Dr.T.Geetha Journal of Engineering Research and Application *www.ijera.com*
ISSN : 2248-9622, Vol. 8, Issue 8 (Part -II) Aug 2018, pp 07-10

RESEARCH ARTICLE OPEN ACCESS

Fuzzy Logic in Growing Stages of Rice Plant

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ABSTRACT
This paper deals with the growing stages of the Rice plant. Rice is the most important cereal food crop of the world. It is the staple food for more than half of the world's population. Rice is the one of the oldest cultivated crop in china and India for several thousand years .The world cereals has been derived from 'ceres', name of a Roman Goddess, means 'Giver of Grains'. Most of the rice area lies between stages equator and 40°N. In this paper we described the growing stages with fuzzy logic. Fuzzy ideas and Fuzzy logic are so often utilized in our routine life that nobody even pays attention to them. Fuzzy logic in the narrow sense is symbolic logic with a comparative notion of truth developed fully in the spirit of classical logic.
Key Words: Fuzzy Logic, Fuzzy Set, Membership Function, Fuzzy inference system.

Date of Submission: 09-08-2018 Date of acceptance: 24-08-2018

I. INTRODUCTION:

Fuzzy logic is a method to solve problem in expect system which can be viewed as an extension of the classical set. In sharp contrast to the idealized world of mathematics, our perception of the real world is pervaded by concepts which do not have sharply defined boundaries e.g: tall, fat, many, most, slowly, old, familiar, relevant much larger then, kind etc. A key assumption in fuzzy logic is that the denotation of such concepts one fuzzy sets, that is, classes of objects in which the transition from membership to non membership is gradual rather than abrupt'(zadeh 1990:99).In cereal food crops Rice is the one of the edible starchy grain and also it the staple food for the world. The family of the Rice is the poaceae and its scientific name is oryza sativa. The crop plant which belong to the family poaceae and are grown for their edible starchy grains / seed called caryopsis (seed coat + pericarp are fused or united) are called as cereals. The word cereals has been derived from 'Ceres', name of a Roman Goddess, means 'Giver of Grains'. It grows from the tropics to subtropical and warm temperature countries up to 40°S and 50°N of the equator. Highest productivity was recorded between 30° and 45° N of the equator. India, China and Egypt lies between 21° to 30° N. The average yield ranges from 2.0 to 5.7 t ha-¹. The countries near the equator show an average yield of 0.8 to 1.4 t ha-¹. [1] through that south India was the place where cultivated rice is originated [1] suggested that India and Burma should be the origin of cultivated crop.

II. FUZZY LOGIC:

The term fuzzy logic emerged in the development of the theory of fuzzy set by lotfti zadeh (1965). Fuzzy logic is a super set of Boolean logic that handles the concepts of partial truth, which is truth values between "completely true and completely false". Fuzzy logic is a form of multi valued logic derived from fuzzy set theory. Fuzzy logic is determined either Yes or No and then fuzzy number is between 0 to 1. For the crisp set it, Characteristic function assigned a value of 1 or 0 to each value 1 indicate that corresponding value belong to the set 0 indicate that corresponding value do not belong to the set. The value between 0 and 1 for corresponding values belong to the set in a certain degree from low, medium to high. In process modeling and control system that are ill defined and with uncertainties can be modeled with fuzzy inference system employing fuzzy ' If- then' rules to quantify human knowledge and resuming processes without employing précised quantitative analyses the fuzzy inference system should include the following functional blocks.

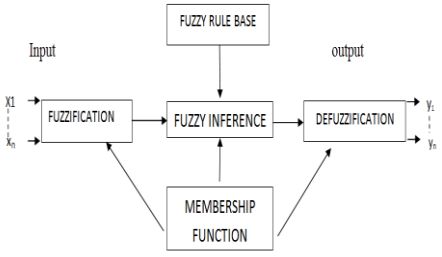

Fig : 1. Fuzzy inference systems

III. FUZZY MEMBERSHIP FUNCTION:

A fuzzy membership function is defining the grade of membership of x in A. the function which maps the fuzzy subset A to a membership value between 0 and 1. In contrast to the characteristic function in conventional set theory which implies that membership of individual objects in a subset as either belonging or not at all, i.e $\mu_{Anf\,(x)}$ {0,1} where A_{nf} is the non-fuzzy equivalent of fuzzy subset A, the fuzzy membership function of x in A expressed as: μA(x) [0,1]that associates with each element x ϵ X its grade of membership $\mu_A(x)$ ϵ [0,1]. Thus $\mu_A(x)=0$ means that x does not belong to the subset A, μA(x)=1 indicates that x fully belongs, and 0<μA(x)<1 means that x belongs to some degree, partial membership is therefore possible. A fuzzy number is a fuzzy subset of real members characterized by a possibility distribution [3]. It is a generalization of the real numbers. Usually, a fuzzy number is defined as a normal and convex fuzzy set in the real line A ϵ R By being normal we mean that the maximum value of membership in a fuzzy set in R is 1. Convex implies that the fuzzy number consists of an increasing and decreasing part, and sometimes a flat part. Functionally, this can be expressed for each of the real numbers a, b, and c as:

