Volume 8, No. 3, March – April 2017
ISSN No. 0976-5697
International Journal of Advanced Research in Computer Science
RESEARCH PAPER
Available Online at www.ijarcs.info

"Optimum Crop Cultivation Date Selection" using Meteorological and Fiscal Parameters in Agriculture Intelligence

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Abstract*:* Agriculture has a vital role to play in the economic development of India. The researchers have developed an 'Agriculture Intelligent' system to bridge the gap between information provided to the agriculture stake holder and the real knowledge requirement of this community. "Optimum Crop Cultivation Date Selection" is one of the crucial applications of Agriculture Intelligent system. The main objective of this study is to select appropriate meteorological and fiscal parameters in this system that provides intelligence to choose optimum cultivation date for given agriculture crop in the district of Surat (Gujarat, India). The objective is considered with a view to achieve higher margin at the time of cropping of that crop. GUI of this application helps the farmer community to take decision with ease.

Keywords:Agriculture Intelligence, Crop Cultivation date Selection, Meteorological Parameters, Fiscal Parameters

I. Introduction

Being agriculture based country India, agriculture sector contributes approximately one fifth GDP and more than 60% workforce of the total population of India is engaged in this sector [1]. About 70% of the population lives in rural areas and majority of them depend upon agriculture as their primary source of income [1]. Over 700 million people population depend upon the rural economy for their livelihood [2]. 60% of the agriculture sector in India depends on the natural resources like rain and sunlight for survival [3]. The agriculture stake holders thus depend on favorable weather for the success of their efforts. The world is full of uncertainties and everyone needs a jacket to handle overt and covert risks. In the domain of agriculture sector, the commodity market price basically depends on various parameters like meteorological and fiscal variations. Meteorological and Fiscal data can be therefore used to reduce risks in agriculture product trading faced by the agriculture stake holders. "Climate variability in recent past and signals of climate change over the Indian region cause concern in the agricultural sector and also make farming more challenging in the country"[4].Under such anomalies of meteorological and fiscal parameters, more scientific and accurate information is needed by the farmers in the country for proper farm management including risk management and further develop their adaptive capacity with improved planning and better management decisions.

To provide good services to farmers, there are several web services available like Agriculture Marketing Research & Information Network, AGMARKNET, IASL, Precision Agriculture etc. [23-30]. However, majority of them only provide information and not knowledge that can help agriculture stake holders. In spite of several advancements in the existing information availability, the farmer community is still in dilemma regarding the price of the agriculture product at the time of submission in the APMC. The main hypothesis of this research is that a meteorological data impacts and associated in the market price determination for the agriculture product. The main goal of this study is to present the relevance of meteorological and fiscal data that helps agriculture stake holders in their risk management and betterment of their ultimate goal of profit making. To achieve said goal researchers have studied literature review as given in the next topic.

II. Literature Review

'Agriculture Intelligence' [5] coined by Ghadiyaliet.al., bridges the gap between information provided to the agriculture stake holder and the real knowledge requirement of this community. To know the impact of meteorological data on agriculture product, researchers have studied many researches. Through literature study, the researcher came to know about the contribution of the ***meteorologicalparameters*** in the quality and quantity of the agriculture product.

ValliManickam et.al.[6]studied the impact of meteorological parameters in terms of climate variability, on the economic well-being in East Godavari and Vishakhapatnam Districts of Andhra Pradesh, India. This study has considered the parameters such as climate factors, land use patterns and agriculture productivity to determine the production of selected agriculture commodity. *P. Roudier et.al.*[7]have studied the role of climate forecasts in smallholder agriculture with respect to two agro-ecological zones of Senegal, West Africa. This study examines how farmers would adjust their strategies to different observed and predicted climatic scenarios, including seasons of average, below average, and above average rainfall. *Prof DrLekshmiVijayan et.al.*[8], have evaluated the significance of meteorological parameters in the implementation of agriculture engineering practices in the Tabuk region of the Royal Kingdom of Saudi Arabia. This study observed that among all the meteorological parameters, temperature and humidity influences the production of crops like wheat, potato, fruits and vegetables. *C.W. Fraisse et.al*[9]developed 'Ag-Climate', a climate forecast information system for agriculture risk management for south-eastern USA. This tool is useful to the agriculture stake holders like Extension agents, Farmer, Forest managers and Crop consultants. These all above studies as well as other studies [10, 11, 12 and 13] in the world have shown that meteorological data influence the production and quality of agriculture commodities and therebythey have an important role in market price determination.

