ISSN:0975-9646

A WEB BASED TOMATO CROP EXPERT INFORMATION SYSTEM BASED ON ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING ALGORITHMS

Prof.M.S.Prasad Babu[1] N.V.Ramana Murty[2] S.V.N.L.Narayana[3]

1. Professor, Department of CS & SE, Andhra University, Visakhapatnam, Andhra Pradesh, India.
msprasadbabu@yahoo.co.in
2. Associate Professor, Department of MCA, G.V.P.College for Degree & P.G.Courses (A), Visakhapatnam, Andhra Pradesh, India.
murty_nadiminty@yahoo.com
3. Head of the Department, Department of Physics, M.R.P.G.College, Vizianagaram, Andhra Pradesh, India
laxminarayanasvn@yahoo.com

ABSTRACT

Tomato is now the most widely grown vegetable crop in World. It is grown throughout the world in farm gardens, small home-gardens, and by market gardeners for fresh consumption as well as for processing purposes. This Tomato crop expert advisory system is aimed at a collaborative venture with eminent Agriculture Scientist and Experts in the area of Tomato Plantation with an excellent team of computer Engineers, programmers and designers. This Expert System contains two main parts one is Tomato Information System and the other is Tomato Crop Expert System where in Information system, the user can get all the static information about different species, Diseases, Symptoms, chemical controls, Preventions, Pests, Virus of Tomato fruits and plants. In Advisory System, the user is having an interaction with the expert system online; the user has to answer the questions asked by the Expert System. Depends on the response by the user the expert system decides the disease and displays its control measure of disease. This Tomato Crop Information Expert System deals with different varieties of Tomato Crop, Identification of various diseases generally occurs to tomato crop based on the symptoms. This Rule based Expert System validates the symptoms of the tomato crop using the techniques of ID3 Algorithm and some optimization algorithms. This is a Web based Expert System with java as the front end and SQL as the backend.

KEYWORDS:

Expert Advisory System – Information System – Rule Based – ID3 Algorithm-Optimization Algorithms – Web Based – JSP – SQL

1. INTRODUCTION

Expert systems are computer applications, which embody some non-algorithmic expertise for solving certainty pes of problems. For example, expert systems are used in diagnostic applications servicing both people and machinery. Machine learning is a set of tools that allow us to "teach" computers how to perform tasks by providing examples of how they should be done. The tomato is one of the most important "protective foods" both because of its special nutritive value and also because of its widespread production. It is the world's largest vegetable crop after potato and sweet potato, but it tops the list of canned vegetables. Tomatoes are used for soup, salad, pickles, ketchup, puree, sauces and in many other ways. The inhabitants of Central and South America have used tomatoes as food since prehistoric times. It has originated in Peruvian and Mexican regions. It was introduced into Europe by the Spanish explorers in the early sixteenth century. European migrants later on introduced it to the U. S. A. and Canada. The Portuguese perhaps introduced it into India though there is no definite record of when and how it came to India. Tomato is said to be the native of tropical America. The word tomato, not used until 1695, is said to be derived from the Aztec 'Xitomate' 'Sitotomate'. From tropical America it spread to other parts of the world in the 16th century and it became popular in India within the last six decades.

1.1 World Wide Tomato Area Production and Productivity

Table 1

Country	Area in Ha	Production in Mt	Yield in g/Ha
World	4,550,719	125,015,792	27471
Brazil	58,385	3,303,530	56581
China	1,305,053	31,644,040	242047
Cuba	60,000	800,000	13333
Egypt	195,000	7,600,000	38974
India	540,000	7,600,000	14074
Indonesia	50,020	587,790	11751
Mexico	67,084	2,148,130	32021
Russia	146,000	1,980,000	13561
Spain	70,400	4,473,573	63545
USA	172,810	12,766,000	73873

1.2 Nutritive Value

They have outstanding vitamin contents like ascorbic acid or vitamin C, vitamin A, thiamine or vitamin B_1 and riboflavin or vitamin B_2, in that order. The outstanding value of the tomato as a source of special nutrients needed in the diet is indicated by its nutritive value (per 100 g of edible portion).

