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Energy Required To Soil for Grape Production with Micro Nutrient Zinc Sulphate

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ABSTRACT: Grape (Vitisvinifera) is one of the major important fruit crops ofMaharashtra. The high crop gives more profit through export as foreign exchange. The yield in grapes is related to the several factors like an adequate and timely supply of macro and micro nutrients through the critical stages of the plant life cycle, with emphasis on different nutrients at different stages of the growth. However, at present, the input in the form of fertilizer e.g. Zinc Sulphate, requirement is increasing, thus increasing the cost of production. Doses of Zinc Sulphate are decided by the experts after soil testing. In the present study, the soil samples are collected from different vineyards of the Maharashtra and KarnatakaState. Although grapes have been grown in the area for many decades, a recent conversion of vineyards into quality grape production and suggests that there is further potential to improve qualitythrough fine –tuning of grape by using fuzzy information System.The present study is conducted to decide the actual requirement of Zinc Sulphate; the Fuzzy Information System (FIS) is developed. The laboratory data obtained from the analysis of soil testing report is used as an input to FISand output results are compared with the results suggested by the expert. It is found that the Zinc Sulphaterequirement as suggested by FIS of any grape vineyard is less than the suggestionsgiven by laboratory expert. This results help to reduce the cost of production without affecting the yield level of the grape vineyardwhile maintaining the soil quality.

Keywords: Grape, Soil, Yield,Nutrients, Fuzzy Inference System**.**

I. INTRODUCTION

In India, Grape is grown on an area of about 1.19 lakh hectares with an annual production of 25.85 lakh metric tons. In Maharashtra, it is grown on an area of 90,000 hectares with production of 21.60 lakh metric tons (National Horticulture Database, India, 2015). For the development of framework of vine, plant needs adequate supply of macro and micro-elements in order to match their normal physiological and biochemical functions [(3)]. Besides basic mineral nutrients (nitrogen, phosphorus and potassium), some other elements (magnesium, iron, zinc, boron, etc.) are considered to be essential for plant metabolic processes as they are co-factors and/or activators of many metabolic enzymes [(1)]. Theexcess of nutrient and its deficiency can both lead to physiological disordersand reduction in yield in the vines. Nutrient deficiencies occur when plants cannot reach sufficientavailability of nutrients for their basic metabolism in the surrounding environment, while in case of abundance of minerals, especially trace metals (e.g. zinc, copper, manganese), sometimes toxicity phenomena can occur. An understanding of the seasonal uptake and partitioning of mineral nutrients of grapevines is essential in order to manage fertilizer applications. The availability of mineral nutrients is often determined by the soil chemical properties and nutrient interactions.

Among the micronutrientsZinc plays an important role in many biochemical reactions within the plants. Zinc modifies and/or regulates the activity of cabonic anhydrase, an enzyme that regulates the conversion of carbon dioxide to reactive bicarbonate species for fixation to carbohydrates in these plants. Zinc is also a part of several other enzymes such as superoxide dismutase and catalase, which prevents oxidative stress in plant cells. In the process of cell differentiation after flowering, high levels of IAA or zinc in the plant will increase cell differentiation [(4)]. The greater the cell differentiation the larger and denser the fruit. Also with more cells developed there is a greater demand for Calcium. Higher levels of zinc increase the plants ability to absorb calcium to build the cells the plant has created.

The nutrient requirement of grapevine is assessedduring each flowering time. This is based on the soil test report. It has been noted that the suggestions for requirement of the nutrients from the same vineyard may vary from laboratory to laboratory. The nutrient requirement of individual vineyard is differentand is based on the nutrient status of each garden. The method used for analyzing the nutrient in a given sample varies from laboratory to laboratory. This shows that vagueness is present in nutrient suggestion. There is also vagueness in the interpretation of the test results. To utilizethe test result in better way and reduce input cost, the use of FIS in grape cultivation can be better option. Considering this FIS is developed for efficient use of Zinc Sulphate for

grape. The principal contribution of fuzzy logic- is its high power of precision [13.14]. Most of the practical applications of fuzzy logic are associated with its relational facet.

