TARGET ORIENTED IRRIGATION SCHEDULING OF AGRICULTURAL CROPS THROUGH MICRO IRRIGATION

Biharilal. R. Patel[1] Kuldeep. B. Patel[2] and Madhusudan M. Parikh [3]

[1] Sr. Associate Professor, Department of Soil & Water Engineering,
Navsari Agricultural University, Navsari-396450, India
E-mail: biharilal_pht@yahoo.co.in

[2] Lecturer, Water Resources Engineering and Management Institute,
The M.S. University of Baroda, Samiala – 391410, India
E-mail: kbp_9999@yahoo.co.in

[3] Sr. Associate Professor, Department of Soil & Water Engineering,
Navsari Agricultural University, Navsari-396450, India
E-mail: mmparikh_guj@yahoo.in

ABSTRACT

In the new era of agriculture where every thing is limited (water, land, and other inputs), the target oriented agriculture must be adopted in India. Considering every drop of water or each gram of grain is precious for the mankind, any kind of wastage of water or loss of crop production can not be afforded. The existing irrigation schedules of agricultural crops recommended by the scientists either under or over irrigate the crops many times resulting into either a lot of wastage of water or reduction in crop production. Also owing to their too many problems, farmers do not adopt these irrigation schedules as such as they neither result into increase in crop production nor save any water. Looking to the preciousness of water and importance of increasing crop production, the need of the hour is to reschedule the existing irrigation recommendations keeping in view the problems faced by the irrigators. An attempt has been made in this paper to sort out the irrigational problems faced by the irrigators with micro irrigation systems and also to solve these problems by rescheduling target oriented irrigation.

Keywords: Target agriculture, WPF

INTRODUCTION

Irrigation scheduling of crops is done based on the results obtained from field experiments. In these experiments the treatments are fixed randomly. Since the experimental plot size is a limiting factor owing to less availability of land area for the experimentation, a limited number of treatments are taken. Mostly 3 to 4 treatments are taken. Based on the crop yield obtained and water consumed by the crop, any one treatment is recommended for the farmer's use. But sometimes that recommended treatment may not be the best suited for the crop owing to different reasons e.g. the climate, the area, etc. This affects the crop yields adversely. This way the recommendations become un-adoptable by the farmers. In fact, there must be a choice with the irrigator of varying the crop yield or water saving. These way a large numbers of experiments are conducted throughout the country and lot of money and manpower is wasted. In this paper an attempt has been made to analyze the recommendations made by the scientists with the following objectives:

1. To study the ways of fixing irrigation treatments
2. To study basis of recommending the treatments
3. To study the problems faced by the irrigators with these recommendations, and
4. To find a feasible solution to these problems in the form of a new approach for irrigation scheduling

METHODOLOGY

Results of over 150 studies conducted with sprinkler, mini-sprinkler and drip irrigation methods with different crops and at different locations over the years have been collected and analyzed considering the following parameters: the treatments tried, treatment recommended, water saving in per cent, and yield increase in per cent. The problems occurring in implementing these recommendations by the irrigators have also been analyzed.

RESULTS AND DISCUSSION

Results of over 150 experimental results have been considered for the study. Results of few drip and sprinkler studies along with their recommendations have been presented as a sample in Table 2 and Table 3.

How the irrigation treatments are decided presently?

There are two approaches followed generally for deciding the treatments. The first one is one the basis of the climate prevailing in the area, a volume (V) of water required for the crop is calculated and that is treated as the base (middle or central) treatment. Then some treatments are taken on the lower side and some on the higher side of that (V) volume of water. And this way the treatments are fixed.

In the other approach, based on the evaporation data of the area in the particular season and general water requirement of the crop (low, medium, high), scientist fix the treatments vaguely keeping some treatments on the lower side and some on the upper side. A normal trend of deciding the treatments of irrigation studies are given below in Table 1.