Table –2

Moisture	93.1 g	Vitamin A	320I.U
Protein	1.9 g	Thiamin	0.07 mg
Fat	0.1 g	Riboflavin	0.01mg
Minerals	0.6 g	Nicotinic acid	0.4 mg
Fibber	0.7 g	Vitamin C	31 mg
Carbohydrates	3.6 g	Sodium	45.8 mg
Calcium	20 mg	Potassium	114 mg
Magnesium	15 mg	Copper	0.19 mg
Oxalic acid	2 mg	Sulfur	24 mg
Phosphorous	36 mg	Chlorine	38 mg
Iron	1.8 mg	Calories	23mg

1.3 Climate And Soils

1.3.1 Climate

The tomato is a warm -season crop. It is not only sensitive to frost but it does not thrive at low, non-freezing temperatures. High temperatures, accompanied by low humidity and dry winds, frequently damage floral parts and there is no fruit-set. Tomato pollen grains germinate best at 29 .4^{0}C, nearly as well at 21.1^{0}C, poorly at 10^{0}C and very poorly at 37.3^{0}C. The crop does well under an average monthly temperature of 21^{0}C to 23^{0}C but commercially it may be grown at temperatures ranging from 18^{0}C to 27^{0}C. Temperature and light intensity affect the fruit-set, pigmentation and nutritive value of the fruit. Both high and low temperatures interfere with the setting of fruit. The tomato withstands drought fairly well but fruits are subject to blossom end rot and to growth cracks if moisture supply follows drought. It cannot be grown successfully in regions of higher rainfall.

1.3.2 Soils

The tomato grows on practically all soils from light sandy to heavy clay. Light soils are good for an early crop, while clay loam and silt-loam soils are well suited for heavy yields. The best soil for tomato is rich loam, with a little sand in the upper layer, and a good clay in the sub-soil. Good texture of the soil is of primary importance. Tomatoes do best in a soil that has a soil reaction from pH 6.0 to 7.0. If the soil is acidic liming is advocated.

2. PROPOSED SYSTEM

The proposed system is Tomato crop expert advisory system. It is aimed at a collaborative venture with eminent Agriculture Scientist and Experts in the area of Tomato Plantation with an excellent team of computer Engineers, programmers and designers. The program is divided into two aspects

1) Information System

2) Advisory System

In In formation s ystem, the user can get a ll the st atic in formation about different sp ecies, D iseases, Sy mptoms, chemical c ontrols, Pre ventions, Pests, Virus of Tomato fruits and plants.

In Ad visory S ystem, the u ser is having an in teraction with the exp ert system on line; the user h as t o answer th e questions a sked b y the Ex pert System. Depends on the response b y the u ser th e expert sy stem decides the dise ase and displays its control measure of disease.

This web app lication i s e xpected to hav e the following features:

1) This web applic ation provides time-to-time up dates o f Tomato information to the users at their doorsteps regarding diseases, virus a nd i ts control m easure, which leads to good yields.

2) This site contains four major section s named Info rmation Systems of Tomato cro p, To mato Advisory S ystem, o ther services related to web app lication and an additional feature is li nks to other agriculture systems

3) The web directory service, articles and the discussion forum service provided in the website will help the tomato fraternity in a greater wa y to i nteract e ach o ther to pro duce b etter findings i n the area of tomato field.

2.1 Functional Requirements for Tomato Expert System:

2.1.1 Inputs –

The system needs the in formation about the symptoms from the user to produce the output.

2.1.2 Outputs-

The outputs of the system will be:

1) Information Diseases
2) Small De scription a bout t he disease
3) Chemical controls
4) Preventions

2.1.3 Store-

The i nformation colle cted throu gh experts is stored as a data base (K nowledge Base) that serves as a re pository f or q uick processing and future retrieval. The system stores the information in html files.

1) About Tomato system
2) About Tomato Varieties
3) Climate and Soil
4) Nutrients

5) Common Symptoms
6) Common Diseases
7) Chemical Control
8) Preventions

The System Stores the information related to expert design in knowledge base in the following ways.

2.1.4 Rules: A set of rules, which constitute the program, stored in a rule memory of production memory and on an inference engine required to execute the rules.

2.1.5 Dataset: The monitoring data is in the MySQL database. It can be used as any other data stored in a database. This greatly increases the opportunity with which you can conduct post-analysis of the monitoring data.

