MODELING THE PRODUCTION AND THE PROTECTION OF THE TOMATO CROP IN MIDDLE EGYPT

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Abstract

Exposed tomato 'crop in Egypt infected a large number of insect pests since transplanting plants and even harvesting and injury may lead to severe damage to both feeding on shoots or fruits or through the spreading of some diseases and these lesions cutworm, white tomatoes fly, cotton aphids, green peach aphid, potato tubers moth, cotton leaf worm, leaf miners, red spider mite tomato fruits worm and tobacco bud worm.

In order to work a successful program of integrated pest management tomato computer program used in this study as a tool for integrated pest management and is a program that begins with a series of screens, which enables the user to modify any of the default data at the beginning of the simulation. The key data for the unity of the crop tomato varieties, planting date, geographic location, field of simulation. The basic data of insect pests date of observation and the number of individuals in the samples. Comparing tomatoes scenes growth curve and is expected through the program was to predict the average deviations 0.00, -2.33, -2.44, -4.11, and 13.44 days of the planting dates, and vegetative growth (from the fifth vegetative node to the eighteen node), inflorescence, fruit formation stage, fruit ripening, respectively.

Differences were also tested in numerical density of insect's tomatoes between expected and actual numbers. The program explained that the accuracy level in prediction for the average of three seasons: 66.35% for aphids, 68.62% for red spider mite, 82.78% for white fly, and 64.11% for the cotton leaf worm. 73.96% for the potato tubers moth, 56.43%, of the tomato fruits worm and 50.83% for tobacco bud worm.

It could be concluded from the obtained results that the evolution of curves of growth recorded in fact not much different from those obtained by laboratory model and can be implemented as a tool of integrated pest management programs tomatoes.

INTRODUCTION

Prediction is the expectation of a particular act in the future and prediction of plant pests is the expectation of the occurrence of such lesions early, before it takes place with the appropriate period of time. This critical period can be taken where necessary to resist the disease, and thus avoid the heavy loss caused by pests. In other words, the prediction of plant pests explain to farmers in a particular area that the conditions are right enough for the disease and that the use of effective means to resist the disease would lead to the survival of crop injury and consequently a large profit to the farmer.

Expert systems are one of the branches of science and artificial intelligence based on the simulation of human expertise and intelligence that we generate through the new programs with a special character just like the human expert in charge of bringing the program to be an expert, answer for matters, But also you may consult it, or it provide accurate information that challenging the validity and accuracy of the human itself. In other words, the percentage of error does not exceed one percent and this is what was missing from the human nature. Since the human being is not far wrong, as we know it. Among the areas of artificial intelligence neural networks, which form a marked improvement in the way of human thinking? It simulates the process of information collection, use and intensified in the human mind in order to reach a decision and is capable of modeling the highly non-linear relations, and easily overcome the loss of data and incomplete or inaccurate and identify hidden relationships between variables.

Despite many IPM successes using technologies such as host plant resistance and biological control, synthetic pesticides have remained the predominant component of IPM programs through the last three decades (Allen and Rajotte 1990). Wearing (1988) has pointed out that the delay in the adoption of IPM has to do with the complexity of the programs and the considerable time and resources that must be devoted to implementation.

Despite the complexity, looking at pest management from the whole-farm level opens new avenues for pesticide and pest management (Stone and Warren 1993). By anticipating how the overall farm plan contributes to pest outbreaks, one can avoid cropping systems and practices that lead to pest management problems. To help manage the complexity of this process, a multi-objective computer decision aid was designed to help farmers generate alternative whole-farm plans that are profitable and environmentally sound (Buick *et al.* 1992, Stone 1995).

There are many different definitions of IPM but the practical implementation of IPM falls into two basic categories, preventive and therapeutic. Preventive tactics strive to avoid problems before they happen and therapeutic tactics attempt to correct problems that have already occurred (Wintersteen and Higley 1993). IPM in the preventive mode requires that pest management options be considered before the crops are planted rather than waiting for the pest problems to occur. One way to implement preventive IPM is through the use of decision support systems.

A decision support system (DSS) is a computerized system for accessing and processing data and providing recommended courses of action as developed through the use of analytical methods (Ignizio 1991). In agriculture, a DSS may help farmers make tactical and strategic management decisions in areas such as cultivar selection, timing of planting and harvesting, and pest management (Plant and Stone 1991). Because farmland is part of a larger landscape, developing sound pest management strategies should include consideration of each field as a component of the farm, and each farm as a component of a larger landscape or watershed. In other words, IPM should be part of a holistic management plan for all related resources (Bridge 1993).

The crops system is a whole-farm planning and scheduling system that considers soil conservation, nutrient management, pest management, and economic constraints to generate farm plans (Buick *et al.* 1992). Each of the areas of consideration requires an automated evaluator to provide input for the process of assessing potential farm plans. This research deals specifically with the pest management aspect of this system.

The planning engine is a three-level hierarchy, and within each level is preplanning, planning, and post-planning phases. Post-planning phases at each level facilitate detection of failure conditions (cases in which no plans can be found that meet all goals and constraints), allowing the system to return control to the user. At the third level, a two-dimensional constraint-propagation algorithm assigns crops and tillage practices to fields to obtain a final six-year plan.

Structure

The main components of an expert system are the knowledge base, the inference engine, and working memory. The knowledge engineer converts expert knowledge into a form that can be manipulated by computer software. This knowledge is then stored in a knowledge base. The user provides information about a specific problem via a user interface. The inference engine uses the knowledge provided to come to some conclusions and/or give advice about the specific problem (Plant and Stone 1991). To arrive at conclusions about a problem, the inference engine must search for a solution in an efficient and effective manner. Any search will be guided by a variety of data and constraints. The search strategy that begins with data and constraints and uses them to filter a large selection down to a few choices is called *forward chaining* (Ignizio 1991). Here the inference engine examines a set of rules, each assertion being evaluated to determine its truth. For those rules that evaluate to true, their conclusions or *consequents* are added to the knowledge base. This process continues until no further consequents can be determined. Forward chaining allows the knowledge engineer to use rules to develop information from a limited set of initial data. This type of reasoning is appropriate, for example, in a monitoring situation where it is desirable to learn as much as possible about the state of a monitored system based upon the available data (Walters and Nielsen 1988). This is a rule-based system developed on the Microsoft Windows platform. Knowledge about crops and pest management is represented in the form of IF/THEN rules, demons, and "when-changed" methods. The inference engine analyzes specific crop system information entered by the user to determine potential risks of outbreak for wheat crop pests common to Virginia. These potential outbreak risks are presented as low, medium, and high levels of risk and are presented for each of 15 pests of wheat in Virginia (Peter L. Warren 1999).

Modeling evaluation

The evaluation of an expert system must address the justification for the employment of an expert system and the verification and validation of the knowledge base (Ignizio 1991). Validation is often confused with verification. Validation refers to building the right system (that is, substantiating that a system performs with an acceptable level of accuracy), whereas verification refers to building the system "right" (that is, substantiating that a system correctly implements its specifications) (O'Keefe, Balci, and Smith 1987).

Such an evaluator can take many forms, including a simulation model, a knowledge-based system, or a statistical discriminate analysis.

