"DESIGN & DEVELOPMENT OF KNOWLEDGE BASED SYSTEM FOR SOYBEAN CROP MANAGEMENT"

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Abstract: Knowledge Based System is defined as "A computer program that contains expert knowledge about a particular problem domain, often in the form of if – then rules that is able to solve the problems at a level equivalent to or greater than human expert." Basically the roll of Knowledge Based System is to provide solutions (advice) to solve a particular problem and this solution is based on knowledge collected from number of experts. This paper deals with design and development of Knowledge Based System which helps Soybean Growers for Soybean crop management. Soybean crop management includes different factors as Seed Selection, Soil Preparation, Water Management, Fertilizers Management, Insect Management, Disease Management and Weed Management. The Soybean Growers should have sound knowledge and decision making capability related to all these factors, so that they will get high yield which is directly proportional to profit. This system helps Soybean Growers to take sound decisions during every growth stage of crop.

Keywords: Knowledge Based System, Soybean, Seed Selection, Soil Preparation, Water Management, Fertilizers Management, Insect Management, Disease Management, Weed Management, Knowledge Base.

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1) INTRODUCTION:

1.1) Soybean in Western Maharashtra:

Soybean or Soya bean is widely grown for its edible bean which has numerous uses. It contains 20% oil and 40% high quality protein. Soybean is rich in valuable amino acid lysine(5%) in which most of the cereals is deficient. In addition it contains good amount of minerals, salts and vitamins (thiamine and riboflavin) and its sprouting grain contain a considerable amount of Vitamin C, Vitamin A. A large number of western dishes such as bread, chapatti, milk, meal, sweets etc can be prepared with Soybean. It is widely used in making high protein food for children and also industrial production of Antibiotics. As an agricultural use, Soybean built up soil fertility by fixing large amount of atmospheric nitrogen through the root nodule and also leaf falls on ground at maturity. Soybean being a richest, cheapest and easiest source of best quality proteins and fats. Soybean oil can be used to produce cleaning agent. So because of these numerous uses Soybean is sometime called as a "wonder crop".

In India, production of soybean is restricted mainly to Madhya Pradesh, Utter Pradesh, Maharashtra and Gujarat. If we consider Maharashtra, Vidharbha, some part of Marathwada, and Western Maharashtra are produces Soybean. Soybean Growers are large scale in Western Maharashtra which includes Satara, Sangli, Kolhapur, Pune, Solapur and Ahmadnagar districts.

1.2) Problems of Soybean Growers:

Considering the Soybean growers, to get maximum yield, Grower must have a proper knowledge for taking decision related to different factors of crop management as Seed Selection, Soil Preparation, Water Management, Fertilizer Management, Insect Management, Disease Management and Weed Management.

Now let us discuss problems of Soybean Growers related to above mentioned factors

1.2.1) Seed Selection: To increase yield, grower have to select best variety. Number of varieties are available, but here growers are unaware about varieties, their production, their pest resistant capability etc.

1.2.2) Water Management: Here excess water and less water are also affects on growth. Most of the farmers give water by flood irrigation and only few uses drip irrigation or sprinkler irrigation. So here farmers should know the ratio and schedule of water irrigation.

1.2.3) Fertilizers Management: Soybean has its own nutrition requirement i.e. it require primary and secondary nutrient. Any deficiency of nutrient will directly affects growth of crop. So here grower should apply fertilizers in proper manner. Improper application of fertilizers affects growth as well as soil fertility which decreases yield. Also they should know the time of fertigation and spraying schedule.

1.2.4) Insect Management: Normally Soybean is attacked by number of insects like Bihar Leaf Eating Caterpillar, Tobacco Leaf Eating Caterpillar, Green Semi Looper, Thrips, Aphids, Jassids, Red Mite and many more. These insects definitely damage the crop which affects the growth. There are number of cultural and mechanical control measures are available to control or prevent attack of these insects. Also chemical control is available to control attack of insects. Here Grower needs knowledge of symptoms and control measures of all insects.

1.2.5) Disease Management: Soybean also infected by some disease like Root Rotting, Bacterial blight and Asian Soybean Rust. This disease affects growth of crop. To control infestation of these diseases, cultural, mechanical and chemical control measures are available. Here Grower needs knowledge of symptoms and control measures of disease.

1.2.6) Weed Management: Number of different types of weeds is grown into Soybean. These weed grown in parallel with Soybean crop. It intakes nutrients from soil which creates nutritional deficiency in soil. To remove the weed and to control the weed, there are number of cultural and mechanical control measures are available. Some herbicides are also available.