There were several studies conducted which determine future market price based on ***fiscal parameter*** such as archive price data. *GovardhanaRaoet.al* [14] studied the seasonal variation and forecasting in wholesale price of rice in Guntur district of Andhra Pradesh. The study analyzed trends and seasonal variations of rice wholesale price from 1991 to 2010 using price forecasting model ARIMA and predicted the future trend of rice price. *Ticlavilca et.al.*[15]have performed multiple predictions for agricultural commodity prices before one, two or three months. *ManpreetKaur et.al.*[16]have discussed applications and techniques of Data mining in agriculture considering the problem of price prediction of crops. *Linwood Hoffman*[17] has developed a model to forecast the seasonal average of the agriculture commodity 'Corn' using future prices. *Wen HUANG et.al.*[18]checked the role of high frequency data in forecasting agricultural commodity futures. This all studies show the importance of fiscal parameter 'Archival Price' in agriculture price determination. The approaches used by different researchers are time series analysis with various statistical techniques such as Multivariate Relevance Vector Machine (MVRVM) and soft computing techniques such as neural network. The volatility of an agriculture commodity price is very high and therefore price forecasting for decision makers in this domain has become more sensitive and challengeable compared to non-agricultural domain

To judge the impact of another fiscal parameter 'agriculture commodity market supply' on its market price, the researcher studied about the demand and supply mechanism and its impact on agriculture market. *Mordecai Ezekiel*[19]theoretically explained the Cobweb Theorem ofagricultural product price policy determination. In support of the Cobweb Theorem, several econometrics literatures [20-22] show that particular agriculture product supply determines the entire price strategies of that product in the market for the next year.

Based on the literature review, researcher had selected appropriate meteorological & fiscal parameters and construct a model as given in next topic.

III. Experimental Design and Methodology

Entire experiments is divided in to two sub sections such as A) Meteorological Parameter Selection, B) Fiscal Parameter Selection and C) Model Construction

A. Meteorological Parameter Selection

Total fourteen ***meteorological parameters*** are available in meteorological database. In this study first of all, the researcher conducted experiments in WEKA for top three most impacted parameter selections. The researcher excluded five non impact parameters out of these fourteen parameters as per the geographical location Surat, Gujarat, India. This study has accepted the parameter Average Temperature per day (Temp_Avg) and hence excluded Maximum Temperature of day (*Temp_Max*) and Minimum Temperature of day (*Temp_Min*). Rainfall of day (Rainfall) has been considered in this study and hence excluded Rain Indicator for the day (*Rain_Indi*). Mean Wind Speed (Mean_W_Spe) has been considered in this study and hence excluded Maximum Wind Speed (*Max_W_Spee*). The sea Level remains same for entire geographical location Surat, India and hence Sea Level Pressure (*SLP*) parameter has also been excluded.

Based on location specific (Surat, Gujarat, India) meteorological data, the researcher performed experiments in WEKA using nine meteorological parameters to select top three most impacted parameters as show in below Table 1.

Table 1 List of Meteorological Parameters for experiments

Sr.	Parameter Name	Parameter Description
1	**Temp_Avg**	Average Temperature per day
2	**Humidity**	Average Humidity per day
3	**Rainfall**	Average Precipitation (Rain) per day
4	Mean_W_Spe	Average Wind Speed per day
5	Mean_Visib	Average Visibility per day
6	Rain_Indi	Rain Indicator
7	Thunder_Indi	Thunder Indicator
8	Snow_Indi	Snow Indicator
9	Fog_Indi	Fog Indicator

As shown in Table 1, out of these nine parameters, the top most three impacted parameters were identified using 'Ranker' search method and PCA as attribute evaluator in WEKA. They were Temp_Avg, Humidity and Rainfall. The experiments were carried out for all ten selected agriculture commodities and results were generated. But for visual convenience, only three agriculture commodities namely Bhindi (Lady Finger), Green Chilly and Potato have been shown in Table 2, Table 3 and Table 4 respectively given below.