The requirements of this research include the ability to work with heuristics, to reach decisions based on incomplete information, and to search efficiently through combinatorial explosive problems. Several possible approaches to constructing a pest management evaluator were examined with these requirements in mind. Information systems such as geographic information systems, management information systems, and database systems provide information in a variety of forms, but they do not incorporate a problem-solving methodology. Likewise, simulation models can be very informative and predictive, but they lack the ability to reason (Plant and Stone 1991). Operations research methods have the ability to analyze and find optimal solutions but they lack the ability to handle qualitative information and heuristics, and they often require simplification of their models to accommodate the solution methodology (for a good example, see Onstad and Gould [1998] analyzing scenarios for the development of insecticide resistance in European corn borers exposed to transgenic corn). Discriminant analysis is a statistical technique used to test for mean group differences, describe overlaps among groups, and to construct classification schemes (Eisenbeis and Avery 1972). In their work with Africanized honeybees, Daly and Balling (1978) showed how discriminant analysis was able to separate Africanized bees from European bees where conventional taxonomy was unreliable. Since discriminant analysis is a classification procedure it does provide useful information. But one of the assumptions of discriminant analysis is the classification of an individual item into one of several groups is based on the distance of the item's observation vector from the mean score vector within each of the groups (Marcoulides and Hershberger 1997). Since one of the requirements of this project is the ability to deal with heuristics, and heuristics are not something that can be converted to a linear model, this method was rejected.

In Egypt Tomatoes are subject to attack by a large number of insect pests from the time plants first emerge in the seed bed until harvest, however, severe damage may result either from their feeding on the fruit or by spreading certain diseases .i.e.

Cutworm *Agrotis ipsilon* (BCW), tomatoes' whitefly *Bemisia tabaci* (CWF), tomatoes' aphid *Aphis gossypii* (CA), green peach aphid *Myzuz persicae* (GPA) , Potato tuber moth *Phthorimaea operculella* (PTM), tomatoes' leaf worm *Spodoptera Littoralis* (CLW) , Faba bean leaf miner *Liriomyza trifolii* (FBLM) , two spotted spider mite *Tetranychus urticae* (TSSM), tomatoes fruit worms *Helicoverpa zea*,(TFW), and tobacco budworm, *Heliothis virescens* (TBW).

Climate has a profound effect on the distribution and abundance of invertebrates such as insects, and the mathematical description of the climatic influence on insect development has been of considerable interest among entomologists. Additionally, as temperature exerts great influence among the climate variables, by directly affecting insect phenology and distribution, most of the models that describe insect development are temperature driven.

The rates of development in insects under natural conditions are largely determined by temperature. In most microenvironments, temperature is characterized by daily and seasonal cyclic variations with superimposed irregular fluctuations. However, studies of insect development rate most often involve experiments performed under constant temperatures (Howe 1967). In the development and application of development-rate models, it is always assumed that development rate at a given temperature is independent of thermal regime, whether the model is linear or nonlinear in relation to temperature. This assumption is also inherent in efforts to derive development-rate models from data obtained under varying temperatures, such as the work by Dallwitz & Higgins (1978). According to this assumption, development rate follows a definite function with respect to temperature, when other factors are equal and the amount of development can be calculated by ac-cumulating the fraction of development per unit time; i.e., rate summation (Kaufmann 1932). The procedure may be expressed as:

$$D = \int r\,[T\,(t)]\ DT$$

Where development D: is a function of temperature. T: which in turn is a function of time, t, and the development rate, r; adjusts instantaneously to temperature.

The above assumption is fundamental to the formulation of development-rate functions for phonological models. Life table studies are fundamental to not only demography but also too general biology. In such studies, development tunes and survival rates of each stage, longevity of adults, and the daily fecundity of females are recorded for every individual. Using elementary statistics, means and standard deviations can be calculated. In traditional life-table analysis, these means are used to calculate age-specific survival rates and age-specific fecundity using either the Leslie matrix (Leslie 1945) or Birch's method (Birch 1948). These procedures have been widely used by researchers in many different fields (Laing 1969, Shib *et al.* 1976, Cave & Gutierrez 1983, Vargas *et al.* 1984, Carey & Vargas 1985). However, variation in development rate is well known, even when a population is kept under constant laboratory conditions. The range of variation depends on many factors (for example, temperature and food). To assume that all individuals have the same development rate is biologically unrealistic and may be misleading. Therefore, ignorance of such variation when using either the Leslie matrix or Birch's method should be carefully considered. The method of incorporating this variation is the use of distributed delay theory in modeling (for example, Gutierrez *et al.* 1984, Plant & Wilson 1986). On the other hand, Chi & Liu (1985) developed an age-stage life table theory for both sexes, incorporating variable developmental rates among individuals. In comparison with the distributed de-lay models, Chi & Liu's model is different in that both sexes were included, and variation in development rates was integrated sequentially for all stages and expressed in the form of a stage distribution. The stage structure of a population can also be calculated in Chi & Liu's model. Furthermore, most life-table analyses have been concerned only with the "female" population. Most lepidopterans, coleopterans, and orthopteran pests are not parthenogenesis, however, and both males and females are economically important. Moreover, the development rate may differ between the sexes. Susceptibility to either chemical or biological control agents may be quite variable among stages and sexes. These and many other differences among stages and sexes explicitly point out the inadequacy of the female age-specific life table. In addition, whether to calculate the intrinsic rate of increase of a "female" population or of the population as a whole is a central question in ecology. In the theoretical model of Chi & Liu (1985), the population parameters are calculated with respect to both sexes and incorporating variable developmental rates among individuals. However, the major obstacle in taking the variable developmental rates and tire male population into account is the difficult and tedious work of applying the age-stage, two-sex life table theory to the raw data analysis.

The number of days between observable events, such as tomatoes' seedling emergence and first squares of the duration of insect generations can characterize the growth and development of plants and insects. The number of days between events, however, may be misleading because growth rates vary with temperatures. The measurement of events can be improved by expressing development units in terms of the temperature and time. The deviation between events is then based on accumulated degrees per unit time above a lower temperature re-presenting a threshold of growth.

The goal of this study is to test the accuracy of the "Model Cottamin" (under publication) in measuring the interaction of pest-plant-weather components on two tomatoes' varieties in forecasting the occurrence timing of plant phenomena's and pests infestation's peak as well as the density of its populations.

MATERIALS AND METHODS

COTTAMIN **(under publication)** is method derived from temperature for measuring the organisms' growth based on cumulative heat above the lower growth threshold. (Wilson and Barnett 1983). Unlike simple phenomena's models, however, biological rates are not strictly linearly proportional to heat above the lower threshold; factors such as solar intensity, water deficit stress, and so on regulate these temperature dependent rates. The linear approximation to physiological time, however, serves as a useful parameter for estimating potential rates of structural production (numbers) and biomass accumulation, which is in turn modified by the feedback mechanisms incorporated into the model.

It is consisting of two modules: one for plant phenomena's and the second for the pest's populations. The crop module predicts the four main plant organs; seedlings, leaves, flowers, and bolls. Each component has its own life table measurements such as birth rates, death rates, and growth rates. Pest's module also has the same features for the five tested pests

The COTTAMIN's software starts with series screens enabling the user to modify any of default data at the beginning of simulation. Key data for the crop's module include tomatoes' varieties, planting's date, and field's geographical location for simulation. Key data for the five insect pests include observation da and the numbers of individuals in samples.

Simulations

Microsoft's Visual C11 compiler version 6.0 (Microsoft 2000) was used for programming the model. Running the simulation requires specifying the Julian day of planting, as well as the initial number of insects.

The model requires the daily weather's data, constant percentage hatch and the mean density-dependent larval survival model for the predicting the movable insect adults and oviposition.

Stochastic versions of the model use random weather, hatch, and larval survival in various combinations and begin with an initial adult population of 1,000/m2. A common problem with stochastic population models is that there is some probability that the population will be zero. As a result, extinction eventually occurs if enough simulations are conducted, and the population can never recover without modeling recolonization. Extinctions occurred for this model, and because dispersal is not modeled, no mechanism exists in the model for population recovery. As a result, simulations were conducted in 500-yr blocks and annual output from a block was retained only if the population did not become extinct. Experimentation indicated that 10,000 simulated years of output were sufficient for the mean and the standard deviation to stabilize.