II. LABORATORY DATA BASE

The soil samples are collected from the fields of Solapur, Sangli, Nasik, Pune districts of Maharashtra andBelgaon, Bijapur, Gulbarga districts of Karnataka state. The soil samples are thentestedin the laboratory of Maharashtra Rajya Draksh Bagaitdar Sangh, Manjri Farm, Pune (Maharashtra).

Database: The data base developed under laboratory observations are presented in table 1.

Table 1: The data base used developed for input and output parameters in grape vineyard

Class No.	INPUT (ppm)	OUTPUT	
		30-60 days after pruning (Kg/acre)	Foliar spray (gm/litre) If deficincy observed
1	1	19	2.5
2	2	17	2.5
3	4	15	2.5
4	10	13	2.5
5	15	11	2.5
6	150	8	2.5
7	350	5	2.5

III. FUZZY INFERENCE SYSTEM DEVELOPED:

The Block diagram of Fuzzy Inference System is shown in fig.1.Fuzzy Inference System[7,11,16,19] is developed by using triangular membership functions for input and output variables is shown in fig.2.For Defuzzification,Centroid method is used.The system results are carried out by using MATLAB Software GUI tool[12].

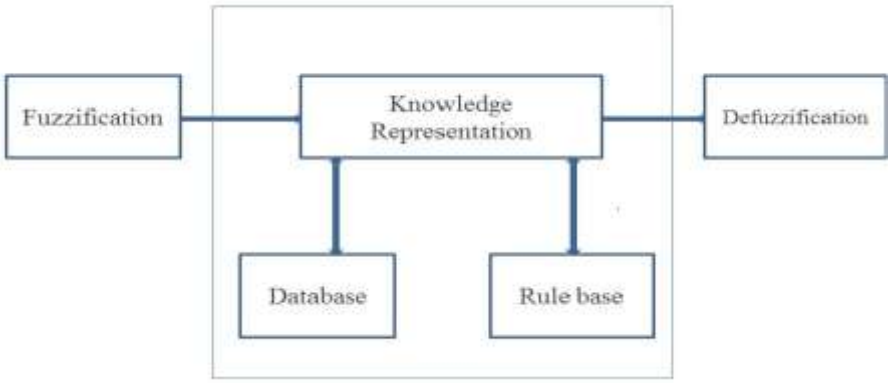

Fig.1: Block diagram of Fuzzy Inference System

Input and output variables of Fuzzy Inference System are shown in Fig.2

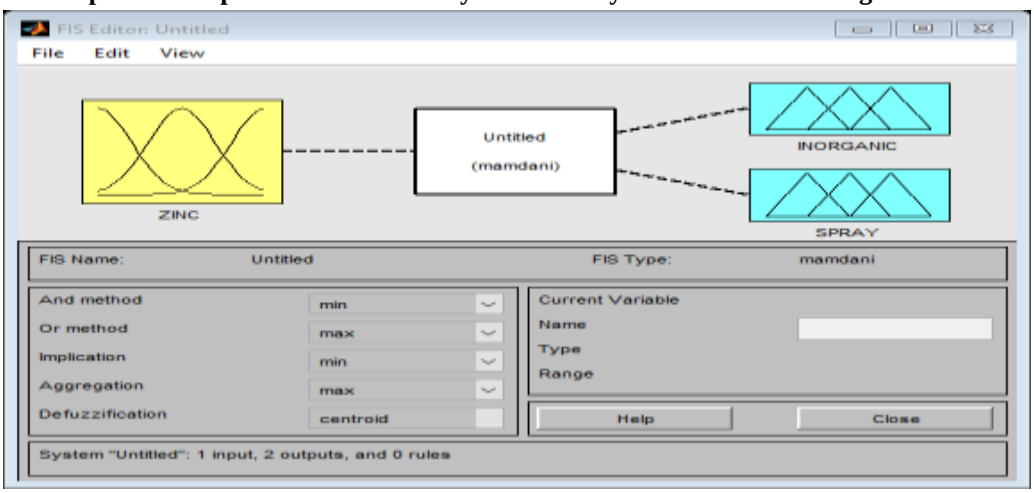

Fig.2: Fuzzy Inference System

3.1. Fuzzification: It is the process of conversion of precise quantity to a fuzzy quantity which is the first step in Fuzzy inference System. It includes Data base and Rule base.

a.Data Base:

The fuzzy system represents structured information in the form of a fuzzy set (FS). The input and output universe are modeled using FS [(11)]. It consists of fuzzy domains such as: VL (Very Low), JL(Just Low), L (Low),N (Normal), H **(**High), JH (Just High), VH (Very High).