$\mu_A(b) \geq \min(\mu A(a), \mu A(c))$, a<b<c

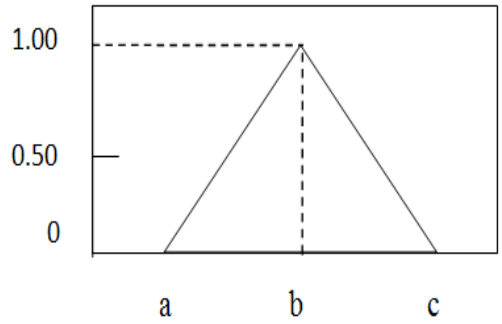

Fig-2 Triangular.

The simplest fuzzy number is the so-called triangular fuzzy number [3] with its characteristic membership function written as:

$$\mu A(x) = \begin{cases} 0 & x \leq a \\ (x-a)/(b-a) & a < x \leq b \\ (c-x)/(c-b) & b < x \leq c \\ 0 & c < x \end{cases}$$

Fig. 2 illustrates the membership function of triangular fuzzy number. The fuzzy numbers play an equivalent role in fuzzy models to the classical (real) numbers in non-fuzzy models, hence their universal importance in fuzzy operations.

GROWING STAGES OF RICE PLANT	RANGE	LOW	MEDIUM	HIGH
Seedling	[0 35]	[0-13]	[13 20 30]	[30 35]
Active Vegetative	[0 33]	[0 16]	[16 25 31]	[31 33]
Vegetative Lag phase	[0 30]	[0 15]	[15 21 28]	[28 30]
Reproduction	[0 30]	[0 22]	[15 25 33]	[30 35]
Ripening	[0 35]	[0 12]	[12 20 25]	[25 30]

Table : 1 Temperature of Input functions for growing stages of rice plant.

Fuzzy Input membership functions are given below:

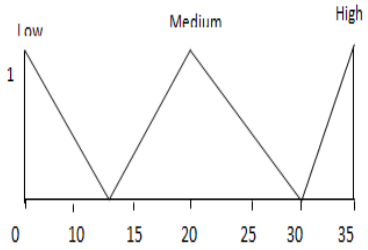

Fig: 3. Fuzzy Membership function of seedling temperature

$$\mu \text{ Low } (x) = \begin{cases} 0, & x \geq 13 \\ 1, & x = 0 \\ (13-x)/(13-0) & 0 < x < 13 \end{cases}$$

$$\mu \text{ Medium}(x) = 1 \begin{cases} 0, & x \leq \text{ }) \, x \geq 30 \\ (x-13)/(20-13) & 13 < x < 20 \\ & x = 5 \\ (30-x)/(30-20) & 20 < x < 30 \end{cases}$$

$$\mu \text{ High } (x) = \begin{cases} 0 & x \leq 13 \\ 1 & x = 35 \\ (x-30)/(35-30) & 30 < X < 35 \end{cases}$$

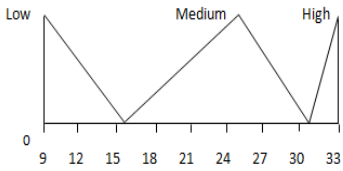

Fig: 4 Fuzzy Membership function of Active vegetative temperature

$$\mu \text{ Low } (x) = \begin{cases} 0, & x \geq 16 \\ 1, & x = 0 \\ (16 - x)/(16 - 0) & 0 < x < 16 \end{cases}$$

$$\mu \text{Medium}(x) = \begin{cases} 0, & x \geq 16 \text{ (or) } x \geq 31 \\ (x - 16)/(20 - 16) & 16 < x < 25 \\ 1, & x = 25 \\ (31 - x)/(31 - 25) & 25 < x < 31 \end{cases}$$

$$\mu \text{ High } (x) = \begin{cases} 0, & x \leq 31 \\ 1, & x = 33 \\ x - 31)/(33 - 31) & 31 < x < 33 \end{cases}$$