COTTAMIN validation data were collected from Fayum Governorate tomatoes' fields (90 Km south Cairo) in Middle Egypt.

Data were collected throughout three successive Tomatoes-growing seasons (2011-2013). Hybrid 737 and Kassel Rock varieties cultivated. Data was collected on: 1-pests numbers 2-injured plant numbers, 3-tometoes fruits numbers, 4- predator numbers, and 5-current weather's data.

Protocol was as follows: 1- pheromone traps: Seven BCW, TBW, TFW, PTM and CLW pheromone delta traps were placed from January 1st to the end of December.

The lure baits were replaced with new one every 2 weeks or less depending on the weather. Adult males from each pheromone trap were checked twice per week.

Yellow sticky traps were used for aphids and white fly. Visual examination for red mite was made on all plants found in 25 m quadrate randomly selected.

2- Tomatoes' plants: Twenty-five meters of canopy were examined weekly for:

a) Plant height/m b) Crop injury (serpentine mines in leaves, and holes are chewed in fruits and buds and the infestation percentages were estimated in the lab

RESULTS AND DISCUSSION

Knowledge acquisition is the process of collecting the knowledge necessary for solving a problem and encoding it into a form that allows for efficient computer manipulation. Knowledge acquisition is comprised of two tasks: knowledge elicitation and knowledge representation. These two tasks do not necessarily occur in sequence and both usually take place throughout the development life cycle as deficiencies in the knowledge base are realized and modifications are made. In knowledge elicitation, domain knowledge is obtained through various means including interviews with experts and book and journal references. In knowledge representation, the elicited knowledge is converted to a form for efficient computer manipulation (Nikolopoulos 1997).

I - Prediction of Tomatoes phenomena's

In 2011 tomatoes' growing season data were collected from three different planting dates in Fayum Governorate cultivated with tomatoes Hybird 737. The three planting dates were: 20/07/2011, 12/08/2011, and 27/08/2011. In 2012 tomatoes' growing season the cultivated tomatoes' variety was Kassel Rock and the Planting dates were: 15/07/2012, 01/08/2012, and 24/08/2012. The Cultivation Dates for 2013 tomatoes' growing season for Hybrid 737variety were: 28/05/2013, 03/07/2013, and 26/08/2013.

Table (1) illustrated the plant phenomena's; seedling date, 5th vegetative node to 18th node, flowering, fruit formation and fruit ripening. The table shows deviation between the observed data that collected from the fields and the predicted that obtained after applying the Cottamin model by days.

As it could be seen the average of deviation ranged from 0.00, -2.33, -2.44, -4.11, and 13.44 days for; seedling date, 5th vegetative node to 18th node, flowering, fruit formation and fruit ripening respectively.

As it could be concluded from the obtained results, the growth development curves observed actually did not differ significantly than those obtained by COTTAMIN model **(under publication)** as all observed curves demonstrated a similar growth rate curve prior to the COTTAMIN model.

Data in Table (2) demonstrate the deviation of means between observed and predicted tomatoes' phenology by means of heat units.

The careful examination of date in the table reveal that the general average of devotion of DD's for the nine cultivation dates for the five plant stages tested ranged from 14.40, -2.00, 4.04, -8.22, -5.88 seedling date, 5th vegetative node to 18th node, flowering, fruit formation and fruit ripening respectively.

II – Prediction of Tomatoes' key pests

In Egypt Tomatoes are subject to attack by a large number of insect pests from the time plants first emerge in the seed bed until harvest, however, severe damage may result either from their feeding on the fruit or by spreading certain diseases .i.e. Cutworm Agrotis ipsilon (BCW), tomatoes whitefly Bemisia tabaci (CWF), tomatoes aphid Aphis gossypii (CA), green peach aphid Myzuz persicae (GPA) , Potato tuber moth Phthorimaea operculella (PTM), cotton leaf worm Spodoptera Littoralis (CLW) , Faba bean leaf miner Liriomyza trifolii (FBLM) , two spotted spider mite Tetranychus urticae (TSSM), tomatoes fruit worms Helicoverpa zea,(TFW), and tobacco budworm, Heliothis virescens (TBW).

The proposed model (COTTAMIN) predicate the occurrence of these insect pests, consequently the goals of this work is to make the validation of that model.

Figure (1-7) demonstrate the observed and predicted population of aphids, red mite, while fly, cotton leafworm, potato tuber moth, tomatoes fruit, and tobacco budworm during three successive tomatoes' growing seasons (2011-2013) at Fayum Governorate, Middle Egypt.

Simulated and observed tomatoes tested insect pests densities are depicted in Table (3). COTTAMIN Model explained only 66.15 % of the variability in the field for all the tested insects, 66.35% for aphid as an average for the three seasons, 68.62% for red mite, 82.78 % for the white fly, 64.11 % for the cotton Leafworm and 73.96 % for the potato tuber moth, 56.43% for tomatoes fruit worms and 50.83% for tobacco budworm. The predicted trend of population peaks is closed to the actual population peaks, the general average for pest component as whole reached to 66.15 %.

However, the COTTAMIN model **(under publication)** could be successfully used for tomatoes' insect pests predictions in Fayum, Middle Egypt.

The first effort for a formal description of the relation between temperature and developmental rate was taken by botanists, to model the effect of temperature on plant growth and development. However, similar modeling procedures extended to most of the poikilothermic organisms, including insects as well. To date, the earliest experiment that related the velocity of insect development and heat, was made by Bonnet (1779) on the study of the reproduction rate of Aphis evonymi, F. , while the major assumption and principles that have been brought out by these earlier works, constituted the basis for all future research. Nevertheless, since then, several theoretical and experimental works have been carried out and current progress in entomology, mathematics and computation offers new means in describing the relation of temperature to insect development.

Based on such linear relationships, between thermal constants and lower temperature thresholds, for several cold-blooded species, it is suggested that there is an inverse relationship between lower temperature thresholds and the thermal constant associated with latitude and/or habitat that adapts each species

also based on the particular morphology and size of the species. For example, size at maturity is a function of the rate and duration of growth, and large size at maturity implies a long generation time and a correspondingly large requirement.

Thus, any model which provides biologically important parameters is useful in modeling population dynamics under several temperature regime alterations. In addition, by incorporating more factors in the equations, climate-driven models have the potential to describe the general ecological behavior, abundance, distribution, and outbreaks of insects on a regional or even global scale, with important practical applications.

Thus, although simple predictive models have been developed during the last century, the development and broader availability of personal computers in the 70s and 80s resulted in the rapid development of computer-based models to predict responses of insects in relation to climate.

CONCLUSION

The results show it is possible to simulate the expertise of integrated pest management with a reasonable degree of accuracy.

It is only with this gathering of disciplines that it will be possible to make holistic choices about pest management in our diverse ecosystems.

This expert system, as a standalone decision support tool, needs more testing before it can be used in the field. While the insect component has reached an acceptable level of performance and is ready for further implementation. In this research all weather events were given equal chances of occurring throughout the state. By incorporating historical weather patterns in to the knowledge base there may be a way to weight weather events by region or by county.

In conclusion, it has been shown that preventive IPM can be implemented through whole-farm planning. More specifically, crop-specific decision support systems help facilitate preventive IPM.

