VERBALE DEL COLLEGIO DEI DOCENTI DEL DOTTORATO DI RICERCA IN SCIENZE DELLE PRODUZIONI VEGETALI E ANIMALI, XXXIIII CICLO
RIUNIONE DEL 18 NOVEMBRE 2020

Il giorno 18.11.2020 dalle ore 8.00 alle ore 18.00 si è svolta la riunione del Collegio dei Docenti del Corso di Dottorato di Ricerca in Scienze delle Produzioni Vegetali e Animali - XXXIII ciclo in modalità telematica (posta elettronica), come da convocazione del 16.11.2020 per discutere e deliberare sui seguenti punti all'OdG:

(1) Comunicazioni
(2) Proposta di nomina della commissione e della data dell'esame finale di Dottorato di Luca ROSSINI e Deepak UPRETI (XXXIII ciclo)
(3) Varie ed eventuali

Sulla base delle e-mail pervenute, sono risultati presenti alla riunione i seguenti componenti del Collegio: Prof. Roberto MANCINELLI, Prof.ssa Stefania ASTOLFI, Prof. Raffaele CASA, Prof. Enio CAMPIGLIA, Dott.ssa Chiara FRAZZOLI, Prof.ssa Stefania MASCI, Prof. Stefano SPERANZA, Prof. Valerio CRISTOFORI, Dott. Alberto BATTISTELLI, Prof. Giorgio Mariano BALESTRA, Prof. Andrea MAZZUCATO, Prof. Rosario MULEO, Prof. Nicola LACETERA, Prof.ssa Carla CEOLONI, Prof. Umberto BERNABUCCI, Prof.ssa Adalgisa GUGLIELMINO, Prof. Giuseppe COLLA, Dott.ssa Anna Maria D'ONGHIA, Prof. Francesco ROSSINI, Prof. Francesco SESTILI, Prof.ssa Elena DI MATTIA, Dott. Angelo SANTINO, Prof. Lorenzo BOCCIA, Dott. Gianluca BURCHI, Dott.ssa Mariateresa CARDARELLI, Dott. Aldo CERIOTTI, Dott. Sergio LUCRETTI, Prof. Eduardo Gabriel VIRLA, Dott. Eugenio BENVENUTO e pertanto è stato raggiunto il numero legale.

Assume la funzione di Presidente la Prof.ssa Roberta BERNINI - Coordinatore del Collegio dei Docenti del Dottorato e di Segretario verbalizzante il Prof. Francesco SESTILI.

(1) Comunicazioni
(1a) La Prof.ssa BERNINI comunica ai componenti del Collegio che, con Decreto Rettorale 623/2020 del 23/10/2020, i dottorandi di ricerca del XXXIII ciclo Guido BERNABEI, Mariangela CLEMENTE, Alberto CREMA, Andrea LIA, Sara FRANCESCONI, che hanno richiesto la proroga di due mesi del termine del Corso di Dottorato, viene posticipata al 31.12.2020 la conclusione del loro percorso formativo. Inoltre, rende noto che l'Ufficio Offerta Formativa ha pubblicato le Linee Guida per il conseguimento del titolo di Dottore di Ricerca stabilendo anche le sessioni di esame.
Sulla base di quanto definito dall'Ateneo, la Prof.ssa BERNINI ha comunicato ai dottorandi di cui sopra e ai relativi tutor che entro il 15.01.2020 sarà convocata una riunione del Collegio dei Docenti per valutare l'ammissione delle tesi alla fase dei referee esterni. Inoltre, ha comunicato agli stessi le scadenze entro le quali le tesi devono essere concluse per avviare l'iter dell'esame finale:

- per la sessione primaverile di marzo/aprile: 31 gennaio 2021
- per la sessione estiva di giugno/luglio: 30 aprile 2021
- per la sessione autunnale di settembre/ottobre: 30 giugno 2021

Le sessioni di esame previste entro dicembre 2020 e febbraio/marzo sono accessibili solo ai dottorandi che non hanno richiesto la proroga di due mesi.

(1b) Il Presidente comunica al Collegio dei Docenti che le tesi dei dottorandi Luca ROSSINI e UPRETI Deepak, i due dottorandi di ricerca che non hanno richiesto la proroga di cui sopra, sono state valutate dai valutatori esterni, come previsto dalla normativa vigente.

Luca ROSSINI ha presentato una tesi dal titolo " *Development of stochastic models for plant protection* " (Tutor: Prof. Stefano SPERANZA).

Sulla base delle positive valutazioni pervenute, riportate in allegato, il dottorando Luca ROSSINI è ammesso all'esame finale.