Zinc Sulphate domain is used as input for FIS which may carry out the Fuzzification for suggestion of Zinc Sulphateto the soil specific vineyard. The suggestion of Zinc Sulphate varies in the range of 0 kg/acre to 350 kg/acre. The seven fuzzy sets for input variable Zinc Sulphate are shown in Table 2.

Table 2: Fuzzy Set for input variable Zinc Sulphate

Sr.No.	Zinc Sulphate Measured (Membership Function)	Fuzzy sets for Zinc Sulphate (kg /acre)
1	μ_{VL}	L(1,1, 2)
2	μ_{JL}	Λ(1, 2, 4)
3	μ_{L}	Λ(2, 4, 10)
4	μ_{N}	Λ(4, 10, 15)
5	μ_{H}	Λ(10, 15, 150)
6	μ_{JH}	Λ(15, 150, 350)
7	μ_{VH}	⅃(150, 350, 350)

Depending upon theZinc Sulphatevalue in the soil of individual garden, the doses of Zinc Sulphate are to be supplied. The linguistic values for suggested Zinc Sulphate are chosen as: VH (Very High), JH(Just High), H (High), N (Normal), L **(**Low), JL (Just Low), VL (Very Low).The values of Zinc Sulphate are within the range of 5-19 kg/acre. Here Zinc Sulphate Spray is constant as 2.5gm/liter. It is shown in table 3.

Table 3: Fuzzy set for output variable Inorganic fertilizer

Sr.No.	Fertilizer (Membership Functions)	Fuzzy set
		30-60 days after pruning (Kg/acre)
1	μ_{VH}	L (19, 19, 17)
2	μ_{JH}	Λ (19, 17, 15)
3	μ_{H}	Λ (17, 15, 13)
4	μ_{N}	Λ (15, 13, 11)
5	μ_{L}	Λ (13, 11, 8)
6	μ_{JL}	Λ (11, 8, 5)
7	μ_{VL}	⅃ (8, 5, 5)

Membership function for input variable Zinc Sulphate measured in soil is shown in Fig.3.

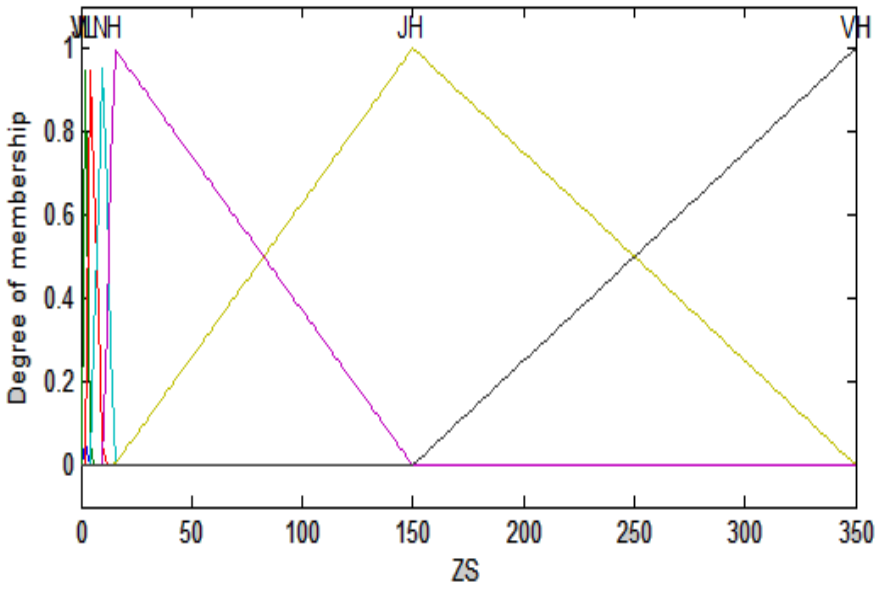

Fig 3: Fuzzy membership function for Zinc Sulphatemeasured

Membership functions for output variables i.e. fertilizer and foliar spray are shown in Fig.4a, 4b respectively.