But excess use of herbicide can destroy the whole crop. So grower should have sufficient knowledge of all these control measures, but most of the growers do not have sufficient knowledge.

During the study, Researcher observed that majority of farmers does not have information about above mentioned factors. Also most of the growers took decisions based on their traditional knowledge of crop management with which highest yield is not possible. Moreover while dealing with above discussed problems, Farmers consults with people from local Agricultural service provider or agriculture agencies and possibly got misguided with wrong or insufficient solution. Also this Agricultural service provider advised to use respective services which are available at their centers which may increase unnecessarily production cost.

Thus above discussed are different problem that Soybean Growers facing today.

1.3)   Knowledge Based System and Soybean cultivation:

To address different problems of Soybean Growers stated in 1.1.4, numerous researches are being carried out and new results are discovered at the research institutions. But all these research findings and results were not reached to the farmers i.e. at implementation level because of lack of proper communication channel like Decision Support System or Expert System. So it was observed that, the major road block for adapting precision agriculture is lack of proper decision support system. So Researcher found that, need of hour is virtual expert who can give personalized expert advice to a large community of farmers, specific to advice or solve different problems related to different crop management.

As stated earlier, Knowledge Based System is a computer program which stores knowledge of Experts in the form of if – then rules and delivers it into the different forms to user which will help them to solve specific problem. Knowledge Based System assists people in making of environmentally sound and economically viable decisions. [9.1]

Here Researcher decided to design and develop a Knowledge Based System. It will work as Virtual Expert and guide to farmers to solve different problems related to different Soybean crop management factors.

2)   STATEMENT OF RESEARCH PROBLEM:

Now days, Soybean is wonder crop with high proteins and oil and having huge demand in market and also it increases soil fertility. To increase yield, farmer should have complete

knowledge of different Soybean crop management factors or they need expert who help or advice them to take decisions related to different crop management factors. Means if farmer got complete knowledge or an Expert then definitely they will get high yield which turns into high profit. To address these problems, there should be Knowledge Based System which will help or guide farmers into management of different crop and so Researcher carried out the research entitled "DESIGN & DEVELOPMENT OF KNOWLEDGE BASED SYSTEM FOR SOYABEAN CROP"

3)   REVIEW OF LITURATURE:

Peter B Goodell & other (1990) [9.2], have focused on integrated Expert system for Cotton production and management, developed in Egypt, that simulates human problem solving behavior. This system is useful for Growers to manage crop production. The system also Growers predicts the effects of any one decision on subsequent events. In 1990, near about 100 cotton producers have taken advantage of this program. This system has plant and pest simulation models to diagnose the pest.

Pinaki Chakraborti, Dr. Dilip Kumar Chakraborti (2008) [9.3], discussed the success of expert system for management of Malformation disease of Mango i.e. ESMMDM. To suggest suitable treatment package, system considers number of facts like plant variety, number of malformed shoots and climatic facts etc.

G.N.R. Prasad, Dr. A Vinaya Babu (2006) [9.4], discussed various Agricultural expert system. They said that in this competitive world, for decision making, the farmers always rely on agricultural specialist and advisor who provide useful information. Timely agricultural specialist assistance is most helpful for farmers. But most of the time, farmers could not get this assistance. To solve this problem, expert systems were emerged as a tool with extensive potential in agriculture. In this paper, author also discussed another expert system are as follows.

A. J. Castro and Garcia – Torres (1995) [9.5], explains an expert system SEMAGI. SEMAGI is a interactive microcomputer program developed for sunflower crop. This program evaluates the potential yield reduction from multispecies weed infestations and from the parasitic weed

broomrape and to determine appropriate selection of herbicide. It combines related knowledge of herbicides, weed and their interactions. SEMAGI performs an economic study considering the factors like herbicide treatment selected, herbicide treatment cost, expected yield increase from the weed control treatment and sunflower selling price.

Harvinder S. Saini, Raj Kamal and A. N. Sharma (2002) [20], introduces Web based fuzzy expert system for integrated pest management in Soybean i.e. SOYPEST. SOYPEST provides an Integrated Pest Management decision support to the farmers through the internet. This has been used for the crops grown in different regions of India. It provides diagnosis of pest and its preventive and curative measures.

Howard W. Beck and others (1989) [9.6], discussed SOYBUG, an expert system developed to advise Florida farmers on control of four important insect pests of soybeans: velvet bean caterpillar, stink bug, corn earworm, and soybean looper. This system integrates rules, based on crop phenology and economics and gives pesticide suggestion.