Table 2 Meteorological Parameters identification for Market Price determination of an agriculture commodity -*Bhindi (Ladies Finger)*

Sr. No.	Algorithm Used		Top Three Ranked Meteorological Parameters		
	Attribute Evaluator	Search Method	(1)	(2)	(3)
1	FilteredAttributeEval	Ranker	Temp_Avg	Humidity	RainFall
2	LatentSymenticAnalysis	Ranker	Temp_Avg	Humidity	RainFall
3	**PrincipalComponent**	**Ranker**	**Temp_Avg**	**Humidity**	**RainFall**
4	CfsSubsetEval	BestFirst	Temp_Avg	Mean_Visib	-
5	CfsSubsetEval	ScatterSearch	Temp_Avg	RainFall	Mean_Visib
6	CfsSubsetEval	SubsetSize ForwardSelection	Temp_Avg	Mean_Visib	-

Table 3 Meteorological Parameters identification for Market Price determination of an agriculture commodity - *Green Chilly*

Sr. No.	Algorithm Used		Top Three Ranked Meteorological Parameters		
	Attribute Evaluator	Search Method	(1)	(2)	(3)
1	FilteredAttributeEval	Ranker	Temp_Avg	Humidity	RainFall
2	LatentSymenticAnalysis	Ranker	Temp_Avg	Humidity	-
3	**PrincipalComponent**	**Ranker**	**Temp_Avg**	**Humidity**	**RainFall**
4	CfsSubsetEval	BestFirst	Humidity	Mean_Visib	Mean_W_Spe
5	CfsSubsetEval	ScatterSearch	Humidity	Mean_Visib	Mean_W_Spe
6	CfsSubsetEval	SubsetSize ForwardSelection	Humidity	Mean_Visib	Mean_W_Spe

Table 4 Meteorological Parameters identification for Market Price determination of an agriculture commodity - *Potato*

Sr. No	Algorithm Used		Top Three Ranked Meteorological Parameters		
	Attribute Evaluator	Search Method	(1)	(2)	(3)
`	FilteredAttributeEval	Ranker	Temp_Avg	Humidity	RainFall
2	LatentSymenticAnalysis	Ranker	Temp_Avg	Humidity	-
3	**PrincipalComponent**	**Ranker**	**Temp_Avg**	**Humidity**	**RainFall**
4	CfsSubsetEval	BestFirst	Mean_Visib	Mean_W_Spe	Rain_Indi
5	CfsSubsetEval	ScatterSearch	Mean_Visib	Mean_W_Spe	Thund_Indi
6	CfsSubsetEval	SubsetSize ForwardSelection	Mean_Visib	Mean_W_Spe	Rain_Indi

On the basis of Tables 2, 3 and 4, the researcher inferred that Temp_Avg, Humidity and Rainfall have higher impact and utilize for further analyses.

B. *Fiscal Parameter Selection*

In the era of competitive market, the agriculture commodity also gets influenced a lot by demand and supply rule. The Cobweb model gives path with regards to such demand and supply mechanism in volatile agricultural market. "The Cobweb model is an economic model that explains why prices might be subject to periodic fluctuations in certain types of markets. It describes cyclical supply and demand in a market where the amount produced must be chosen before prices are observed"[19].The connote of Cobweb Theorem is "*current year's price determines the next year's supply and next year's supply determines that year's price*".

Eleven experiments were carried out using ***fiscal parameters*** such as Old Supply, Old Price and Current Supply as well as earlier selected meteorological parameters such as Temp_Avg, Humidity and Rainfall to predict agriculture commodity market price. The researcher designed the experiments using the online statistical tool WESSA [31] with linear and non-linear regression analysis and 'nntool' of Matlab (R2012a) [32] with 'feed forward back-propagation' algorithm. Experiment design results show that linear and non-linear regression have very less amount of variation in prediction of the future price. After these experiments, it was decided to involve *Old Supply* as fiscal parameter for further analyses.

