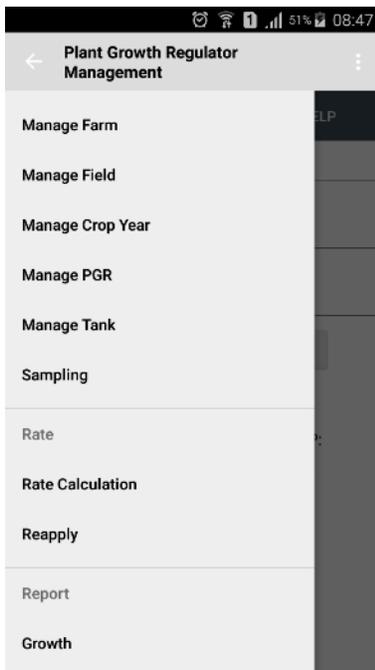


Figure 1. The main menu.

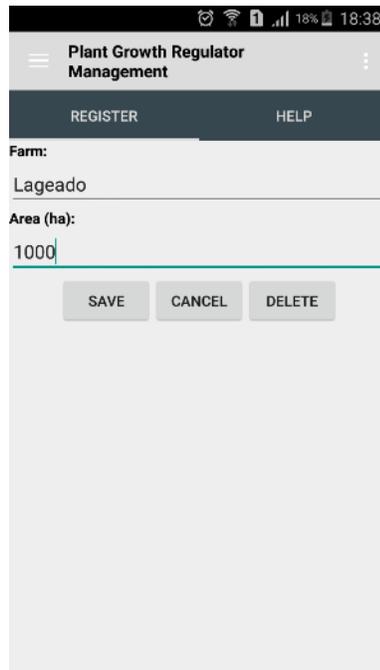


Figure 2. Farm registration.

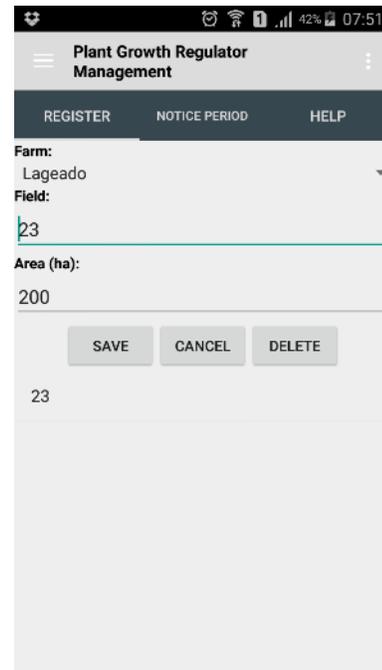


Figure 3. Field registration.

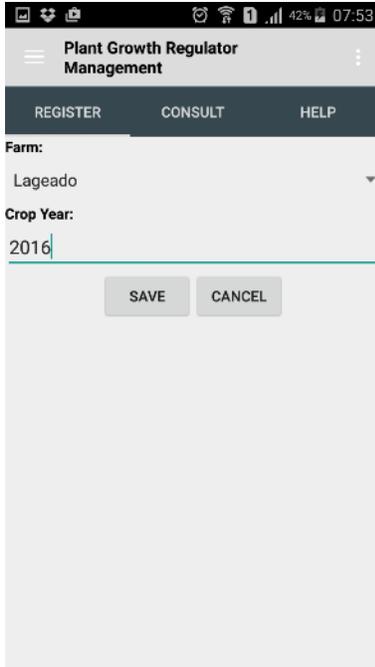


Figure 4. Crop year registration

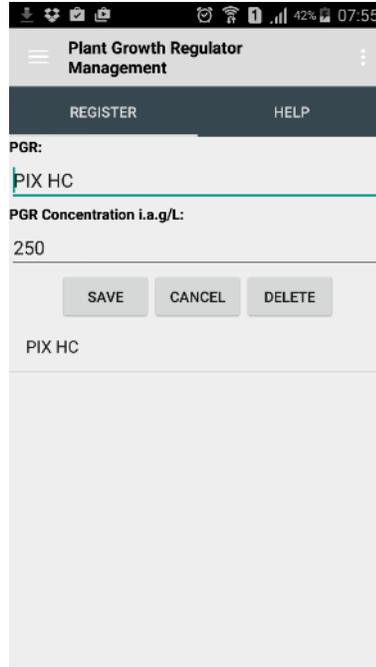


Figure 5. PGR registration.