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Table (1) Deviation between observed and predicted tomatoes phonology by Cottamin model, by means of days (2011-2013), Fayum, Middle Egypt

Planting Dates		Seedling	5th vegetative node to 18th node	Flowering	Fruit formation	Ripening
20/07/2011	Observed	7/20	8/15	8/17	8/23	10/3
	Predicted	7/20	8/15	8/18	8/26	10/12
	Deviation	0	0	-1	-3	-9
12/08/2011	Observed	8/12	9/7	9/9	9/16	11/3
	Predicted	8/12	9/8	9/12	9/20	11/16
	Deviation	0	-1	-3	-4	-13
27/08/2011	Observed	8/27	9/23	9/25	10/3	12/10
	Predicted	8/27	9/24	9/28	10/7	12/17
	Deviation	0	-1	-3	-4	-7
15/07/2012	Observed	7/15	8/8	8/12	8/18	9/25
	Predicted	7/15	8/8	8/13	8/23	10/6
	Deviation	0	0	-1	-5	-11
01/08/2012	Observed	8/1	8/25	8/29	9/4	10/14
	Predicted	8/1	8/27	8/31	9/8	10/29
	Deviation	0	-2	-2	-4	-15
24/08/2012	Observed	8/24	9/16	9/20	9/26	11/10
	Predicted	8/24	9/21	9/25	10/4	12/10
	Deviation	0	-5	-5	-8	-30
28/05/2013	Observed	5/28	6/25	6/27	7/4	8/12
	Predicted	5/28	6/26	6/27	7/5	8/15
	Deviation	0	1	0	1	3
03/07/2013	Observed	7/3	7/27	7/30	8/7	9/14
	Predicted	7/3	8/1	7/31	8/8	9/21
	Deviation	0	-5	-1	-1	-7
26/08/2013	Observed	8/26	9/18	9/21	9/27	11/12
	Predicted	8/26	9/26	9/27	10/6	12/14
	Deviation	0	-8	-6	-9	-32
Average of Deviation		0.00	-2.33	-2.44	-4.11	-13.44

Table (2) Deviation between observed and predicted tomatoes phonology by Cottamin model, by means of heat units (2011-2013), Fayum, Middle Egypt

Planting Dates		Seedling	5th vegetative node to 18th node	Flowering	Fruit formation	Ripening
20/07/2011	Observed	644	391	464	521	1113
	Predicted	659	385	427	538	1123
	Deviation	-15	6	37	-17	-10
12/08/2011	Observed	619	394	424	528	1118
	Predicted	603	384	436	537	1121
	Deviation	16	10	-12	-9	-3
27/08/2011	Observed	597	395	423	530	1120
	Predicted	538	377	426	530	1123
	Deviation	59	18	-3	0	-3
15/07/2012	Observed	655	373	435	529	1126
	Predicted	638	371	428	541	1128
	Deviation	17	2	6.5	-12	-2
01/08/2012	Observed	648.7	376	434	528	1129
	Predicted	607	380	434	541	1123
	Deviation	41.7	-4	0	-13	5.5
24/08/2012	Observed	556	347	440	542	1129
	Predicted	549	381	421	537	1121
	Deviation	6.9	-34	18.87	5	7.6
28/05/2013	Observed	450	397	424	528	1066
	Predicted	475	410	425	539	1124
	Deviation	-25	-13	-1	-11	-58
03/07/2013	Observed	420	379	424	542	1129
	Predicted	465	415	414	529	1134
	Deviation	45	36	-10	-13	5
26/08/2013	Observed	390	376	427	529	1124
	Predicted	406	415	427	533	1119
	Deviation	-16	-39	0	-4	5
Average of Deviation		14.4	-2	4.04	-8.22	-5.88
± S. D		29.74	23.94	15.31	7.12	20.35

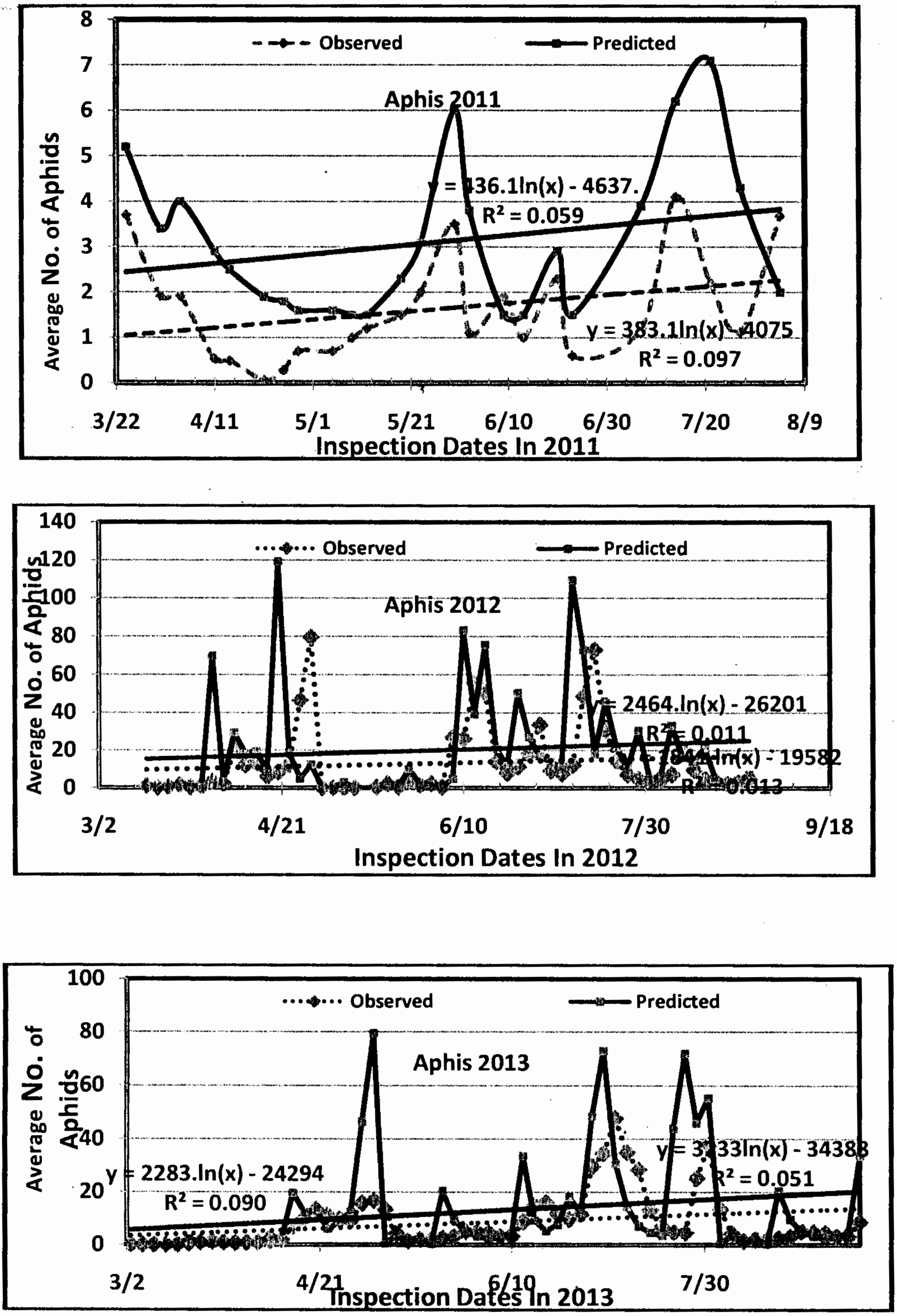


Fig. (1) Observed and predicted population of Aphids during three successive tomatoes growing seasons (2011-2013) at Fayum Governorate, Middle Egypt