As shown in Annexure - Table 5, the experiments were conducted with training data from January 2010 to December 2014 and testing data from January 2015 to December 2015. Input parameter(s), predicted parameter and technology or tools used in these experiments are as mentioned in Annexure - Table 5. The experiment started with Sr. No. 1 and 2 that indicate the prediction of next year's supply (Predicted Supply–P_S) using old year's price (O_P). Such predicted supply (P_S) was used for experiments Sr. No. 2 to predict price (PRC) for all last 5 years' data. Sr. No. 3 indicates the same experiments as indicated in Sr. No. 2 but here the method used is $\mathbf{Q^2}$ i.e. Quadratic (2nd degree) model in WESSA. Experiment Sr. No. 4 input as Old Price (O_P) and predict current year price (PRC). Experiment Sr. No. 5 to 11 involved meteorological as well as fiscal parameters and predict current year price (PRC).

The experiment Sr. No. 7 and Sr. No. 8 used meteorological parameters - Temperature (TM), Humidity (HM) and Rain Fall (RF) and fiscal parameter Last Year Supply (LYS) as input parameters and predict future price (PRC) as output parameter. These experiments show higher accuracy compared to the remaining experiment designs. So these parameters were selected for all further experiments.

C. *Model Construction*

Agricultural model was simulated on the basis of selected meteorological and fiscal parameters as per above topic 3.1. *Daily Average Temperature* (x_1), *Humidity* (x_2) and *Rainfall* (x_3) act as meteorological parameters and *Old Supply* (x_4) acts as a fiscal parameter to predict the agriculture commodity future market price. In this model, Predicted Market Price $(\hat{y})$ is dependent variable and Daily Average Temperature (x_1), Humidity (x_2) and Rainfall (x_3) as well as Old Supply (x_4) is independent parameters. As shown in equation-(3.10), y' is predicted value using MLR model. In this equation $Const$ is the intercept of the regression line. $\beta_1, \beta_2, \beta_3$ and β_4 are regression coefficient (Beta) value with respect to the parameter Temperature (x_1), Humidity (x_2) and Rainfall (x_3) and Old Supply (x_4).

$$y' = \beta_1 \times x_1 + \beta_2 \times x_2 + \beta_3 \times x_3 + \beta_4 \times x_4 + Const \qquad (3.2.1)$$

For the model performance enhancement, the researcher introduced a new *Fitness Factor*α. "*Fitness Factor*α*is the number element contributing to generate the best result amongst the possible given set of results. The resultant set do not have best result after and before of this value*." This fitness factor varies for different agriculture commodities for different MLRs. In this way the output of equation (3.2.1) will be substituted in equation (3.2.2) and finally results in dependent parameter value (y') i.e. predicted agriculture produce market price (y') with Fitness Factor***α***.

$$\hat{y} = y' + (\alpha - 1) \times y' + e \qquad (3.2.2)$$

IV. Experiments Results and Discussion

Using the model equation without fitness factor (3.2.1) and with fitness factor (3.2.2), selected ten agriculture commodities price prediction done and it was compared with actual price of that agriculture commodity and find out accuracy percentage as shown in Table 6. Training data used here is for ten years from 2006 to 2015 and testing data is used for one year 2016 from agriculture marketing network portal of Government of India for fiscal data [33] and from meteorological department for meteorological data [34,35]. Here, it is defined as Accuracy 'Without Fitness Factor' (only using multiple linear regressions) and Accuracy 'Using Fitness Factor'. This comparison is made for monthly model from both the approaches as shown in Table 6 below.

Fitness factor experimentally found during model validation of each selected agriculture commodity as shown in Figure 1. This factor suggests the value at where the marker price prediction has the highest accuracy with respect to that agriculture commodity for the selected training and testing period.