Deepak UPRETI ha presentato una tesi dal titolo " *Exploitation of multi-temporal and multi-sensor satellite data for improving biophysical and agronomic variables retrieval and yield prediction through data assimilation with crop growth model*" (Tutor: Prof. Raffaele CASA).

Sulla base delle positive valutazioni pervenute, riportate in allegato, il dottorando Deepak UPRETI è ammesso all'esame finale.

La Prof.ssa BERNINI e il Collegio dei Docenti si congratulano con i dottorandi e i loro relatori per le ottime valutazioni ottenute dai referee esterni.

(2) Proposta di nomina della commissione e della data dell'esame finale di Dottorato di Luca ROSSINI e Deepak UPRETI (XXXIII ciclo)

In conformità al Regolamento di Ateneo in materia di Dottorato di Ricerca, la Commissione esaminatrice proposta per l'esame finale dei dottorandi Luca ROSSINI e Deepak UPRETI è la seguente:

Componenti effettivi

- Prof. Ines DELFINO - Associato, SSD FIS/07
  Università degli Studi della Tuscia
  E-mail: delfino@unitus.it
- Prof. Giovanni LANEVE - Associato, SSD ING-IND/05
  Università degli Studi di Roma La Sapienza
  E-mail: giovanni.laneve@uniroma1.it
- Prof. Lara MAISTRELLO - Associato, SSD AGR/11
  Università di Modena e Reggio Emilia
  E-mail: lara.maistrello@unimore.it

Componenti supplenti

- Prof. Simone ORLANDINI - Ordinario, SSD AGR/02
  Università di Firenze
  E-mail: simone.orlandini@unifi.it
- Prof. Antoine HARFOUCHE - Associato, SSD AGR/05
  Università degli Studi della Tuscia
  E-mail: aharfouche@unitus.it

L'esame finale si svolgerà il 16 dicembre alle ore 10.30 per via telematica (GMeet).

(3) Varie ed eventuali
Nulla da discutere.

Il Segretario verbalizzante
Prof. Francesco SESTILI

Il Presidente
Prof.ssa Roberta BERNINI

PhD Program in Plant and Animal Science, University of Tuscia, Viterbo (Italy)

Coordinator: Prof. Roberta BERNINI

Reviewer report

Title of the thesis: Development of stochastic models for plant protection

PhD student: LUCA ROSSINI

Reviewer (surname, name and affiliation): Eric Wajnberg (INRAE, France)

Scientific quality	Excellent	Good	Fair	Poor
Originality of the research		✓		
Suitability of the title with respect to the content		✓		
Efficacy of the abstract		✓		
Clarity of the aims	✓			
Exhaustiveness of the introduction/state of art		✓		
Suitability of the methodology		✓		
Description of the experimental procedure			✓	
Interpretation of the results		✓		
Appropriateness of the discussion			✓	
Completeness of references		✓		
Overall evaluation		✓		

General comments and remarks:

The thesis is accepted:

☑ *In the present form*

☐ *After minor revisions*

☐ *After major revisions*

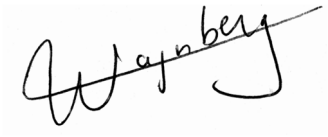
With major revisions, is it requested a revised version after 6 months?

☐ *YES*

☑ *NO*

Date: 15 October 2020

Signature



Report on the PhD thesis document of LUCA ROSSINI

Development of stochastic models for plant protection

PhD Program in Plant and Animal Science,
University of Tuscia, Viterbo (Italy)

Situation of the problem

Understanding animal population dynamics in natural settings has always been a difficult task, especially in poikilotherm species like insects (whose development is influenced by abiotic factors like temperature), and there was a tremendous amount of works that have been published on this over the last decades worldwide. For this, the use of mathematical modelling approaches appears to be of utmost importance, especially when the insects studied are actually crop pests that we want to control to enhance crop production.
The work described in the PhD thesis document proposed by LUCA ROSSINI was done within this framework. Several models are proposed and presented, and several biological crop pest models are used (along with greenhouse and open field experimental data) to check whether these models are correctly describing observational results obtained. A computer program is also presented, helping in the procedure to fit models to the data.