Table 1: Details of different treatments tried in experiments

Sr. No.	Treatments
1	0.30, 0.45, 0.60, 0.75
2	0.40, 0.55, 0.70, 0.85
3	0.40, 0.60, 0.80, 1.0
4	0.45, 0.60, 0.75, 0.90
5	0.50, 0.70, 0.90, 1.10
6	0.60, 0.80, 1.00, 1.20
Normal range of all the experiments = 0.3 to 1.2	
0.3 for low water requiring crop whereas 1.2 for high water requiring crops	

How the treatments are recommended presently?

Suppose, the Sr. No. 4 in Table 1 is the treatment followed in the study. Then based on the crop yield obtained and water saving achieved, either treatment 0.60 or 0.80 will be recommended for the irrigators. The recommendation would be like this: irrigation at 0.6 PEF is recommended for an increase in yield of 20 % and water saving of 30%. Or treatment 0.80 is recommended for an increase in yield of 35% with no saving of water.

Here the point is to be noted is that there is large gap of 0.2 PEF between two treatments. In other words, the results of crop yield or water saving between these two values of PEF is not known. This way a misleading irrigation ratio is recommended to the irrigator.

Recommended treatments for sprinkler irrigation studies

The irrigation recommendations made for some of the crops have been presented in Table 2. It can be seen that most of the crops have been recommended at 0.6 PEF.

Table 2: Recommended Sprinkler irrigation ratios IW/CPE ratio)

Crop	Recommended Irrigation Treatment	Water Saving (%)	Yield Increase (%)	Location	Treatments Tried
Cabbage	0.6	40	3	Navsari	0.4, 0.6, 0.8
Cauliflower	0.8	35	12	Navsari	0.6, 0.8, 1.0
Groundnut	0.8	24	30	Navsari	0.6, 0.8, 1.0
Lucerne	0.7	16	27	Anand	0.5, 0.7, 0.9
Potato	0.6	46	4	Deesa	0.4, 0.6, 0.8
Okra	0.4	28	23	Navsari	0.3, 0.4, 0.5,
Wheat	0.6	62	19	Navsari	0.45, 0.60, 0.75
Sugarcane	0.4	30	12	Navsari	0.3, 0.4, 0.5, 0.6

Recommended treatments for drip irrigation studies

The irrigation recommendations for some of the crops have been presented in Table 2. It can be seen that most of the crops have been recommended at 0.6 PEF

Table 3: Recommended Drip irrigation ratios (PEF)

Crop	Recommended Irrigation Treatment	Water Saving (%)	Yield Increase (%)	Location	Treatments Tried
Banana	0.6	25	10	Navsari	0.4, 0.6, 0.8
Banana	0.6	22	15	Navsari	0.4, 0.6, 0.8
Cabbage	0.6	34	46	Navsari	0.4, 0.6, 0.8
Cauliflower	0.4	40	60	Navsari	0.3, 0.4, 0.5
Rose	0.6	40	40	Navsari	0.45, 0.60, 0.75
Tomato	0.6	40	60	Navsari	0.4, 0.6, 0.8
Tomato	0.6	44	53	Navsari	0.4, 0.6, 0.8
Tuberose	0.6	23	30	Navsari	0.4, 0.6, 0.8