Table 6 Monthly Model Accuracy Comparative Analysis With / Without Fitness Factor - α

MODEL ACCURACY ANALYSIS WITH FITNESS FACTOR		
AGRICULTURE COMMODITY	WITHOUT FITNESS FACTOR α	WITH FITNESS FACTOR α
Bhindi(Ladies Finger)	67.96	83.67
Brinjal	67.76	82.42
Cabbage	67.55	87.70
Cauliflower	65.57	87.21
Green Chilly	58.80	82.07
Lemon	59.32	83.89
Onion	56.80	85.72
Potato	49.08	91.52
Surat Beans(Papdi)	69.96	86.76
Tomato	64.00	80.85

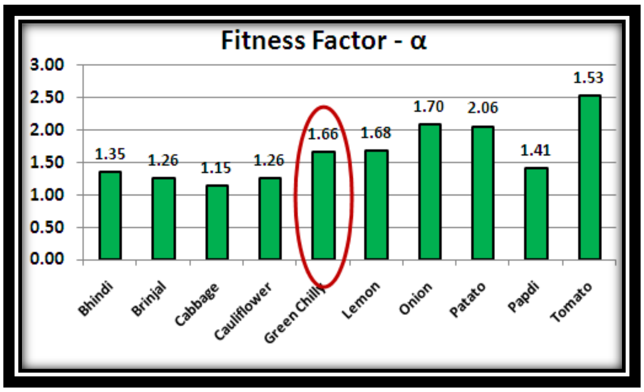


Figure 1 Fitness Factor α Value for Agriculture Commodity Market Price Prediction

As shown in Table 8, month wise related maximum, minimum and average accuracy was produced for given fitness factor. Table 7 shows the Beta value for parameters Temperature, Humidity, Rainfall and old Supply of Green Chilly. E.g. In the month of August, the value for various parameters β1 (Temperature), β2 (Humidity), β3(Rainfall) and β4 (Old Supply) is -15.48, 2.19, -3.12 and 4.06 respectively. Here the intercept value is 1862.50. So the Multiple Linear Regression equation (3.2.1) for August for Green Chilly agriculture commodity will be as follows.

$$y' = -15.48 \times T + 2.19 \times H + (-3.12) \times R + 4.06 \times OS + 1862.50 \quad \textbf{(4.1)}$$

Similarly as shown in Table 7 the fitness factor value **α** for August for Green Chilly agriculture commodity is 2.45. So by substituting the value in equation (3.2.1) for August for Green Chilly agriculture commodity will be as:

$$\hat{y} = y' + (2.45 - 1.00) \times y' + e \qquad \textbf{(4.2)}$$

As shown in equation (4.1), the fixed market value in Indian Rupee for agriculture commodity is ₹1862.50 and this value varies by the parameters. e.g. if value of average temperature is increased by 1 degree the market price of this agriculture commodity 'Y' will be decreased by ₹ 15.48/quintal and vice-a-versa. Similarly, if the humidity unit is increased by 1 unit, 'Y' will be decreased by ₹2.19 /quintal and vice-a-versa. If the rainfall is increased by 1 millimeter, 'Y' will be decreased by ₹ 3.12/quintal and vice-a-versa. Similarly, the value of last year August supply affects (increases) 'Y' by ₹4.06/quintal.

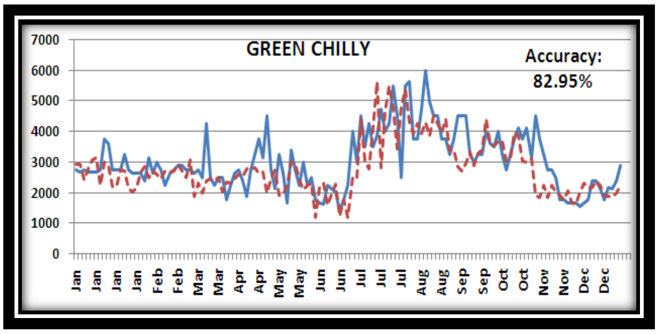
Table 7 Model Accuracy Analyses for: Green Chilly