General remarks

The thesis manuscript starts with a general and brief chapter (chapter # 1) introducing the research work presented in the document. This section first nicely presents the need for mathematical approaches in biology in general, but especially to describe population dynamics of ectotherm animal species, like insects, particularly within an agriculture framework.
The following seven chapters are each consisting of the text of a scientific publication (provided *in extenso*, as far as I was able to see), all published in international journals by the author. Such a choice renders the overall text of the thesis logical and easy to follow. These chapters are presenting the following research work:

- Chapter # 2: Presentation and development of the so-called "Distribution Delay Model", which is based on a system of ordinary differential equations. Applications are presented on both the pepper weevil *Anthonomus eugenii* (based on data collected in greenhouses) and on the European grapevine moth *Lobesia botrana* (based on open field data). The corresponding work was published in Ecological Modelling.

- Chapter # 3: Presentation of a software – called *EcoSim* – produced by the author, that implements the Distribution Delay Model presented in the preceding chapter. This software have been coded using the ROOT object-oriented computer language. Here too, an application using data on the pepper weevil *Anthonomus eugenii* is presented. This work was published in Ecological Informatics.

- Chapter # 4: An alternative model to the Distribution Delay Model discussed chapter # 3, *i.e.*, the so-called "Von Foerster equation", is presented, and the two models are

compared. An application using data on the European grapevine moth *Lobesia botrana* is presented. This work was published in Ecological Informatics.

- Chapter # 5: A generalized version of the Von Foerster equation model is proposed and presented, apparently as a better alternative. An application using data on the tomato leaf miner *Tuta absoluta* is presented. This work was published in Ecological Modelling.

- Chapter # 6: The generalized Von Foerster equation model is fitted to data obtained on the pepper weevil *Anthonomus eugenii*. The goal is to define the methodology that should be used to describe the development rate function relating the effect of temperature to insect developmental physiology. Another goal is to validate the model and its ability to describe field data. This work was published in Florida Entomologist.

- Chapter # 7: The *EntoSim* software presented chapter # 3 is further developed, to consider the generalized Von Foerster equation model. An application on the European grapevine moth *Lobesia botrana* is presented. This work was published in Crop Protection.

- Chapter # 8: A further refinement of the generalized Von Foerster equation model is presented – *i.e.*, the so-called "integro-differential generalized Von Foerster equation model" – that explicitly takes into account the effect of population density of a given generation on the next one. Again, an application on the European grapevine moth *Lobesia botrana* is presented. This work was published in Ricerche di Matematica.

Finally, a brief chapter (chapter # 9) presents some general concluding remarks.

Generally speaking, and especially since most of the thesis document is based on already published articles, I found the text well written, in correct English and logically presented (although it contains several typographical errors). I really enjoyed reading it, following easily all the steps the author decided to develop during his research work. For example, I think it was a good idea to regroup all the references cited in the different chapters into a single section at the end of the document.

Overall, I noted that the authors already published nine articles in international journals, seven of them are signed in the first position. Providing that the author started his research work in 2017 (as far as I was able to understood), this gives more than two articles published per year, which appears to be far above what is usually seen in this discipline worldwide. I also additionally noted one book chapter, three manuscripts already submitted to international journals, and several talks and posters presented in national and international conferences. Hence, there is no doubt that the work presented here is of a good quality. However, several remarks could be made on the PhD document. They are listed in the following part of this report.

Comments and remarks

Even if the quality of the work presented is beyond doubt, several comments and remarks are worth making here.

- Except the production of a specific computer software, the PhD work presented is based essentially on the development of four modelling frameworks: (1) the Distribution Delay

Model, (2) the Von Foerster equation model, (3) the generalized Von Foerster equation model, and (4) the integro-differential generalized Von Foerster equation model. We clearly understand that each of these modelling frameworks presents some advantages and drawbacks. However, nowhere in the PhD document, there is a real, formal comparison between them. Even after reading the entire text in details, I actually remained unsure about which one should be preferably used and in which situation(s). I think such a formal comparison, eventually based on specific numerical/statistical tools and not necessary long, would have been interesting and useful, for example in the last concluding chapter.

- One of the main arguments presented in the PhD document is that such a mathematical, computer-assisted approach will be useful to develop a sound and more accurate pest control strategy. As a matter of fact, "plant protection" is even explicitly mentioned in the title of the thesis. However, my feeling is that the work presented actually do not talk about plant protection, and more generally about how application within agricultural settings can be implemented. In this respect, although I know this is not the expertise of the author, I found this a bit frustrating that this is actually not discussed, even rapidly. Only in several places in the text, the use of the models in Decision Support Systems (DSS) in crop protection is mentioned, but I guess it would have been of utmost interest to see how, technically, such a nice modelling effort could be really included in the development of a plant protection process, up to its final application. For example, was there a Graphic User Interface (GUI) developed around the *EntoSim* software to enable it to be used by all protagonists involved in controlling crop pests, etc.?