Yushu Yang, Fullin Wang, Yongsheng Ma (2005) [9.7], introduces Intelligent Soybean Decision- Making System, to help pleasant to solve practice problem which they encounter in the production of Soybean about picked seeds, prevention and cure the pests, analysis of economic benefits and it provide the technician of Soybean production with decision making service.

S.J. Yelapure, R.V. Kulkarni, (2012), [9.8], studied different expert system in agriculture and concluded that there is not any expert system available in India which will guide farmers from soil preparation to harvesting. So there is need of such system, where growers get knowledge at one point.

By reviewing above literature, Researcher found that many expert systems are designed and developed in agriculture sector. But no one made attempt to develop or state an expert system which can guide related to all factors of Soybean crop management. Also number of attempt made to develop expert system for Soybean crop but each one concentrate on individual factor not all factors in one case. So researcher made attempt to develop knowledge based system

which will guide or advice to growers regarding to take decision related to all Soybean crop management factors.

4) OBJECTIVES OF STUDY:

The proposed study is undertaken with specific objective as under

1. To study different factors related to crop management of soybean like Seed Selection, Soil Preparation, Water Management, Fertilizer Management, Insect Management, Disease Management and Weed Management.

2. To study problems faced by farmers while taking decision related to different Soybean crop management factors.

3. To extract knowledge from experts regarding stated problems of Soybean crop.

4. To design & develop Knowledge Base.

5. To design and develop Knowledge Based System to solve stated problem of Soybean Growers.

5) RESEARCH METHODOLOGY:

5.1) Method of Research:

Researcher adapted "Applied Research" method for his study. This type of research aims at finding a solution for an immediate problem facing by society. Here Researcher intended to develop a knowledge Based System which guide or helps farmers to solve problems related to Soybean crop management factors and provide perfect solution to it.

5.2) Methods of Data Collection:

To study the research problem, Researcher required collecting the data related to Soybean life cycle stages, different crop management factors etc. Here Researcher has collected both primary and secondary data.

5.2.1) Primary Data:

This data is directly collected from respondents. There were two types of respondents. One is Agriculture Academicians and Research Persons and other is Soybean Growers who have a practical knowledge.

5.2.2) Secondary Data:

Secondary data was collected by referring various books, journals, diaries published by agriculture universities and websites. Here Researcher collected secondary data like Soybean, Soybean life cycle, different crop management factors.

6) CONCEPTS CONSIDERED DURING DISEASE MANAGEMENT:

During study, Researcher studied all Soybean crop management factors and so it becomes difficult to specify the concepts of all factors. So for simplicity purpose, here Researcher intended to specify the concept of factor Disease Management.

6.1) Most observed diseases on Soybean during its life cycle are as follows

a) Root Rotting   b) Bacterial Blight

c) Asian Soybean Rust   d) Soybean Mosaic Virus

6.2) Water management, rain conditions and up and downs in temperature are the different factors due to infestation of different diseases is possible on Soybean Crop.

6.3) Each disease shows its own symptoms on Soybean so we can identify disease by observing symptoms. Here diseases and symptoms are specified in table 1

Table 1:   Diseases and their symptoms observed on Soybean.

Disease	Symptoms observed on Soybean
Root Rotting	1) 'Microphomina fungus attacks on root in seedling stage' 2) 'Roots get rotted' 3) 'Seedling get wilted and dead'
Bacterial Blight	1) 'Small, angular, translucent, water soaked, yellow to light brown spots appears on leaves, and then angular lesion enlarges and merge to produce large irregular dead areas.' 2) Younger leaves are most infected and are destroyed, stunted.' 3) 'Early defoliation of lower leaves' 4) 'Large, Black lesions develops on stem and petioles'
Asian Soybean Rust	1) 'Small tan - to - dark brown or reddish brown lessions, 2 - 3 mm in diameter found on under surface of leaves and they can also occur on petioles, pods and stem' 2) 'Infected leaves will have mottled appearance'

	3) 'Infection often begins on lower leaves'
Soybean Mosaic Virus	1) 'Distorted, puckered and wrinkled leaves' 2) 'A typical mosaic pattern appears on leaves', and 'Plant get stunted'

6.4) Different Cultural control measures are available to control infestation of different diseases, specified in table 2