3. MACHINE LEARNING ARCHITECTURE OF TOMATO CROP ADVISORY EXPERT SYSTEM

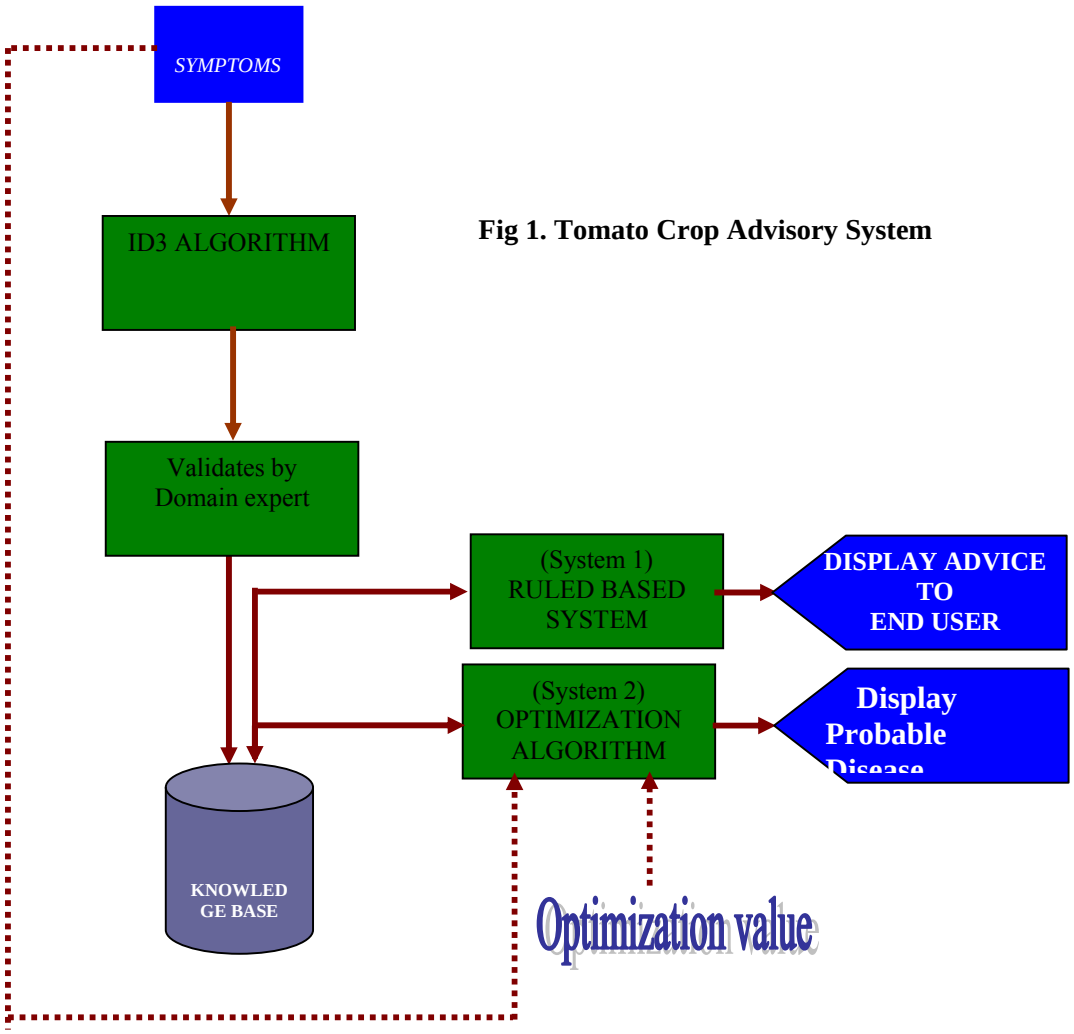


Fig 1. Tomato Crop Advisory System

Fig 2. Architecture of subsystem –I (ID3 ALGORITHM)