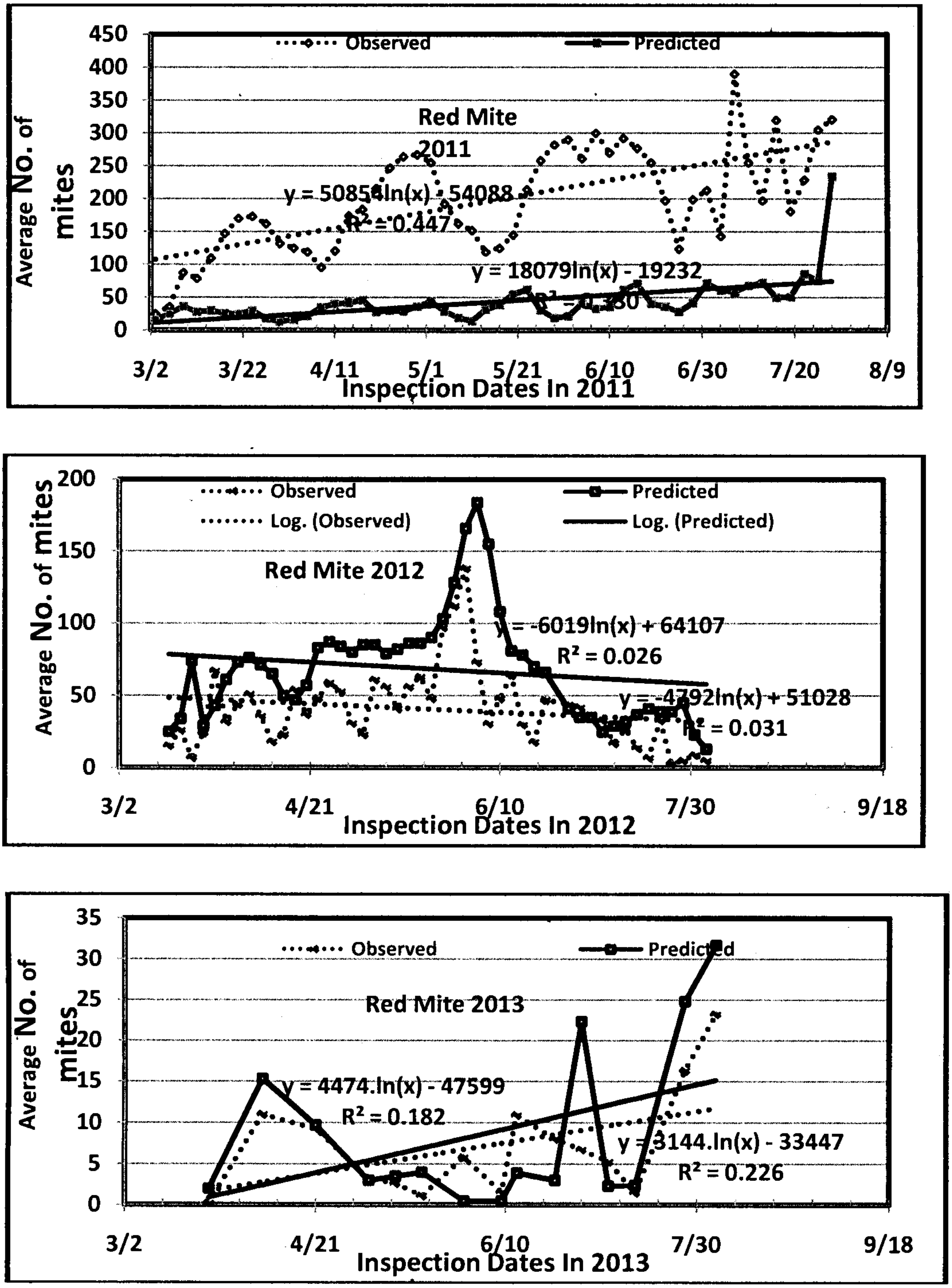


Fig. (2) Observed and predicted population of red mite during three successive tomatoes growing seasons (2011-2013) at Fayum Governorate, Middle Egypt