- Being myself a statistician, I remained a bit "frustrated" by the fact that nowhere in the document there is a real description about the (statistical) methods used to estimate the parameters of the model and their standard errors. The authors talks about "linear" and "non-linear" fits of the models, but what method(s) was(were) used? Apparently, and if I understand well, everything is encapsulated in the "Minuit" tool of the ROOT computer language, and the estimation of the parameters of the models is done by minimizing the so-called "χ^2 function". In my understanding, this method is most likely biased since it does not take into account the statistical distribution of the dependant variables to be modelled or simulated. Why not estimating the parameters, the Hessian matrix (and thus their SE) through the maximization of a likelihood function? This would have been far more accurate, I think, and I discovered that this is feasible with the ROOT language (by the way, the web address provided in the reference [91] of the PhD document, that should point to the ROOT used guide, does not work).

- The work and results presented in the PhD document are providing interesting and relevant information. They also raise many different questions that are also equally interesting about the future developments that are needed, and the corresponding applications in real agriculture contexts. In this respect, the description of the future prospects opened by the present work looks somewhat weak in document. About 20 lines only are presented in the concluding chapter, rapidly mentioning the need to add biomass growth terms and inter-specific interactions only. What should really be addressed in the future theoretical developments that appear to be needed now? What sort of technical details will have to be solved? What sort of (national and international) collaborations would be needed to develop for this? What should be the expected results and how will these results be published? All of these questions, and likely several others, should have been addressed in the document presented. Ready this document, however, there is

actually no doubt that the author could have proposed a rich future research programme in order to complete fruitfully the results presented.

Conclusion

The work done by the PhD candidate is presented in a well-done, convincing, relevant and interesting way. The results obtained are clearly within the questions currently addressed by the corresponding scientific community. These results demonstrate the ability of the authors to develop a sound mathematical framework on the scientific topics he worked on, grabbing the essential components of insect biology/ecology. They also enable him to demonstrate his computer programming skill.
Obviously, these results can be published at the international level, and the authors already fully demonstrated that, producing already a significant number of publications in good-quality international journals. Most of them are signed by the author in the first position. These publications clearly demonstrate the willingness of the author to make his findings known at the international levels. In this respect, I guess it could be advised now to the author to start targeting more generalist journals, with higher Impact Factors.
Of course, the willingness of the authors to publish top-quality results in international journals should still be fostered, and I have no doubt that new interesting results will come soon, contributing to a better understand of insect ecology, and to better define more efficient crop pest control strategies. In this respect, I hope that the couple of comments and remarks detailed above will help the author to reach such goals in the coming future.

Sophia Antipolis, 15 October 2020

ERIC WAJNBERG
e-mail: eric.wajnberg@inrae.fr

PhD Program in Plant and Animal Science, University of Tuscia, Viterbo (Italy)

Coordinator: Prof. Roberta BERNINI

Reviewer report (template)

Title of the thesis: Development of stochastic models for plant protection
PhD student: Luca Rossini

Reviewer (surname, name and affiliation): Garone, Emanuele, Université Libre de Bruxelles

Scientific quality	Excellent	Good	Fair	Poor
Originality of the research	X			
Suitability of the title with respect to the content	X			
Efficacy of the abstract		X		
Clarity of the aims	X			
Exhaustiveness of the introduction/state of art		X		
Suitability of the methodology	X			
Description of the experimental procedure	X			
Interpretation of the results	X			
Appropriateness of thediscussion	X	x		
Completeness of references		X		
Overall evaluation	*X*			

General comments and remarks: The thesis is quite interesting and coherent. The results presented in the thesis have been published on relevant peer-review journals.

The thesis is accepted:

- *X In the present form*
- ☐ *After minor revisions*
- ☐ *After major revisions*

With major revisions, is it requested a revised version after 6 months?

- ☐ *YES*
- ☐ *NO*

Date 02-11-2020

Signature

PhD Program in Plant and Animal Science, University of Tuscia, Viterbo (Italy)

Coordinator: Prof. Roberta BERNINI

Reviewer report (template)

Title of the thesis: EXPLOITATION OF MULTI-TEMPORAL AND MULTI-SENSOR SATELLITE DATA FOR IMPROVING BIOPHYSICAL AND AGRONOMIC VARIABLES RETRIEVAL AND YIELD PREDICTION THROUGH DATA ASSIMILATION WITH A CROP GROWTH MODEL

PhD student: Deepak Upreti

Reviewer (surname, name and affiliation): Dalla Marta, Anna - DAGRI University of Firenze

