An Interval Valued Fuzzy Soft Set Based Optimization Algorithm for High Yielding Seed Selection

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ABSTRACT

As seed selection is a challenging task due to the presence of hundreds of varieties of seeds of each kind, some homework is necessary for selecting suitable seeds as new varieties and kinds of seeds are introduced in the market every year having their own strengths and weaknesses. The complexities involved in the characteristics in the form of parameters results in uncertainties and as a result some uncertainty based model or hybrid models of more than is required to model the scenario and come out with a decision. Soft sets have enough of parameterization tools to support and hence is the most suitable one for such a study. However, as hybrid models are more efficient, the authors select a model called the interval valued fuzzy soft set (IVFSS) and propose a decision-making algorithm for the selection of seeds. A real database of seeds is used for experimental verification of the efficiency of the algorithm. This is the first attempt for such a study. The use of signed priorities and intervals for the membership of values for entities makes the study more efficient and realistic.

KEYWORDS

Agriculture, Decision Making, Interval Valued Fuzzy Soft Sets, Seed Selection, Soft Sets

INTRODUCTION

It is the opinion of many farmers that seed is where all begins and finishes: it is the beginning and the end. According to their own perceptions of seed selection, their aim is in selecting seed, and the effects of their practices on the genetic structure of their varieties. Some observers convey the impression that farmers who do not select seed before planting are “bad” or disinterested (Perrier 1982; Hernandez 1985; Sand Meier et al., 1986). The traditional methods adopted for seed selection have been continuously changing. However, scientific study for selection of seed is very important. These studies will support the farmers in their selection process by the way improving the production. A combination of experimental and survey data is used to relate farmers’ selection to variety characteristics; examine the effect of selection in the presence of genetic instability and record farmers’ perceptions of their own practices. Findings are likely to be relevant for, although not necessarily representative of, other systems (Louette et al., 1998).

Seed selection can be very challenging. There are several hundreds of varieties of seeds of each kind. Many new varieties and kinds are introduced in the market every year having their own strengths and weaknesses. So, it always requires a little homework before choosing seed varieties. Choosing the wrong one may be able to reduce the production by the way causing a lot of loss to the farmers. Yield is what drives profitability and hence high yielding varieties are always in a farmer’s mind.

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But the characteristics of the seeds also vary according to the soil type, whether the land is irrigated one or a dryland and the overall weather condition etc.

Farmers also replace, renew, or modify the seed stocks for their varieties by introducing seed obtained from other farmers within and outside the community. Although farmers rarely pool seed lots of different varieties, they commonly mix seed lots considered to be of the same variety to obtain needed seed quantities. Recognition of this practice led to the definition of a “seed lot” as the physical unit of seeds of a given variety used to produce the next season’s crop. Farmers appear to identify a seed lot as being of a variety if it resembles it phenotypically, meaning that a variety is then a set of farmers’ seed lots bearing the same name. Results of analysis of phenotypic diversity, both among the seed lots of a variety, and among varieties with seed lots bearing different names, support the hypothesis that a variety corresponds closely to that of a phenotype. The domain of agriculture has various branches like soil and seed management, water and irrigation etc. The problems involved in these areas are complex because of many factors such as climate conditions, location etc. So, as the complexity increases the uncertainties involved in these areas also increase.

Now a day farmers face lot of agricultural problems such as drought, natural disaster etc. There are few techniques to overcome these agricultural crises. Some of these are mentioned in (Devereux, 2002; Dercon, 2002). Farmers are the major users of seed in most countries (Tripp, 2001). For the selection of seeds, farmer has to analyze the environmental and other factors which influence the seeds. For example, climate is one of the important factors which affect the seeds. Colombo et al. (Colombo, 2008) discussed how climate variations will affect the growth of tree seeds in Canadian areas. He also mentioned about the uncertainty in climate. Sometimes, the farmers or researchers who are working in this area cannot be able to realize the exact climate due to the uncertainties involved. Few factors which affect the climate are mentioned in (Colombo et al., 2007). So, the importance of uncertainty models arises.

The complexities of the characteristics of the seeds and the other conditions associated make it difficult for selection of seeds not only for the farmers but also for the experts. There are several uncertainties involved in the characteristics of the seeds. These characteristics are many a time cannot be measured in a crisp manner and requires uncertainty based measurements like the grading and even sometimes the values lie in intervals instead of being atomic.

There are several uncertainty-based models in the literature like the fuzzy sets (Zadeh, 1965), interval valued fuzzy Sets (Zadeh, 1975), rough sets (Pawlak, 1982) and soft sets (Mołodtsov, 1999). Also, we have several hybrid models obtained by combining two or more of these models.

Some of the applications of fuzzy logic in agricultural fields are discussed in (Rosaline et al., 2009) are how fuzzy logic can be used in pest management, how it can be used to analyze the soil, how it can be used to develop an expert system for various crops. Some applications of the rough set model are discussed in (Zhu, 2009).

The problem with models like fuzzy sets is lack of parametrization. However, we have to deal with parameters efficiently in selecting seed. So, soft set seems to be an ideal model for this application. Also, hybrid models (Sooraj et al., 2017a, 2017b; Tripathy et al., 2016a, 2016b, 2016c, 2016d, 2016e, 2017; Mohanty et al., 2017) have been found to be more efficient than the individual ones. Since, interval valued fuzzy sets are more general models than fuzzy sets, we have chosen the hybrid model of interval valued fuzzy soft set as the model to capture the characteristics of this application of seed selection. Also, we have provisions for the farmer to specify his priority level for different characteristics, which obviously effect the selection of seeds according to his liking and suitability. We follow the concept of positive and negative parameters. Our approach has been detailed through a real-life data set and the results obtained are encouraging. The detail of the segments of this paper is as follows.
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