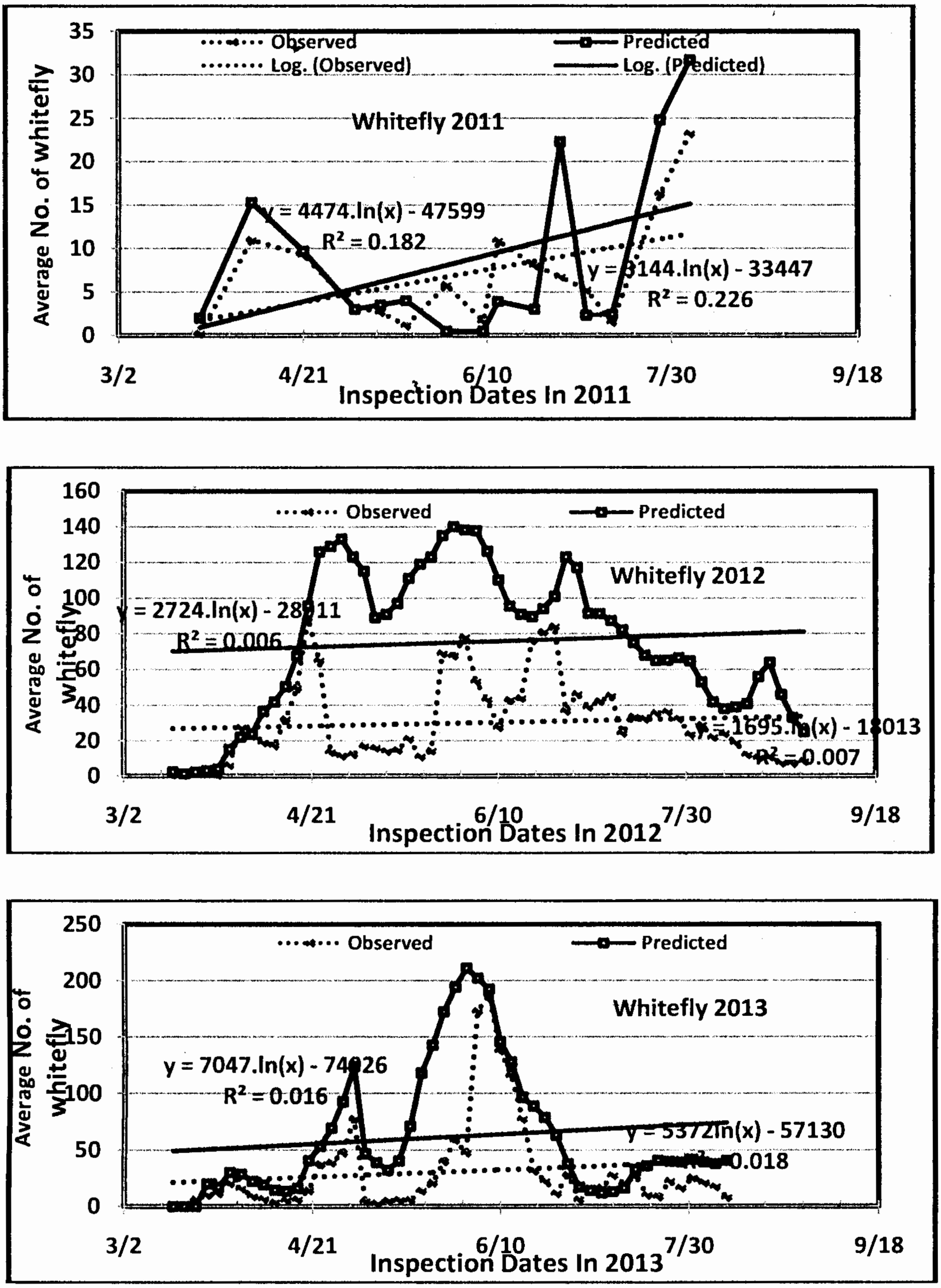
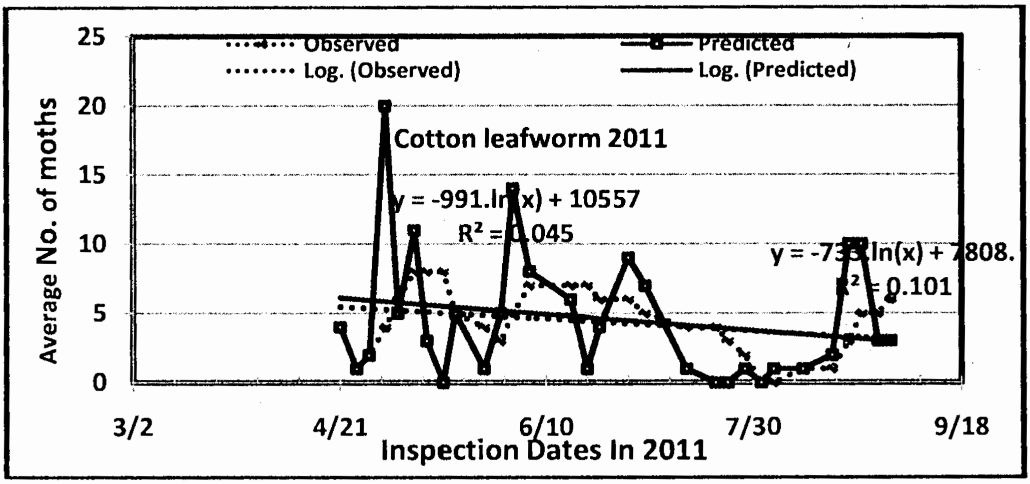
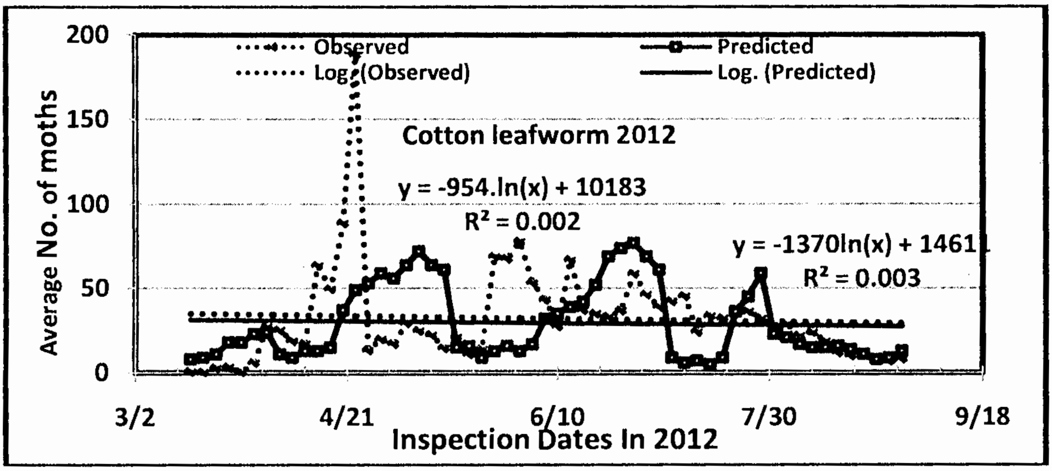


Fig. (3) Observed and predicted population of whitefly during three successive tomatoes growing seasons (2011-2013) at Fayum Governorate, Middle Egypt


Observed
Predicted
Log. (Observed)
Log. (Predicted)
Cotton leafworm 2011
y = -991.ln(x) + 10557
R² = 0.045
y = -73_ln(x) + 7808.
R² = 0.101
Average No. of moths
25
20
15
10
5
0
3/2
4/21
6/10
7/30
9/18
Inspection Dates In 2011


Observed
Predicted
Log. (Observed)
Log. (Predicted)
Cotton leafworm 2012
y = -954.ln(x) + 10183
R² = 0.002
y = -1370ln(x) + 1461
R² = 0.003
Average No. of moths
200
150
100
50
0
3/2
4/21
6/10
7/30
9/18
Inspection Dates In 2012

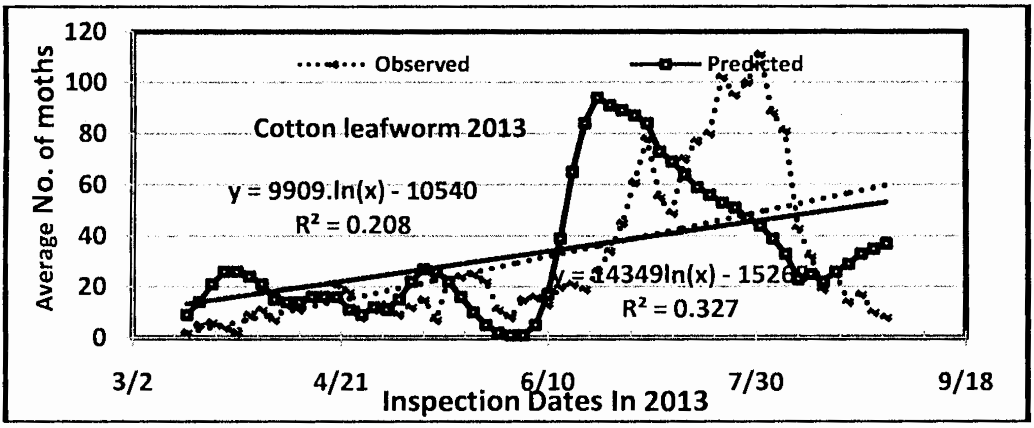

Observed
Predicted
Cotton leafworm 2013
y = 9909.ln(x) - 10540
R² = 0.208
y = 14349ln(x) - 1526
R² = 0.327
Average No. of moths
120
100
80
60
40
20
0
3/2
4/21
6/10
7/30
9/18
Inspection Dates In 2013

Fig. (4) Observed and predicted population of cotton leafworm during three successive tomatoes growing seasons (2011-2013) at Fayum Governorate, Middle Egypt

