INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2003/05–1–43–45
http://www.ijab.org

Comparison of Observed and Predicted Advance Times During Irrigation of Different Border Lengths under Local Conditions

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ABSTRACT

An experiment was carried out to compare the observed and predicted advance times during irrigation of different border lengths. A selected field was prepared for sowing of wheat by performing primary and secondary tillage operations. After planking and sowing of wheat by seed drill, the field was divided into border lengths of 41, 64 and 105 m while keeping their width constant at 6 m. The deviation between the observed and predicted advance times after complete irrigation was 14 m in 41 m border, 16 m in 64 m border and 25 m in 105 m border. The data was analyzed and model for length was calibrated using the analyzed data. The calibrated equation gave good agreement with the actual field data. For 41 m border and 105 m border the results given by the equation were very close to the field data.

Key Words: Irrigation; Border length; wheat

INTRODUCTION

Border irrigation methods make use of parallel ridges to guide a sheet of flowing water as it moves down the field. The strips have zero slopes cross wise but may have little or no slope in the direction of length. The former is called the graded border and the later one is the level border irrigation system. It is best suited to soils having low to moderately high intake rate. For close growing crops, the border irrigation method is preferred because of the advantages of border irrigation associated with mechanized agriculture.

An increase of 13% net profit due to improved lay-out of watercourse system and replacing basin by border irrigation has been reported. Consequently, the length of watercourse was reduced to the tune of 97 m ha $^{-1}$ in border layout (Choudry *et al.*, 1995).

As wheat meets the primary food requirements and occupies much of the cultivated area of the Punjab, analysis of efficient irrigation system for achieving potential production of wheat and other such cash crops is needed. Application efficiency is strongly associated with the appropriate design of system. Therefore, in view of benefits mentioned above, carefully designed irrigation system is needed to replace basin irrigation system for improving crop production. The primary objective of this study is to assess the predictability of Soil Conservation Services (USA) design equation under local conditions and to compare the observed and predicted advance times using calibrated model.

MATERIALS AND METHODS

An experiment was carried out at the experimental farm of the Department of Irrigation and Drainage, University of Agriculture, Faisalabad. A field of 108.7 x 53.7 m was leveled by laser leveling technique.

The selected field was prepared for sowing of wheat by performing primary and secondary tillage operations. After planking and sowing of wheat by seed drill, the field was divided into border lengths of 41, 64 and 105 m while keeping their width constant at 6 m. Each length treatment was replicated four times. The experimental plots were irrigated through field channels developed for the purpose. A non experimental area of about 5 m wide was left to accommodate surplus irrigation water before achieving constant flow.

Irrigations were applied to each experimental plot by gravity method (border irrigation) in accordance with irrigation turn (weekly basis) of the department, each time allowing the water to reach the end of field. The following procedure was adopted to accomplish each irrigation.

The borders were marked at every five meters along the length and the time of advancing sheet of water was observed to assess the rate of advance. The total time to irrigate a border was also noted. Data collected on elapsed time of advance versus distance along the length of border were used to plot the advance curve of the borders.

RESULTS AND DISCUSSION

The advance time for each 5 m interval was calculated from the Soil Conservation Services (USA) design equation for level border. The graph of observed advance time versus the predicted advance time was plotted for the 41, 64 and 105 m as shown in Figs. 1, 2 and 3, respectively. The values showed much deviation between the observed and predicted advance times. The deviation between the observed and predicted advance times after complete irrigation was 14 m in 41 m border, 16 m in 64 m border and 25 m in 105 m border. Thus the equation over predicts the length of border.

The data was analyzed using the computer software MINITAB, (1991) and GEN-STAT, (1988). The model for