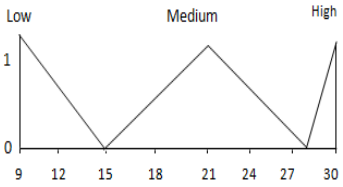

Fig: 5 .Fuzzy Membership function of vegetative lag phase temperature

$$\mu \text{ Low } (x) = \begin{cases} 0, & x \geq 15 \\ 1, & x = 0 \\ (15 - x)/(15 - 0) & 0 < x < 15 \end{cases}$$

$$\mu \text{ Medium } (x) = \begin{cases} 0, & x \geq 15 \text{ (or) } x \geq 28 \\ (x - 15)/(21 - 15) & 15 < x < 21 \\ 1, & X = 21 \\ (28 - x)/(28 - 21) & 21 < x < 28 \end{cases}$$

$$\mu \text{ High } (x) = \begin{cases} 0, & x \leq 28 \\ 1, & x = 30 \\ (x - 28)/(30 - 28) & 28 < x < 30 \end{cases}$$

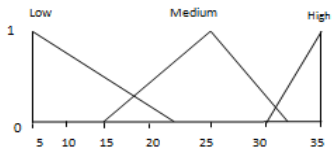

Fig: 6. Fuzzy Membership function of Reproduction temperature

$$\mu \text{ Low } (x) = \begin{cases} 0, & x \geq 22 \\ 1, & x = 0 \\ (22 - x)/(22 - 0) & 0 < X < 22 \end{cases}$$

$$\mu \text{ Medium}(x) = \begin{cases} 0, & x \leq 15 \text{ (or) } X \geq 33 \\ (x - 15)/(25 - 15) & 15 < x < 25 \\ 1, & X = 25 \\ (33 - x)/(35 - 25) & 25 < x < 33 \end{cases}$$

$$\mu \text{ High } (x) = \begin{cases} 0, & x \leq 30 \\ 1, & x = 35 \\ (x - 30)/(35 - 30) & 30 < x < 35 \end{cases}$$

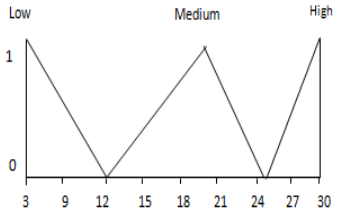

Fig: 7 Fuzzy Membership function of ripening temperature

$$\mu \text{ Low } (x) = \begin{cases} 0, & x \geq 12 \\ 1, & x = 0 \\ (12 - x)/(12 - 0) & 0 < x < 12 \end{cases}$$

$$\mu \text{ Medium}(x) = \begin{cases} 0, & x \leq 13 \text{ (or) } x \geq 30 \\ (x - 13)/(20 - 13) & 13 < x < 20 \\ 1, & x = 5 \\ (33 - x)/(35 - 25) & 20 < x < 30 \end{cases}$$

$$\mu \text{ High } (x) = \begin{cases} 0, & x \leq 30 \\ 1, & x = 35 \\ (x - 35)/(30 - 25) & 30 < x < 35 \end{cases}$$

	Range	Less	Average	High
Growing temperature of Rice plant	[0 35]	[0 22]	[20 25 33]	[30 35]

Table: 2 .Fuzzy output Membership function of growing stage Rice plant

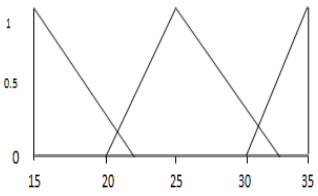

Fig: 8 Fuzz Membership functions of growing stages of Rice plant temperature.

$$\mu \text{Less } (x) = \begin{cases} 0, & x \geq 22 \\ 1, & x = 0 \\ (22 - x)/(22 - 0) & 0 < x < 22 \end{cases}$$

$$\mu \text{ Average}(x) = \begin{cases} 0, & x \leq 20 \text{ (or) } x \geq 33 \\ (x - 20)/(25 - 20) & 20 < x < 25 \\ 1, & X = 25 \\ (33 - x)/(35 - 25) & 25 < x < 33 \end{cases}$$

$$\mu \text{ High } (x) = \begin{cases} 0, & x \leq 30 \\ 1, & x = 35 \\ (x - 35)/(30 - 25) & 30 < x < 35 \end{cases}$$

IV. CONCLUSION

The temperature on growing stage on Rice plant has defined above. When the temperature is less, is not a suitable climatic condition for the Rice plant. We can't reduce or increase the temperature.

Thus the fertilization of the Rice plant is depends upon the month due to the climatic condition. Rice can be grown in different location under as variety of climates. However all the weather factors, solar radiation, temperature, relative humidity have greater influence on Rice yield. Temperature variation and low in tropics and hence needs no significant consideration for the rice cultures in these areas.

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Dr.T.Geetha " Fuzzy Logic in Growing Stages of Rice Plant "International Journal of Engineering Research and Applications (IJERA) , vol. 8, no.8, 2018, pp 07-10