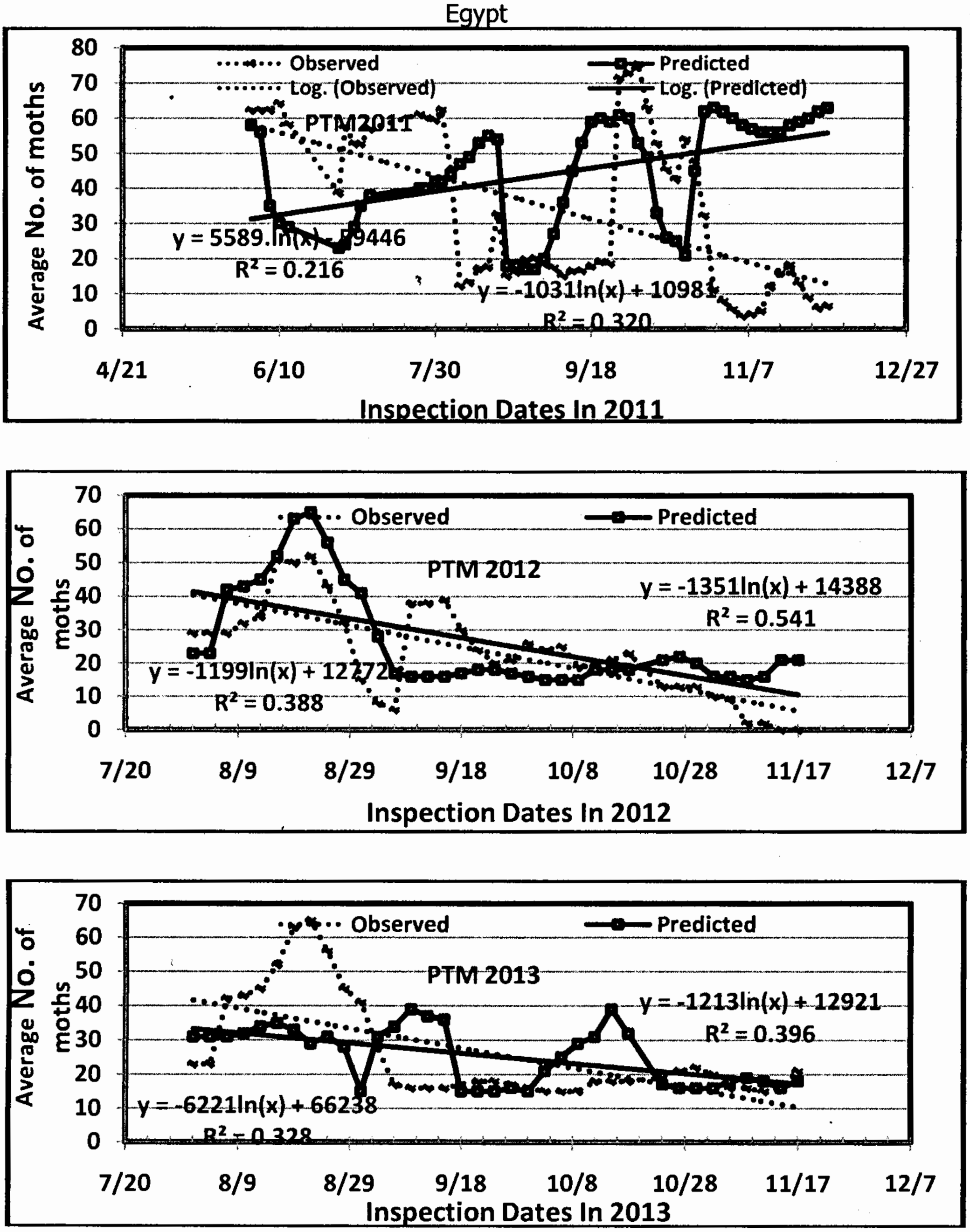


Fig. (5) Observed and predicted population of potato tuber moth during three successive tomatoes growing seasons (2011-2013) at Fayum Governorate, Middle Egypt

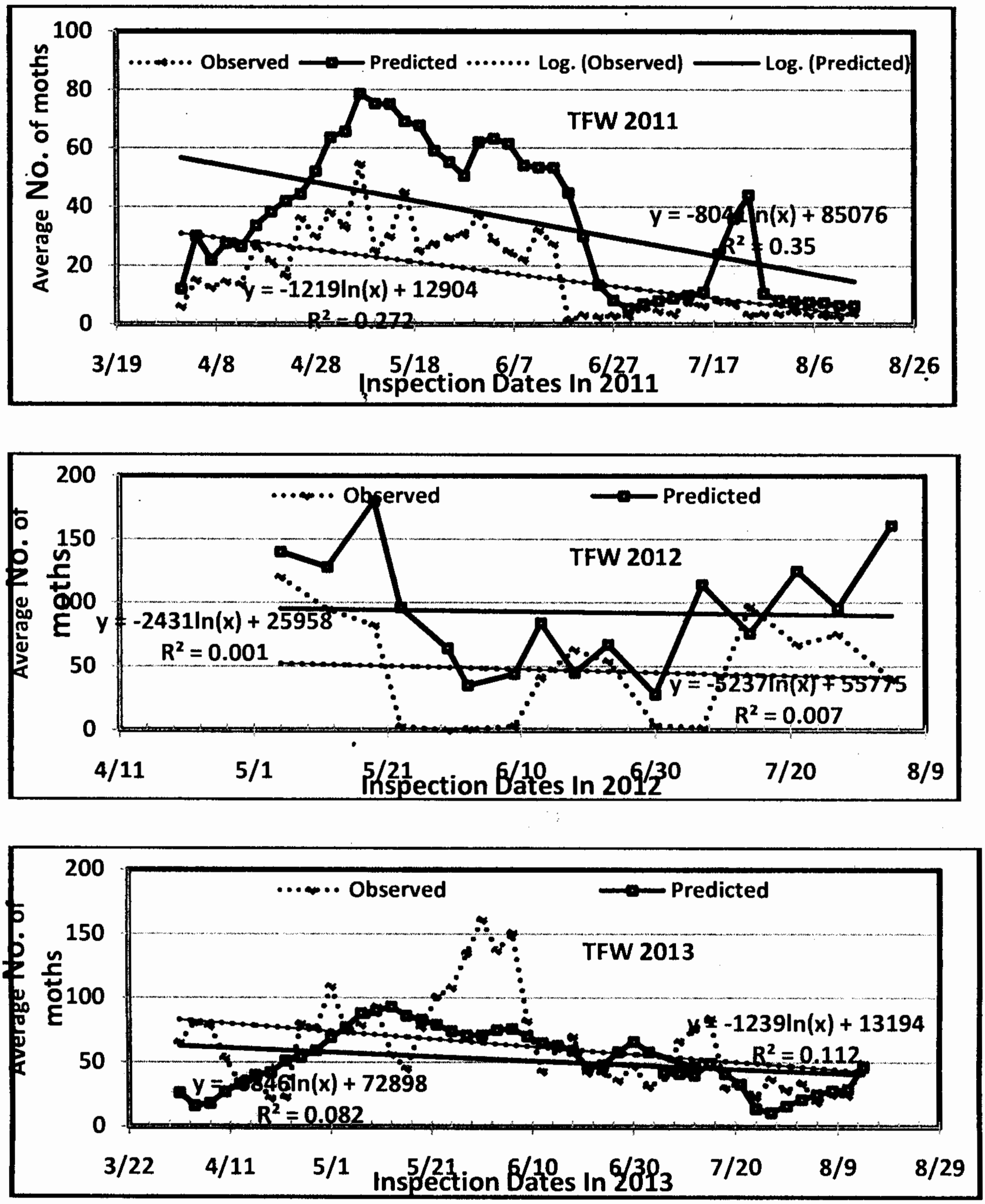


Fig. (6) Observed and predicted population of tomatoes fruit worm during three successive tomatoes growing seasons (2011-2013) at Fayum Governorate, Middle Egypt