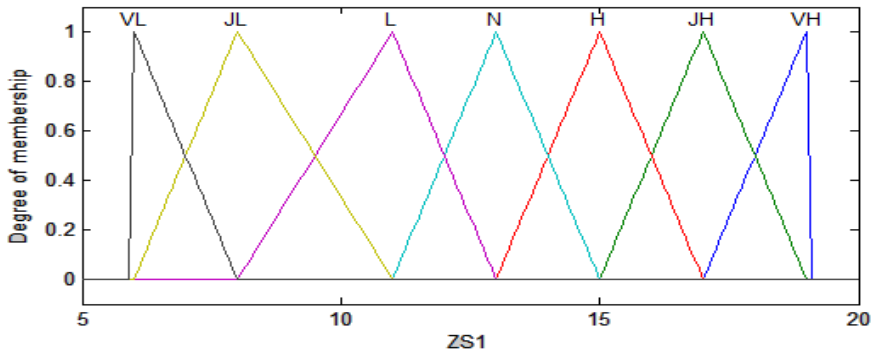

Fig 4a: Fuzzy membership function for Zinc Sulphate suggested

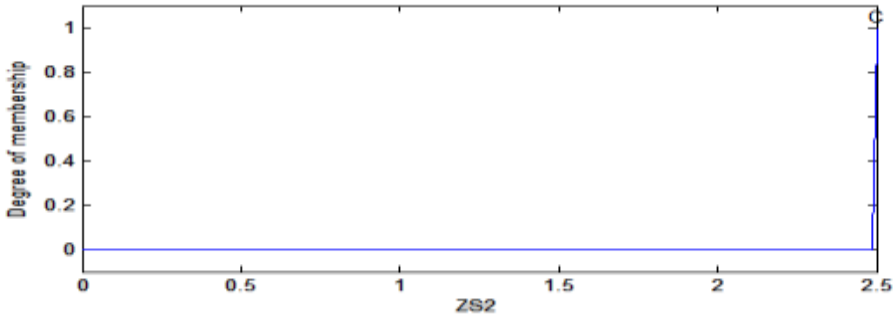

Fig 4b: Fuzzy membership function for Zinc Sulphate suggested

b. Fuzzy Rule base: In this rule base, 07 rules are developed by researcher and shown in table 4.

Table 4:The fuzzy rule basedeveloped is given below.

If Zn is	**VL**	**Then Zn1**	**VH**	**And Spray is**	**C**
	JL		**JH**		**C**
	L		**H**		**C**
	N		**N**		**C**
	H		**L**		**C**
	JH		**JL**		**C**
	VH		**VL**		**C**

The fuzzy rule base is read as:
If Zinc is Very Low ThenZn1 is Very High and Spray is constant.
Fig.5 shows the GUI rule base of MATLAB.