GREEN CHILLY				
MODEL NAME	AVG ACCURACY	MAX ACCURACY	MIN ACCURACY	Fitness Factor-α
GC_Jan	85.14	99.52	78.02	1.65
GC_Feb	91.22	99.39	79.70	1.55
GC_Mar	83.73	99.97	56.59	1.20
GC_Apr	82.97	98.29	50.82	1.60
GC_May	77.03	99.36	44.59	1.10
GC_Jun	77.73	97.68	53.72	0.90
GC_Jul	72.61	98.01	8.21	1.95
GC_Aug	86.16	99.89	71.32	2.45
GC_Sep	88.19	99.94	60.71	2.35
GC_Oct	89.02	99.29	73.09	2.00
GC_Nov	76.79	99.03	42.98	1.55
GC_Dec	84.77	99.50	58.84	1.65
AVERAGE	82.95	99.16	56.55	1.66

Table 8 Monthly Model Parameters Beta Value for: Green Chilly

GREEN CHILLY MODEL PARAMETERS BETA VALUE					
MONTH	TEMPERATURE β1	HUMIDITY β2	RAINFALL β3	OLD SUPPLY β4	INTERCEPT Const
January	-34.63	-1.30	-1.89	9.89	2211.40
February	-10.28	-7.75	0.00	7.58	2278.01
March	30.82	-0.51	-690.15	7.65	829.04
April	33.87	-1.30	615.70	0.60	718.47
May	220.36	-9.72	0.00	4.07	-4208.81
June	-72.40	18.51	2.91	23.27	2273.31
July	-40.85	14.64	-0.08	18.73	1497.11
August	-15.48	2.19	-3.12	4.06	1862.50
September	46.32	-10.69	-1.28	6.58	975.35
October	36.94	3.19	-7.40	7.05	197.07
November	56.84	-0.47	20.14	5.99	-398.39
December	-21.30	10.34	-624.91	3.91	1193.74
AVERAGE	19.18	1.43	-57.51	8.28	785.73

Researchers applied various beta value and fitness factor for various months of entire year for the agriculture commodity Green Chilly and achieved yearly accuracy as 82.95% as shown in following chart.



Actual Value: **Predicted Value:**

Figure 2Actual v/s Predicted Agriculture commodity market price

V. GUI - OPTIMUM CROP CULTIVATION DATE SELECTION

Based on model equation 3.2.1 and 3.2.2 prediction was done for all ten selected agriculture commodities. But for the ease of reader, researchers have mentioned only one agriculture commodity GUI for Optimum Crop Cultivation Date Selection.

Figure 3 displays the optimum cultivation date for selected agriculture commodity. It will display top three cultivation periods for 'Green Chilly' agriculture commodity for 'Monsoon' season. Figure 3 also suggest Rank 'A', 'B' and 'C' of best cultivation period for given season for critical decision making support to the farmer community. The farmer can have a detailed view by clicking on the command button ***View Details***.

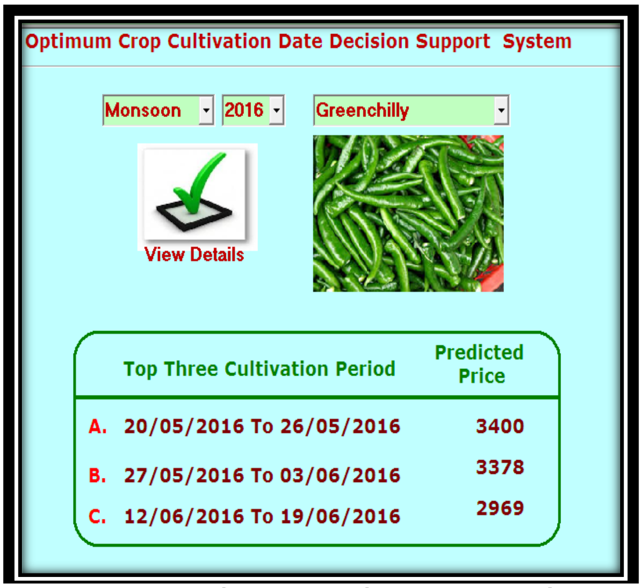


Figure 3Optimum Cultivation Date Selections - Recommendation

Figure 4 gives in detail alternative twelve weeks analysis based on given agriculture commodity and season. Out of such twelve week analysis, it will furnish the best week in which user should cultivate the said agriculture commodity. As shown in Figure 4, it will display alternative weeks for 'Green Chilly' agriculture commodity for 'Monsoon' season. The cultivation prediction alternative starts from last week of May and continues up to third week of August. Out of this broad range it will select the best week of planting date. In this following case, the top most cultivation period will be displayed with its related cropping date range and predicted price in rupee per ton.