Table 2: **Cultural control measures to control infestation of diseases.**

Disease	Cultural Control Measures
Root Rotting	1) 'Deep Summer Plough' 2) 'Seed treatment'
Bacterial Blight	1) 'Deep Summer Plough' 2) 'Use disease tolerant varieties' 3) 'Seed treatment'.
Asian Soybean Rust	1) 'Use disease free seeds'
Soybean Mosaic Virus	1) 'Use disease free seeds'

6.5) Different Mechanical control measures are available to control infestation of different diseases, specified in table 3

Table 3: **Mechanical control measures to control infestation of diseases.**

Disease	Mechanical Control Measures
Root Rotting	1) 'Collect & Destroy infested plant parts or plants' 2) 'Field Sanitation : destroy crop residues' 3) Apply artificial irrigation in infested area with help of bunds
Bacterial Blight	Mechanical Control Measures are not applicable
Asian Soybean Rust	Mechanical Control Measures are not applicable
Soybean Mosaic Virus	Mechanical Control Measures are not applicable

6.6) Different Chemical control measures are available to control infestation of different diseases, specified in table 4

Table 4 :   Chemical control measures to control infestation of diseases.

Disease	Chemical Control Measures
Root Rotting	1) For Drenching: Use one of following fungicide in specified ratio, to control infestation of Root rotting | Fungicide Name	Ratio (gm or ml /liter)
Copper Hydroxide 53.8% WP	2
Thiophanate Methyl 70% WP	2 | 2) For Spraying: Use one of following fungicide in specified ratio, to control infestation of Root rotting. | Fungicide Name	Ratio (gm or ml /liter)
Copper Hydroxide 53.8% WP	2
Thiophanate Methyl 70% WP	2	
Bacterial Blight	Use one of following fungicide for spraying in specified ratio | Fungicide Name	Ratio (gm or ml /liter)
Copper Oxychloride 50% WP	2
Copper Hydroxide 53.8 % WP	2
Copper Oxychloride 50% WP + Streptocycline 250 ppm	2
Copper Hydroxide 53.8 % WP + Streptocycline 250 ppm	2	
Asian	

Soybean Rust	Use one of following fungicide for spraying in specified ratio.	
	Fungicide Name	Ratio (gm or ml /liter)
	Mencozeb 75% WP	2
	Propiconazole 25% EC	1
	Carbendazim 12% WP + Mencozeb 63% WP	1

Soybean Mosaic Virus

1) Seedling Stage:

Use one of following insecticides for spraying in specified ratio

Insecticide Name	Ratio (gm or ml /liter)
Dimethoate 30% EC	2
Chlorpyriphos 20% EC	2
Methyl Dematon 25% EC	2
Triazophos 35% EC + Deltamethrin 1% EC	1.5
Imidacloprid 17.8% SL	0.5
Betacyfluthrin 8.49% EC + Imidacloprid 19.8% EC	0.5
Azadiractin 1% EC	1

2) Vegetative Growth stage:

Use one of following insecticides for spraying in specified ratio.

Insecticide Name	Ratio (gm or ml /liter)
Azadiractine 1% EC	1
Dimethoate 30% EC	2
Triazophos 35% EC + Deltamethin 1% EC	2
Chlorpyriphos 50% EC + Cypermethin 5 % EC	2
Methyl Demeton 25% EC	2
Betacyfluthrin 8.49% EC + Imidacloprid 19.8% EC	0.5

3) Pod Formation stage:

Use one of following insecticides for spraying in specified ratio.

Insecticide Name	Ratio (gm or ml /liter)

Profenophos 40% EC + Cypermethrin 4% EC	2
Triazophos 35% EC + Deltamethin 1% EC	2
Thiodicarb 75% WP	2
Emamectine Benzoate 5 % SG	0.5
Chlorantraniliprole 18.5% SC	0.5

7) DESIGN AND DEVELOPMENT OF KNOWLEDGE BASED SYSTEM:

After reviewing the literature, Researcher found that, no one made attempt to develop an expert system which will guide or helps farmers to solve problem of Soybean crop management, focusing on all factors – Seed Selection, Soil Preparation, Water Management, Fertilizers Management, Insect Management, Disease Management and Weed Management. So Researcher undertaken the work "DESIGN & DEVELOPMENT OF KNOWLEDGE BASED SYSTEM FOR SOYABEAN CROP" and developed a web based, Knowledge Based System "SOYAEXPERT" which provides guidance and solution to solve problems related to different Soybean crop management factors.