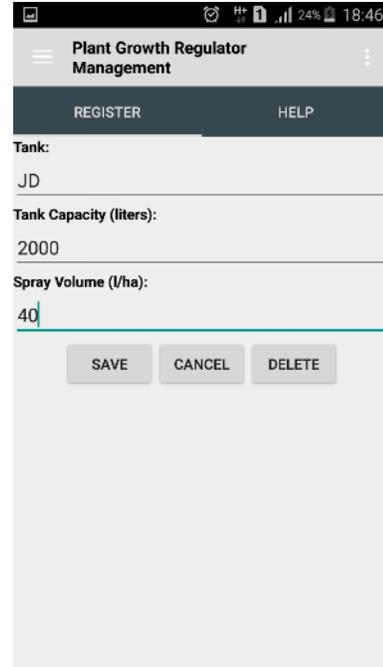


Figure 6. Tank registration.

Collecting samples

Next, the user must select the farm, field and crop year to start the measurement of plant height (in centimeters), node number and the length of the top five internodes (ALT5, according to Landivar, 1998) (in centimeters) (Figure 7). It is necessary to evaluate at least three plants to finish a sample (Figure 8). The value will be the average of three plants for plant height and node number. The ALT5 is automatically calculated by dividing the total length of the top 5 internodes by 5, and it indicates the plant growth vigor. Collected samples can be accessed in the Consult tab by clicking the Refresh button. All samples available for each field can be viewed in this screen (Figure 9).

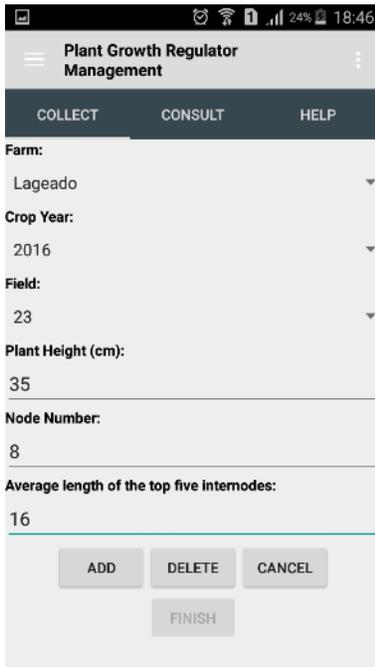


Figure 7. Collecting samples.

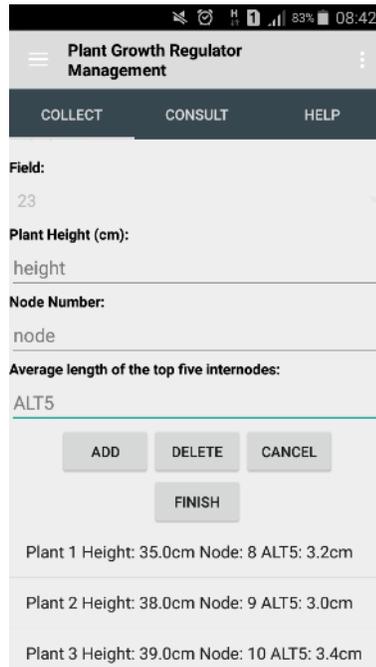


Figure 8. Adding a sample.

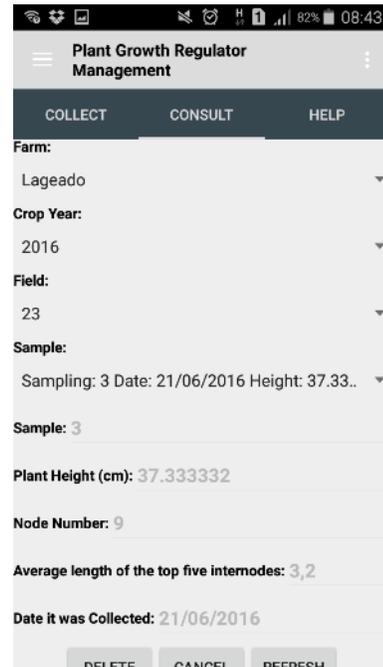


Figure 9. Consulting a sample.

PGR rate calculation

Next, the user must select the farm, crop year, field, PGR type, tank, the sample and finally the cultivar maturity group: Early for early cycle cultivar; Late for intermediate/late cycle cultivars or Late + favorable weather condition for fields with late cultivars plus a favorable weather condition for rank growth such as high temperatures and good soil humidity (Figure 10). In the same screen, the rate (ml ha⁻¹), the total amount of PGR (liters) needed for that field (rate multiplied by field area) and the number of tanks per field will be displayed below cultivar maturity information (Figure 11). In the consult tab, the user can check the complete information about, PGR type, PGR rate and amount per field used in each application (Figure 12).