VI. Conclusion

This study appropriately selected meteorological and fiscal parameter for agriculture commodity market price prediction using various tools and techniques. In spite of highly volatile environment in agri-business, the researcher has been able to achieve more than 80% accuracy in all selected agriculture commodities. This is possible by using additional intelligence – Fitness factor – **α** in model construction. Such constructed model used in one of the vital application of agriculture intelligence - "Optimum Crop Cultivation Date Selection". Thus, such intelligent application helps farmer community in their decision making of crop cultivation period with a view to achieve higher amount of margin at the time of cropping of that crop.

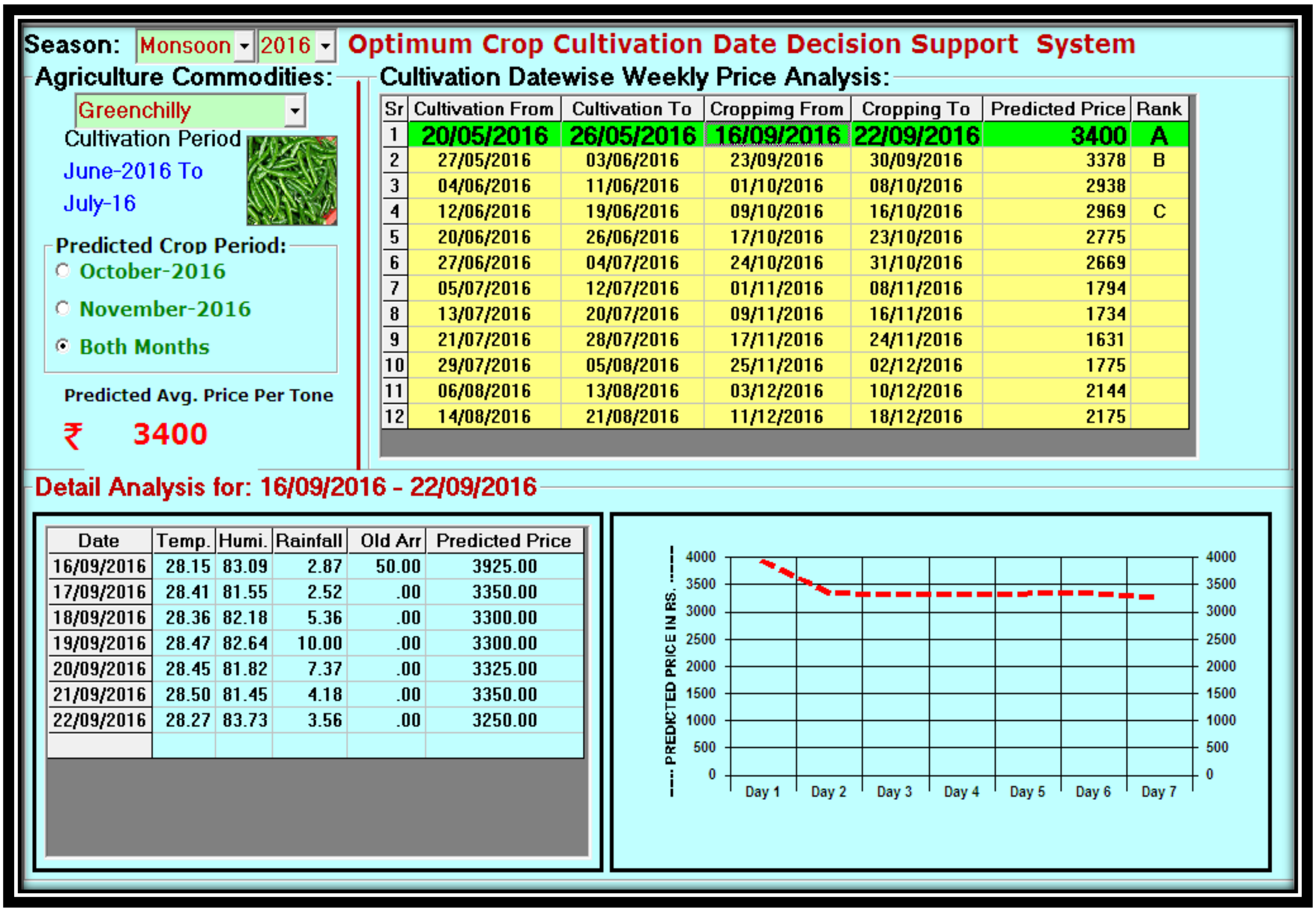


Figure 4 GUI -OptimumCrop Cultivation Date Selections

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Annexure - Table 5 Experiments Design: for Fiscal Parameter Selection

Exp.Sr. No.	Data Used for last Years	Parameter Used						Parameter Predicted	Tool / Method Used	MAPE
1	5	O_P	-	-	-	-	-	*P_S*	Wessa (L)	-
	4	O_P	-	-	-	-	-	*P_S*	Wessa (L)	-
	3	O_P	-	-	-	-	-	*P_S*	Wessa (L)	-
	2	O_P	-	-	-	-	-	*P_S*	Wessa (L)	-
	1	O_P	-	-	-	-	-	*P_S*	Wessa (L)	-
2	5	P_S	-	-	-	-	-	*PRC*	Wessa (L)	23.84