Fig. 1. Comparison of observed and predicted length using model for 41 m border

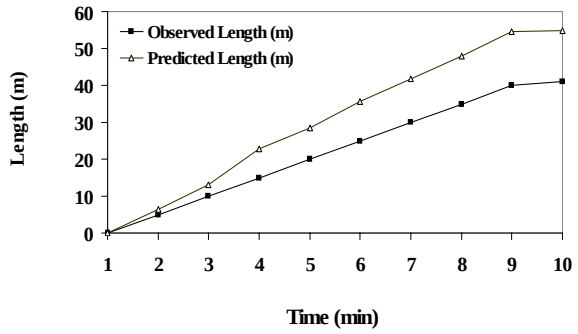


Fig. 2. Comparison of observed and predicted length using model for 64m border

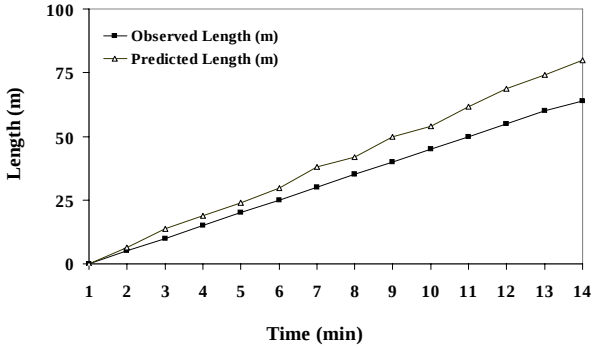


Fig 3. Comparison of observed and predicted length using model for 105 m border

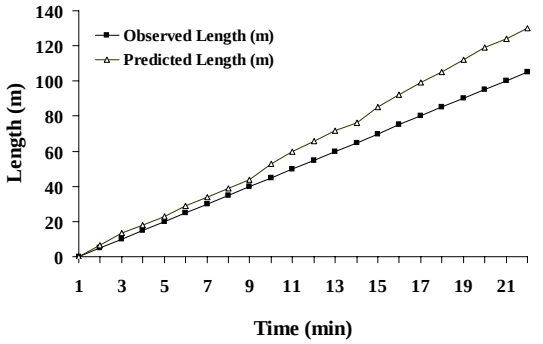


Fig.4. Comparison of observed and predicted length using calibrated model for 41m border

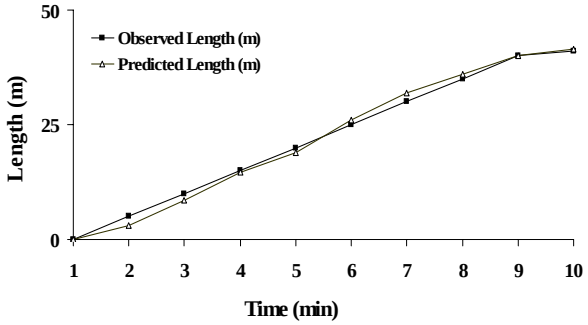


Fig. 5. Comparison of observed and predicted length using calibrated model for 64m border

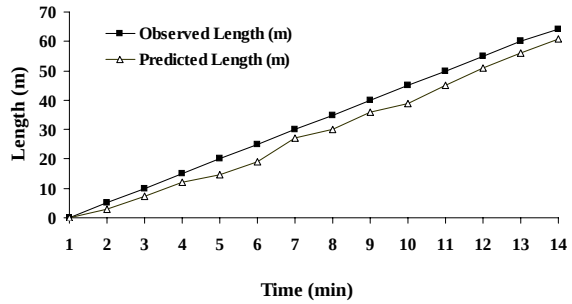
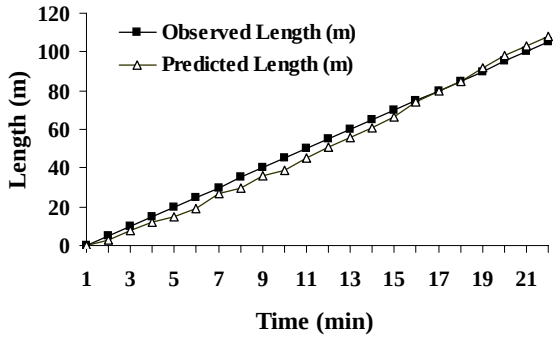


Fig.6. Comparison of observed and predicted length using calibrated model for 105m border



length was calibrated using the analyzed data for length of advance (L_t), time of advance (T_t), intake constants (a,b,c), stream size (Q_u) and roughness coefficient (n). The calibrated equation derived from the field data is as follows.

$$L = \frac{720\, Q_u\, T_t}{\frac{a T_t^{\,b}}{1+b} + C + 18.6_n{}^{0.4562}\; Q_u{}^{0.1729}\; T_t{}^{0.0285}}$$

The calibrated equation gave good agreement with the actual field data in most of the replications. The estimates of the calibrated model parameters are given in Table I.

Table I. Estimates of calibrated model parameters

Current Parameters	Estimated Parameters
0.37500	0.4562
0.56250	0.1729
0.18750	0.0285

Advance time and length were also calculated using calibrated equation. For 41 m border and 105 m border the results given by the equation were very close to the field data. The results of comparison of advance length between observed and predicted calibrated model are given in figs. 4 to 6, respectively. For 64 m border the reading did not match much with the observed length. This may be due to error in taking field data.

CONCLUSIONS

The Soil Conservation Services (USA) equation for the level border over estimated the length and was calibrated using the field data. The resulting equation predicted the field data satisfactorily.

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(Received 09 November 2002; Accepted 12 December 2002)