7.1) Knowledge Base:

A knowledge base is special kind of database providing means to store and retrieval of knowledge. The Knowledge collected by knowledge engineer is stored into knowledge base in the form of IF..THEN rules or also called as production rules. Also there are other methods of knowledge representation like First Order Logic, Predicate Logic and Frames. But because of simplicity and nature of studied problem, Researcher selected Production rules for knowledge representation.

Production rule is having two parts – IF and THEN part. The IF part specify the problem situation is called "Antecedent" of the rule. In "IF" part we can specify one or more situation at a time. The second part is "THEN", which specifies the action to be taken in that situation, is known as "Precedent".

For example   **IF** Identification = ' Leaves get rolled and larvae found in rolled portion'

THEN Insect = 'Leaf Rolling Caterpillar'

Here Researcher design and develop rule base contains knowledge in the form of IF ..THEN rules. For simplicity purpose, Researcher specified the Knowledge Base for Disease Management is as shown in table 5

Table 5:   Knowledge base for Disease Management:

Rule No.	Description
1	**IF** Symptom = 'Microphomina fungus attacks on root in seedling stage' **AND** Symptom = 'Roots get rotted' **AND** Symptoms = 'Seedling get wilted and dead' **THEN** Disease = 'Root Rotting'
2	**IF** Disease = ' Root Rotting' **THEN** Cultural control measures = 'Seed Treatment' and 'Deep summer plough'
3	**IF** Disease = ' Root Rotting' **THEN** Mechanical control measures = 'Collect and destroy infested plant parts or plants.' **AND** 'Field Sanitation : Destroy crop residues.' **AND** 'Apply artificial irrigation in infested area with help of buds.'

4	**IF** Disease = ' Root Rotting' **THEN** Use one of following fungicide for drenching in specified ratio, to control infestation of Root rotting <table><tr><td>Fungicide Name</td><td>Ratio (gmor ml /liter)</td></tr><tr><td>Copper Hydroxide 53.8% WP</td><td>2</td></tr><tr><td>Thiophanate Methyl 70% WP</td><td>2</td></tr></table>
5	**IF** Disease = ' Root Rotting' **THEN** Use one of following fungicide for spraying in specified ratio, to control infestation of Root rotting. <table><tr><td>Fungicide Name</td><td>Ratio (gmor ml /liter)</td></tr><tr><td>Copper Hydroxide 53.8% WP</td><td>2</td></tr><tr><td>Thiophanate Methyl 70% WP</td><td>2</td></tr></table>
6	**IF** Symptom = 'Distorted, puckered and wrinkled leaves' **AND** Symptom = 'A typical mosaic pattern appears on leaves' **AND** Symptom = ' Plant get stunted' **THEN** Disease=' Soybean Mosaic Virus'
7	**IF** Disease = 'Soybean Mosaic Virus' **THEN** Cultural control measures = 'Use disease free seeds.'
8	**IF** Disease = 'Soybean Mosaic Virus' **THEN** Mechanical Control Measures are not suggested to prevent infestation of Soybean

	Mosaic Virus
9	**IF** Disease = 'Soybean Mosaic Virus' **AND** Crop Stage = 'Seedling' **THEN** Use one of following insecticides for spraying in specified ratio, to control infestation of sucking pests, who are spreader of Soybean Mosaic Virus in Seedling Stage of Soybean. <table><tr><td>Insecticide Name</td><td>Ratio (gmor ml /liter)</td></tr><tr><td>Dimethoate 30% EC</td><td>2</td></tr><tr><td>Chlorpyriphos 20% EC</td><td>2</td></tr><tr><td>Methyl Dematon 25% EC</td><td>2</td></tr><tr><td>Triazophos 35% EC + Deltamethrin 1% EC</td><td>1.5</td></tr><tr><td>Imidacloprid 17.8% SL</td><td>0.5</td></tr><tr><td>Betacyfluthrin 8.49% EC + Imidacloprid 19.8% EC</td><td>0.5</td></tr><tr><td>Azadiractin 1% EC</td><td>1</td></tr></table>
10	**IF** Disease = 'Soybean Mosaic Virus' **AND** Crop Stage = 'Vegetative Growth' **THEN** Use one of following insecticides for spraying in specified ratio, to control infestation of sucking pests, who are spreader of Soybean Mosaic Virus in 'Vegetative Growth Stage of Soybean. <table><tr><td>Insecticide Name</td><td>Ratio (gmor ml /liter)</td></tr><tr><td>Azadiractine 1% EC</td><td>1</td></tr><tr><td>Dimethoate 30% EC</td><td>2</td></tr><tr><td>Triazophos 35% EC + Deltamethin 1% EC</td><td>2</td></tr><tr><td>Chlorpyriphos 50% EC + Cypermethin 5 % EC</td><td>2</td></tr><tr><td>Methyl Demeton 25% EC</td><td>2</td></tr></table>