PGR rate – reapply

Cotton fields, especially in tropical regions under rainfed conditions, are subjected to PGR losses due to rain occurrence after PGR application. In this case, it is necessary to reapply the PGR, and based on findings of Echer and Rosolem (2012), the amount of PGR to be reapplied is dependent of time without rain and adjuvant. The user needs to select the farm, field, the day of the last application, the time without rain (in minutes - from the last application to rainfall occurrence), the spray volume (l ha⁻¹) and inform if it was used adjuvant. The rate to be reapplied, the amount per tank and the amount per field will be displayed in the bottom of the screen (Figure 13). In the consult tab it is possible to check the date, PGR rate, adjuvant use and spray volume for each reapplication (Figure 14). Additionally, it is possible to monitor plant growth and a model proposed by Yeates (2007) is used as parameter (full line). Each evaluation done by the user and saved will add a dot in the graph (Figure 15), and when the dot is above the line, plant growth needs to be controlled. Finally, a report for PGR rates applied (Figure 16) and reapplied (Figure 17) shows the number of collected samples, number of applications and the total amount of PGR applied in the field.



Figure 10. Rate calculation: selecting farm, field, PGR, tank sample and cultivar.



Figure 11. Rate calculation: rate, total amount of PGR and number of tanks/field.

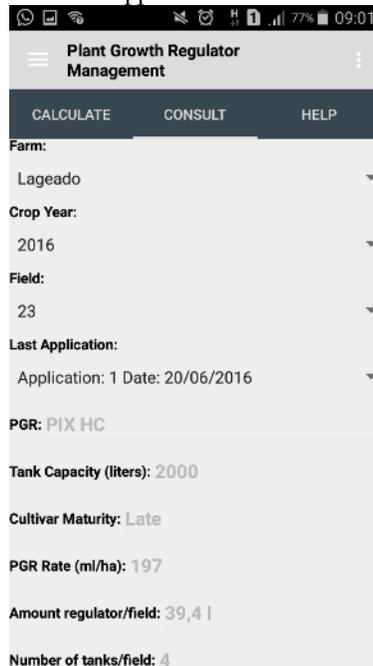


Figure 12. Rate calculation: consult tab.

Plant Growth Regulator Management

REAPPLY CONSULT HELP

Last Application:
Application: 2 Date: 21/06/2016

Time without rain after PGR application (min):
60

Spray Volume (l/ha):
50

Did you use adjuvant in the last application?
 Yes
 No

PGR: PIX HC

Rate to be reapplied: 13,02

Amount regulator/tank: 0,52 l

Amount regulator/field: 2,6 l

SAVE CANCEL

Figure 13. Rate calculation: reapplying.

Plant Growth Regulator Management

REAPPLY CONSULT HELP

Field:
23

Reapply Dose:
Application: 1 Date: 21/06/2016

Time without rain after PGR application (min): 60

Spray Volume (l/ha): 50

Did you use adjuvant in the last application? No

PGR: PIX HC

Rate to be reapplied: 13.02

Amount regulator/tank: 0,52 l

Amount regulator/field: 2,6 l

DELETE CANCEL REFRESH

Figure 14. Rate calculation: reapplying consult.

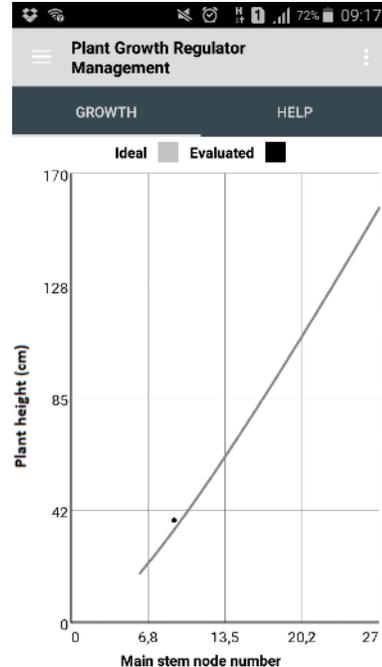


Figure 15. Growth report.

Plant Growth Regulator Management

REPORT HELP

Farm:
Lageado

Crop Year:
2016

Field:
23

Samples: 1

Applications: 2

Total PGR Rate applied (ml/ha): 228.0

Figure 16. Report: the number of samples, PGR applications and the total amount applied can be checked in this tab.

Plant Growth Regulator Management

REPORT HELP

Farm:
Lageado

Crop Year:
2016

Field:
23

Applications: 1

PGR Rate reapplied (ml/ha): 13.02

Did you use adjuvant in the last application?
Yes 0
No 0

Figure 17. Report: the number of reapplications and the rates reapplied as well as the adjuvant use can be viewed in this tab.

Summary

Plant growth regulators (PGR) are an important tool in cotton production systems. However, in large cotton fields, plant monitoring can be a timing consuming work and the time between plant monitoring and decision-making must be short and a smartphone application (app) could help growers in the management of their fields. REGULA was built in Android Studio development platform with the purpose of improve plant monitoring and PGR application methods, from sampling to application report.

Acknowledgements

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References

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