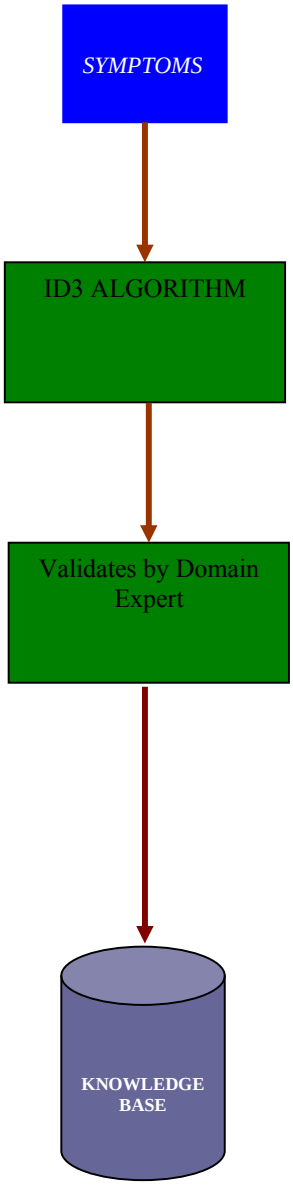
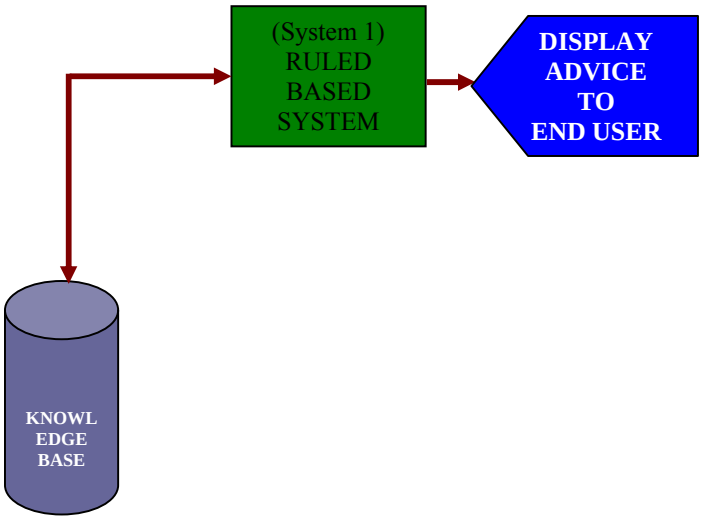


Fig.3 Architecture of subsystem –II (RULE BASED SYSTEM)



3.1 ID3 Algorithm

In decision tree learning, **ID3** (**Iterative Dichotomiser 3**) is an algorithm used to generate a decision tree invented by Ross Quinlan.

The ID3 algorithm can be summarized as follows:

1. Take all unused attributes and count their entropy concerning test samples
2. Choose attribute for which entropy is maximum
3. Make node containing that attribute

The algorithm is as follows:

ID3 (Examples, Target_Attribute, Attributes)

- Create a root node for the tree
- If all examples are positive, Return the single-node tree Root, with label = +.
- If all examples are negative, Return the single-node tree Root, with label = -.
- If number of predicting attributes is empty, then Return the single node tree Root, with label = most common value of the target attribute in the examples.
- Otherwise Begin
  - A = The Attribute that best classifies examples.
  - Decision Tree attribute for Root = A.
  - For each possible value, v_i, of A,
    - Add a new tree branch below Root, corresponding to the test $A = v_i$.
    - Let Examples(v_i), be the subset of examples that have the value v_i for A
    - If Examples(v_i) is empty
      - Then below this new branch add a leaf node with label = most common target value in the examples
    - Else below this new branch add the subtree ID3 (Examples(v_i), Target_Attribute, Attributes – {A})
- End
- Return Root

This algorthim is used to generate rules.

3.2 Symptoms

S1= lesion found over the plant

S2= lesions are found on stems or leaves or roots

S3= fungus on the soil surface or fruit

S4= spots found on the fruit and leaves

S5= any water-soaked areas

S6= spots on fruits with pale brown concentric rings

S7= any irregular spots on leaves, withdark brown color

S8= any narrow yellow halo may surround the spots

S9= The lower leaves may droop first before wilting occurs

This format is stored as a text file. the ID3 program Executes this text file. It generates Rules, which are used to design the Ruled Based system.

4. RULE BASED SYSTEM (SYSTEM-1)

4.1 Rule Based System (System –1)

In the Rule Based System the System takes the Symptoms as Input and produce the Exact Disease with all the facts and Rules that matches with in the Knowledge base. This Rule Based System Consists of Knowledge Base, Inference Engine, User Interface, Expert and the User.

In the Rule Based System the systems accepts the Symptoms from the farmer or the user and give the advice basing on the exact match of facts and rules from the knowledge base.

The output of the this system produce the exact disease basing on the symptoms produced by the user which leads to a disadvantage that if any of the symptom does not match with the knowledge it will not produce any output for the further proceedings.