	4	P_S	-	-	-	-	-	*PRC*	Wessa (L)	24.04
	3	P_S	-	-	-	-	-	*PRC*	Wessa (L)	23.79
	2	**P_S**	**-**	**-**	**-**	**-**	**-**	*PRC*	**Wessa (L)**	**21.54**
	1	P_S	-	-	-	-	-	*PRC*	Wessa (L)	22.11
3	5	P_S	-	-	-	-	-	*PRC*	Wessa(Q^2)	24.03
	4	P_S	-	-	-	-	-	*PRC*	Wessa(Q^2)	24.01
	3	P_S	-	-	-	-	-	*PRC*	Wessa(Q^2)	23.72
	2	**P_S**	**-**	**-**	**-**	**-**	**-**	*PRC*	**Wessa(Q^2)**	**21.55**
	1	P_S	-	-	-	-	-	*PRC*	Wessa(Q^2)	22.27
4	5	O_P	-	-	-	-	-	*PRC*	MATLAB nntool	24.99
	4	O_P	-	-	-	-	-	*PRC*	MATLAB nntool	24.00
	3	O_P	-	-	-	-	-	*PRC*	MATLAB nntool	23.50
	2	O_P	-	-	-	-	-	*PRC*	MATLAB nntool	25.59
	1	O_P	-	-	-	-	-	*PRC*	MATLAB nntool	36.40
5	5	TM	HM	RF	SPL	-	-	*PRC*	MATLAB nntool	21.90
6	5	TM	HM	RF	SPL	LYP	-	*PRC*	MATLAB nntool	22.78
7	**5**	**TM**	**HM**	**RF**	**LYS**	**-**	**-**	**PRC**	**MATLAB nntool**	**18.13**
8	**5**	**TM**	**HM**	**RF**	**LYS**	**-**	**-**	***PRC***	**Wessa (L)**	**20.27**
9	5	TM	HM	RF	LYS	SPL	-	*PRC*	MATLAB nntool	23.96
10	5	TM	HM	RF	LYS	LYP	-	*PRC*	MATLAB nntool	24.90
11	5	TM	HM	RF	LYS	SPL	LYP	*PRC*	MATLAB nntool	27.22

O_P-Old Price, **SPL**-Supply, **P_S**-Predicted Supply **TM**-Temperature, **HM**-Humidity, **RF**-Rain Fall, **LYS**-Last Year Supply, **LYP** – Last Year Price, **PRC**-Price, **(L)**-Linear Model, **(Q^2)** – Quadratic Model