	Betacyfluthrin 8.49% EC + Imidacloprid 19.8% EC	0.5
11	**IF** Disease = 'Soybean Mosaic Virus' **AND** Crop Stage = 'Pod Formation' **THEN** Use one of following insecticides for spraying in specified ratio, to control infestation of sucking pests, who are spreader of Soybean Mosaic Virus in Pod Formation Stage of Soybean.	

Insecticide Name	Ratio (gmor ml /liter)
Profenophos 40% EC + Cypermethrin 4% EC	2
Triazophos 35% EC + Deltamethin 1% EC	2
Thiodicarb 75% WP	2
Emamectine Benzoate 5 % SG	0.5
Chlorantraniliprole 18.5% SC	0.5

12	**IF** Symptoms = 'Small, angular, translucent, water soaked, yellow to light brown spots appears on leaves, and then angular lesion enlarges and merge to produce large irregular dead areas.' **AND** Symptoms = ' Younger leaves are most infected and are destroyed, stunted.' **AND** Symptoms = ' Early defoliation of lower leaves.' **AND** Symptoms = 'Large, Black lesions develops on stem and petiols' **THEN** Disease = 'Bacterial Blight'
13	**IF** Disease = 'Bacterial Blight' **THEN** Cultural control measures = 'Deep summer plough.' **AND** 'Use disease or insect resistant or tolerant varieties.' **AND** 'Seed Treatment.'

14	**IF** Disease = 'Bacterial Blight' **THEN** Mechanical Control Measures are not suggested to prevent infestation of Bacterial Blight
15	**IF** Disease = 'Bacterial Blight' **THEN** Use one of following fungicide for spraying in specified ratio, to control infestation of Bacterial Blight. | Fungicide Name	Ratio (gm or ml /liter)
Copper Oxychloride 50% WP	2
Copper Hydroxide 53.8 % WP	2
Copper Oxychloride 50% WP + Streptocycline 250 ppm	2
Copper Hydroxide 53.8 % WP + Streptocycline 250 ppm	2	
16	**IF** Symptoms = ' Small tan - to - dark brown or reddish brown lessions , 2 - 3 mm in diameter found on under surface of leaves and they can also occur on petioles , pods and stem' **AND** Symptoms = 'Infected leaves will have mottled appearance' **AND** Symptoms = 'Infection often begins on lower leaves' **THEN** Disease = 'Asian Soybean Rust'
17	**IF** Disease = 'Asian Soybean Rust' **THEN** Cultural control measures = 'Use insect or disease tolerant or resistant varieties.'

18	**IF** Disease = 'Asian Soybean Rust' **THEN** Mechanical Control Measures are not suggested to prevent infestation of Asian Soybean Rust
19	**IF** Disease = 'Asian Soybean Rust' **THEN** Use one of following fungicide for spraying in specified ratio, to control infestation of Asian Soybean Rust. | Fungicide Name	Ratio (gm or ml /liter)
Mencozeb 75% WP	2
Propiconazole 25% EC	1
Carbendazim 12% WP + Mencozeb 63% WP	1	

7.2)   Reasoning Methods or Inference strategy :

Researcher prefers Forward chaining as an inference strategy or reasoning method. Forward chaining starts with data available and uses the interference rules to conclude more data until a desired goal reached. In forward chaining strategy interference searches the interference rule until it finds one which the antecedent is true. Interference engine conclude the 'then' clause and adds this information to its data. This procedure will be continued until a goal is reached.

7.3)   Implementation:

Researcher developed a web based, Knowledge Based System "SOYAEXPERT" which provides guidance and solution to solve problems related to different Soybean crop management factors. Researcher developed this system using .NET technology.

8)   CONCLUSION:

Present research is carried out to study Soybean, different Soybean crop management factors, problems of Soybean growers and design and development of Knowledge Based System for Soybean which will guide Soybean growers or farmers to solve different problems related to

different crop management factors. Here Researcher developed a web based knowledge Based System "SOYAEXPERT" for the use of Soybean growers of Western Maharashtra. Farmers can access this system using personal computers as well as mobile also. (Android Operating System).

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