If the system 1 (Rule Based System) unable to produce the exact disease then the system 2 (Optimization Algorithm) explained below starts performing its work.

4.2 Optimization Algorithm (System – 2)

The Base idea of this algorithm is taken from the concept of context-dependent auto associative memory model. The sets of diseases and the symptoms are mapped onto a pair of orthogonal vectors. A matrix memory stores the associations between the signs and symptoms and their corresponding diseases.

4.2.1 Symptoms

S1= lesion found over the plant

S2= lesions are found on stems or leaves or roots

S3= fungus on the soil surface or fruit

S4= spots found on the fruit and leaves

S5= any water-soaked areas

S6= spots on fruits with pale brown concentric rings

S7= any irregular spots on leaves, with dark brown color

S8= any narrow yellow halo may surround the spots

4.2.2.Diseases:

D1= Anthrocnose

D2= Bacterial Spot

D3=Buckeye Rot

D4= EarlyBlight

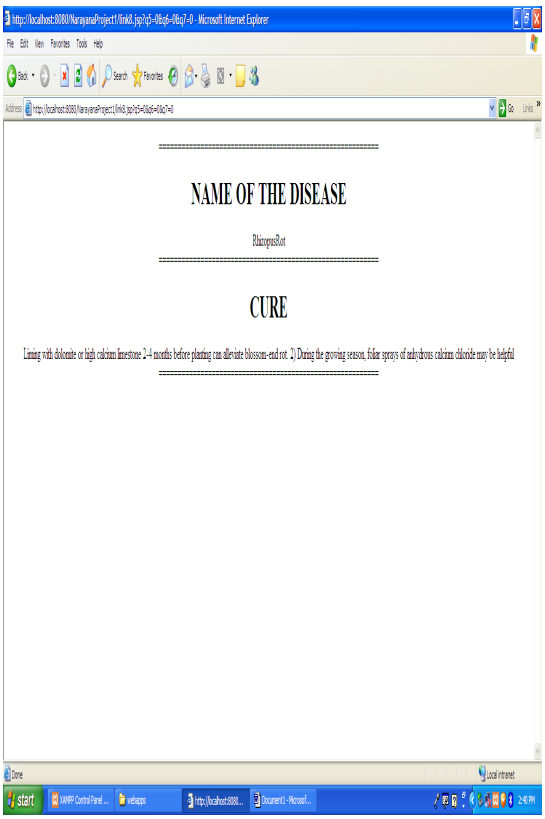
D5= PowderyMildew

D6=Rhizopus Rot

5. RESULTS & DISCUSSIONS

5.1 Results for the Rule Based Algorithm

Fig.4 Identify The Disease:



5.2 Results for Optimization Algorithm

Fig 5. Optimization Results

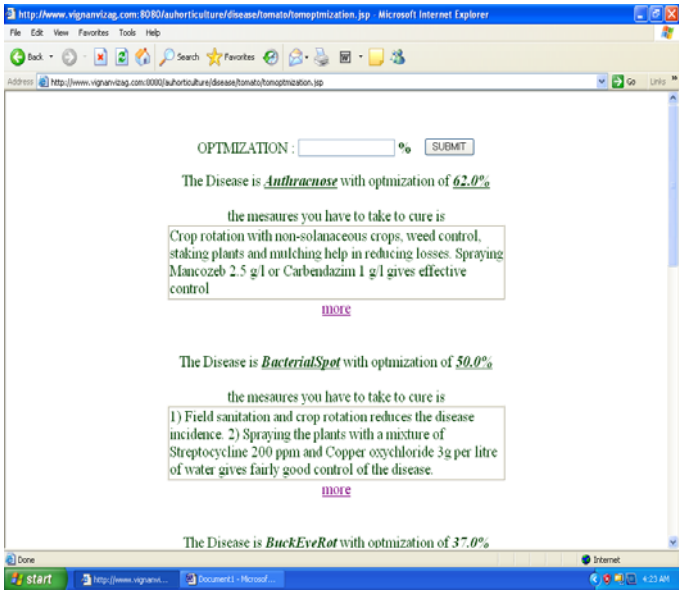


Fig 6. Optimization Results

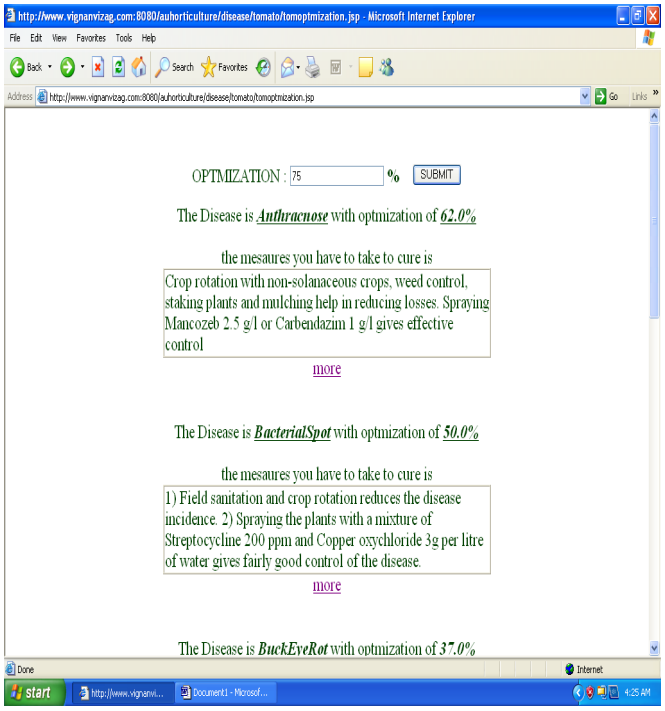
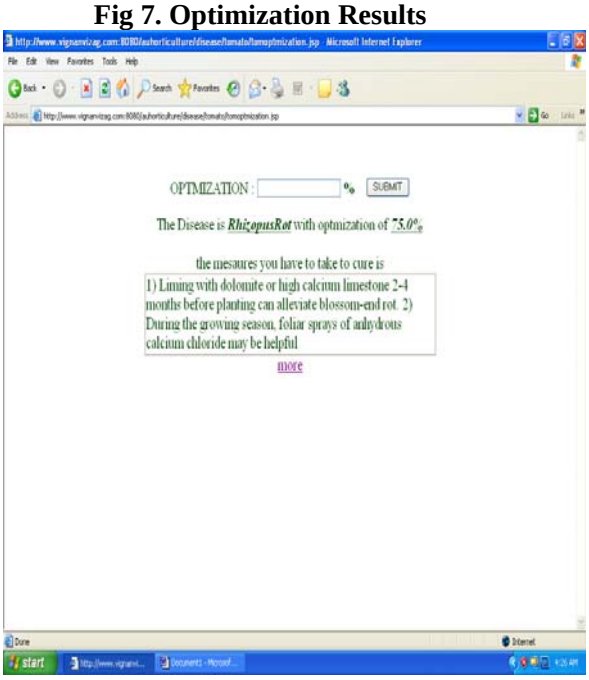


Fig 7. Optimization Results



6. FUTURE WORK

In this Tomato Expert System two algorithms are impletemented, which are

1) ID3 Decision Tree Algorithm

2) Optimization Algorithm

where the ID3 Decision tree algorithm is called for each subset of diseases. The future enhancement will be in such a way using training data from the farmers collect from overall India,to check whether the disease is correct or not from the all subset of diseases.

7. CONCLUSION

This is a web -enabled application developed using java server pages (jsp) and MySql database is used as backend. So as to ensure the quality of the software, all software engineering concepts, including test cases are implemented. Its main emphasis is to have a well designed interface for giving Horticulture related advices and suggestions in the area of Tomato crop field by providing facilities like dynamic interaction between expert system and the user without the need of expert (Tomato crop) at all times. By the thorough interaction with the users and beneficiaries the functionality of the System can be extended further to many more areas in and around the world.

8. ACKNOWLEDGEMENTS

Thank you to every one

9. REFERENCES

1. **TIMOTHY C. LETHBRIDGE ROBERT LAGANIERE:** *Object-Oriented Software Engineering,*,TMH Publications
2. **ANN NAVARRO TODD STAUFFER** *HTML by Example,* PHI Publications
3. **TIMOTHY BRIGGS, SAMEER TYAGI** *Professional JSP* - Wrox Press, Shroff Publishers
4. **C.J. DATE** *An Introduction to Database System*
5. Tomato crop Manual books, Published by **Acharya. N.G.Ranga Agricultural University**
6. **Dayan, P. (1992).** The convergence of TD(A) for general A. *Machine Learning,* 8, 341-362.