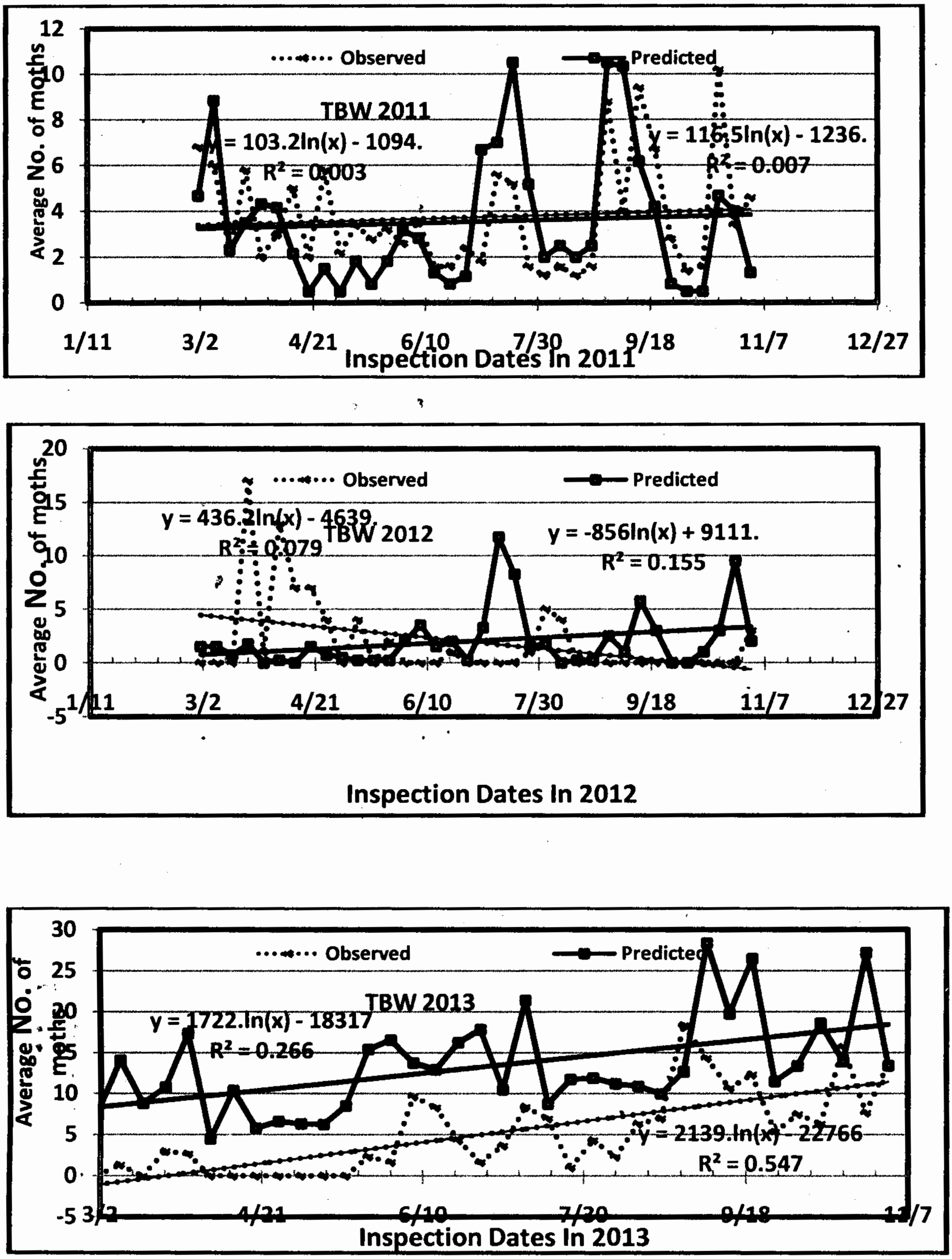


Fig. (7) Observed and predicted population of tobacco budworm during three successive tomatoes growing seasons (2011-2013) at Fayum Governorate, Middle Egypt

Table (3): Simple correlation of Log observed and predicted curves of some cotton insect pests during three successive cotton growing seasons (2011-2013) at Fayum Governorate, Middle Egypt

Pest	Season	R^2		% Accuracy
		Observed	Predicted	
Aphid	2011	0.0979	0.0599	61.18
	2012	0.0138	0.0111	80.43
	2013	0.0902	0.0518	57.43
	Average			66.35
Red Mite	2011	0.4477	0.3303	73.78
	2012	0.0313	0.0269	85.94
	2013	0.3962	0.1828	46.14
	Average			68.62
Whitefly	2011	0.2264	0.1828	80.74
	2012	0.0078	0.0062	79.49
	2013	0.0185	0.0163	88.11
	Average			82.78
Cotton Leafworm	2011	0.1014	0.0456	44.97
	2012	0.0031	0.0026	83.87
	2013	0.3278	0.2081	63.48
	Average			64.11
Potato tuber moth	2011	0.3204	0.2161	67.45
	2012	0.5419	0.3885	71.69
	2013	0.3964	0.328	82.74
	Average			73.96
Tomatoes fruit worms	2011	0.35	0.2726	77.89
	2012	0.0073	0.0013	17.81
	2013	0.1125	0.0828	73.60
	Average			56.43
Tobacco budworm	2011	0.0072	0.0038	52.78
	2012	0.1556	0.0795	51.09
	2013	0.5472	0.266	48.61
	Average			50.83
General Average				66.15

تصميم و انشاء برنامج كمبيوتر لإنتاج و وقاية محصول الطماطم في مصر الوسطى

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يتعرض محصول الطماطم في مصر للإصابة بعدد كبير من الآفات الحشرية منذ شتل النباتات و حتى الحصاد و قد تؤدي الاصابة الى أضرارا بالغة سواء من التغذية على المجموع الخضرى او الثمار أو من خلال نشر بعض الأمراض ومن هذه ألآفات الدودة القارضة ، ذبابة الطماطم البيضاء ، من القطن ، من الخوخ الأخضر فراشة درنات البطاطس ، دودة ورق القطن صانعات الانفاق ،العنكبوت الاحمر ذو البقعتين ، دودة ثمار الطماطم ودودة براعم التبغ.

ومن اجل عمل برنامج ناجح للإدارة المتكاملة الآفات الطماطم استخدم برنامج كمبيوتر فى هذه الدراسة باعتبارها أداة للإدارة المتكاملة للآفات و هو برنامج يبدأ مع سلسلة شاشات مما يمكن المستخدم من تعديل أي من البيانات الافتراضية في بداية المحاكاة. وتشمل البيانات الرئيسية لوحدة المحصول أصناف الطماطم، تاريخ ألزراعة والموقع الجغرافي وحقل للمحاكاة. وتشمل البيانات الأساسية للآفات الحشرية تاريخ ألملاحظة وأعداد الأفراد في العينات. وبمقارنة منحنى نمو الطماطم المشاهد والمتوقع من خلال برنامج التنبؤ كان متوسط الانحرافات ٠.٠٠، -٢.٣٣، -٢.٤٤، -٤.١١، و١٣.٤٤ يوم مقدره بالأيام لتاريخ الزارعة والنمو الخضري (بدا من العقدة الخضرية الخامسة إلى العقدة الثامنة عشر)، مرحلة ألإزهار تكوين، الثمار ومرحلة نضح الثمار على التوالي.

ايضا تم اختبار الفروق فى الكثافة العددية لحشرات الطماطم بين الأعداد المتوقعة والفعلية. وأوضح البرنامج المختبر ان مستوى الدقة فى التنبؤ كمتوسط لثلاثة مواسم ٦٦.٣٥٪ للمن ، ٦٨.٦٢٪ العنكبوت الأحمر، ٨٢.٧٨٪ للذبابة البيضاء، و٦٤.١١٪ لدودة ورق القطن. ٧٣.٩٦٪ لفراشة درنات البطاطس، ٥٦.٤٣٪ ، لدودة ثمار الطماطم و٥٠.٨٣٪ لدودة براعم التبغ.

اتجاه منحنى التعداد المتوقع قريب إلى منحنى التعداد الفعلي ، كما يمكن أن نستخلص من النتائج المتحصل عليها ان منحنيات تطور النمو المسجلة في الواقع لا تختلف كثيرا عن تلك التي تم الحصول عليها عن طريق النموذج المختبر ويمكن تنفيذه كأداة من برامج الإدارة المتكاملة للآفات الطماطم.