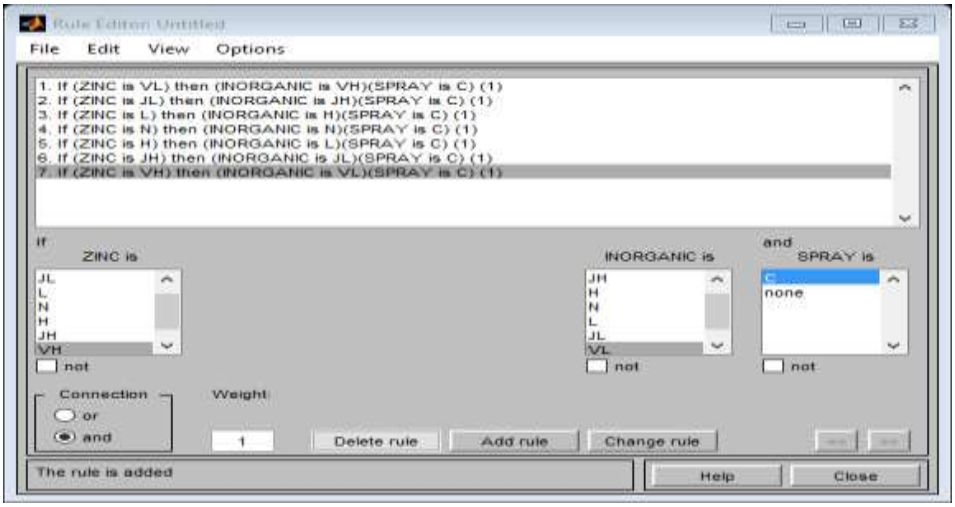

Fig. 5: Rule base for inference system

4. Defuzzication: It is the process of conversion of fuzzy quantity to a precise quantity.
Here centroid Defuzzification method is used and shown in fig.6.

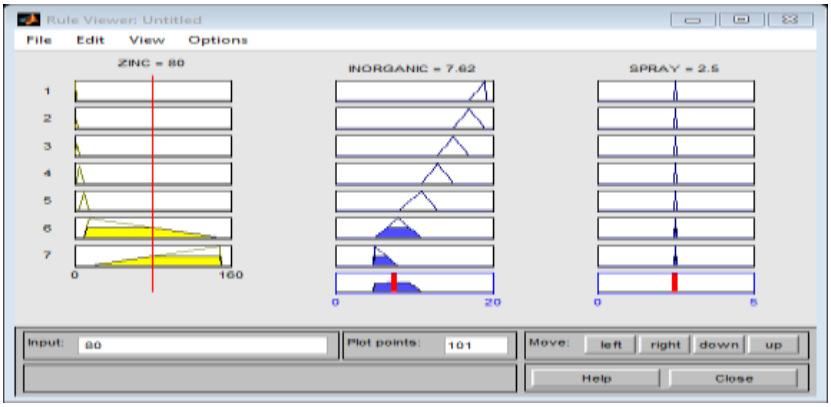

Fig.6: Defuzzication of the System

5. Practical Results for Suggestion of Zinc Sulphate:

The data given in the table 5 shows suggested value for Zinc Sulphatebased on the status of Zinc Sulphate available in the soil samples of different farmers. The data suggested by FIS gives requirement of exact quantity of fertilizer during the season. This can help to save cost of fertilizer and produce more yields.

Table 5: Suggestion of Zinc Sulphate

Sr.No.	Farmer No.	Input Data (ppm)	Zinc Sulphate suggested by Expert		Zinc Sulphate suggested by FIS	
			Zn (kg/acre)	Spray(gm/litre)	Zn (kg/acre)	Spray(gm/litre)
1	733	0.6	19	2.5	17.15	1.57
2	768	1.35	17	2.5	16.24	1.59
3	725	1.82	17	2.5	15.44	1.65
4	652	1.92	17	2.5	15.21	1.66
5	772	2.15	15	2.5	14.79	1.67
6	389	2.47	15	2.5	14.44	1.63
7	223	2.87	15	2.5	14.10	1.56
8	767	4	15	2.5	13.00	1.67
9	338	4.45	13	2.5	12.66	1.67
10	731	4.8	13	2.5	12.44	1.66
11	766	4.85	13	2.5	12.42	1.65
12	127	6.95	13	2.5	11.63	1.53
13	641	6.95	13	2.5	11.63	1.53
14	223	7	13	2.5	11.61	1.53
15	777	7.27	13	2.5	11.54	1.55
16	634	7.49	13	2.5	11.48	1.57
17	506	9	13	2.5	11.04	1.65
18	114	10.55	13	2.5	10.36	1.66
19	102	11.15	11	2.5	10.07	1.63
20	767	11.85	11	2.5	9.77	1.59

IV. CONCLUSION

Laboratoryexpert does not indicate exact quantity of fertilizer Zinc Sulphateto be used for the soil. The FIS system helps to suggest the accurate quantity of Zinc Sulphateused for the soil. This reduces the cost of production of grapes.

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