Scientific quality	Excellent	Good	Fair	Poor
Originality of the research	X			
Suitability of the title with respect to the content		X		
Efficacy of the abstract		X		
Clarity of the aims	X			
Exhaustiveness of the introduction/state of art		X		
Suitability of the methodology	X			
Description of the experimental procedure	X			
Interpretation of the results	X			
Appropriateness of the discussion	X			
Completeness of references	X			
Overall evaluation	*X*			

General comments and remarks:

First of all I want to congratulate the candidate because the thesis is a really good job. The topic addressed is very innovative and requires excellent skills that are completely demonstrated in the published papers. In general, the thesis is well written, it is clear in the contents, objectives and description of the methodologies used. Statistical analysis is appropriate and the results obtained are interesting. May be some procedures still require research and further study, but I think that as part of a PhD a lot of work has been done.

My (minor) review suggestions concern the chapters corresponding to the published papers and the General Conclusions.

As for the papers part, I suggest including the figures and tables directly into the text and not at the end so that the reader does not have to continuously scroll through the document thus losing attention.

For the general conclusions, I believe that the candidate should give a more comprehensive view. As they are written, they now repeat the conclusions of the various papers, while instead I believe that it should be the paragraph where the point of the complete PhD project should be made and discussed to give an overview of the work. What was the purpose of PhD? Which is the logical framework behind the different papers? What were the difficulties and strengths of this type of approach (but not broken down into the different articles)? What are the needs? And maybe even a look at both research and operational perspectives can be given.

I conclude by asking the candidate to also make a quick review of the text that contains some errors (e.g. on page 6 “nonparametric” models instead of parametric; some errors in the Conclusions)

The thesis is accepted:

- ☐ *In the present form*
- X *After minor revisions*
- ☐ *After major revisions*

With major revisions, is it requested a revised version after 6 months?

- ☐ *YES*
- ☐ *NO*

Date

20/10/2020

Signature

PhD Program in Plant and Animal Science, University of Tuscia, Viterbo (Italy)

Coordinator: Prof. Roberta BERNINI

Reviewer report (template)

N.B. The following template should be intended as a flexible model. The actual report may be adapted by the reviewer according to his/her needs.

Title of the thesis: EXPLOITATION OF MULTI-TEMPORAL AND MULTI-SENSOR SATELLITE DATA FOR IMPROVING BIOPHYSICAL AND AGRONOMIC VARIABLES RETRIEVAL AND YIELD PREDICTION THROUGH DATA ASSIMILATION WITH A CROP GROWTH MODEL

PhD student: Deepak Upreti

Reviewer (surname, name and affiliation): Zhenhai Li

National Engineering Research Center for Information Technology in Agriculture, China

Scientific quality	Excellent	Good	Fair	Poor
Originality of the research		×		
Suitability of the title with respect to the content	×			
Efficacy of the abstract	×			
Clarity of the aims	×			
Exhaustiveness of the introduction/state of art	×			
Suitability of the methodology	×			
Description of the experimental procedure	×			
Interpretation of the results	×			
Appropriateness of thediscussion		×		
Completeness of references	×			
Overall evaluation	×			

General comments and remarks:

The thesis is clear give a demonstration about data assimilation by integrating satellite image and crop growth model, including biophysical variables, sensitivity analysis and calibration of crop growth model, and data assimilation strategies. Results confirmed the assumption, and some impressed results were demonstrated, e.g. the effect from input number of satellite imageries. I think this will be a further study point for data assimilation and need to consider.

1. I found the title is one broad title, some methods should be better to focus, E.g. A growth model which model? How about specified the AquaCrop.
2. P22 about the equation (4) of FVC. I am not sure if the measured FVC is computed by this equation? and same with estimated FVC from retravel LAI of PROSAIL? It seemed that estimated FVC is a

little underestimation at low FVC values. If possible, the reason from this equation without considering calibrating.

3. From the results of FVC, biomass and yield, we found a good calibration by using RS and AquaCrop for fvc, but not biomass and yield, a systematic error showed in Fig. 9 in Page 117. I think we should consider more parameters related with biomass and yield accumulation.
4. The conclusion from chapter 4 that "More frequent and increased number of observations from two different sources of satellite data did not improved the efficiency of the assimilation and simulated yield" is interesting. I think this part need to deep explore in the further studying.

The thesis is accepted:

☒ *In the present form*

☐ *After minor revisions*

☐ *After major revisions*

With major revisions, is it requested a revised version after 6 months?

☐ *YES*

☐ *NO*

Date

2nd Nov 2020

Signature

Zhenhai Li