IRRIGATIONAL PROBLEMS FACED BY THE IRRIGATORS WITH THE EXISTING SCHEDULES

- The recommended irrigation treatment does not represent a correct irrigation ratio as needed by the crop matching with prevailing climate since it is recommended vaguely.
- There is a large gap between the two sequential treatments fixed (say 0.4 and 0.6, 0.6 and 0.8) during the experimentation; so the information about water saving, crop yield etc for in between value of ratios like 0.45, 0.50, and 0.55 between 0.4 and 0.6 PEF; 0.65, 0.70, and 0.75 between 0.60 and 0.80 PEF are not available either with the scientists or with the irrigators. Hence, when the climate poses a little change, irrigators find no ways to rescue their crops. They remain in dilemma and crop health gets affected.
- In fact, practically the farmer is recommended the corresponding pump’s running time for the particular recommended irrigation ratio. For example say for irrigating the crop at 0.6 PEF, the pump should be run for two hours or so. This way the farmer only knows those two hours of pumping for irrigating his crop and achieving all the given targets i.e. more yield, water saving, energy reduction etc.
- In such situations, with the fixed irrigation schedule (say 0.5 PEF), sometimes the crop gets over irrigated if the climate is a bit cooler (i.e. the water requirement gets reduced due to a cooler climate) and sometimes under irrigated if the climate is a bit hotter (the water requirement of crop increases). Both the times the crop does not get right amount of water and plant health gets affected.
- There is no consistency in the crop yields obtained by the farmer year to year as recommended by the scientists. Thus they do not keep a trust on the scientist’s recommendations and they do according to their own knowledge and ability

resulting into either over application of fertilizer and water or other inputs in order to get more yields.

- So is the case with the saving of water achieved by the farmers year to year as recommended by the scientists. Again they do not keep trust on the scientist's recommendation and do according to their own understanding and knowledge and apply less or more water.
- The farmers always complain about crop failure. They say either the crop is dyeing in the absence of optimum water availability or there is no saving of any water achieved with the irrigation schedule given by the scientist. In such situation again they lose their trust over the scientific recommendations.
- The farmers do not find any reduction in either their monthly energy bill or in the pump running time due to these climatic changes.
- Low voltage in the electric supply line will pump less water with the same amount of power consumption resulting into under irrigation of the crop as the scientists recommend the farmers the total duration of pumping and not the ratio as the practical way of irrigation.
- High voltage in the electric supply line will pump more water resulting into over irrigation of the crop and more power consumption thereby increasing the bill.
- In a nutshell the irrigators are not happy with the present schedules and perhaps that is the reason they are not following these schedules and they according to their knowledge and understanding.

What should be done now?

Looking to the problems and requirement of the irrigators, there is an urgent need to change the existing approach of irrigation scheduling. The new approach must be such that:

- It is easy to adopt by the farmers.
- The crops must receive optimum amount of water every time.
- The crop yield they get is consistent and should not have too much variation every season or year.
- The water saving must be consistent every time.
- Based on the climatic condition, they must get the maximum possible yield.
- They must receive the reduction in energy bill and pumping duration.

Target oriented irrigation schedule needed

In order to overcome all the problems faced by the irrigators and also the scientists worry about non-adoption of their recommendations by the farmers, a new approach of irrigation scheduling must be adopted. And that approach is target oriented irrigation scheduling.

What should be targeted?

The target can be fixed for two things. One is the crop yield and the other is water saving (or the amount of water to be used for the crop production). The climate is changeable with time. Therefore the schedule made should also be changeable with climate. The target can be easily fixed for the winter and summer crops based on the water availability with farmers. If there is ample water available for the season, the crop yield should be made the target. On the other hand if water is short, water can be made the target and corresponding yield must be sought.

What should be the approach?

The simple approach is the development of water production function of the crops. Once the water production function is developed, one can make a target based on the prevailing climate from time to time. That is if there was enough rainfall in monsoon one can target a maximum possible yield. Or if the water availability is a problem then one should target the amount of water to be used for the crop and accordingly the maximum possible crop yield with that water should be targeted.

Water production function (WPF)

First of all the water production function should be developed for the crop using the existing experimental data. Then based on the function, one should predict the crop yield with different water availability conditions i.e. 5, 10, 15, 20, 25, 30, 35, 40, 45 or 50 % reduction in water availability. For all these water availability conditions, the crop yields must be predicted. Thereafter the irrigation scheduling should be fixed for the targeted yield.

CONCLUSION

The existing irrigation schedules are not effectively serving the purpose of the irrigators and thereby they are not being trusted and adopted by them. As a result the Indian agriculture is not making any progress as it should make. The need of the time is to reschedule existing irrigation schedules based on developing water production function.

REFERENCES

1. Water management at a glance. A research bulletin of Water Management Project, Navsari Agricultural University, Navsari-396450.