THESIS

MODELING OF FERTILIZER'S NUTRIENT DISTRIBUTION IN SOIL PROFILE ALONG A FIELD

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2007-PG-WRM-06

For the Degree of

MASTER OF SCIENCE

IN

WATER RESOURCES MANAGEMENT

CENTER OF EXCELLENCE IN WATER RESOURCES ENGINEERING
University of Engineering and Technology Lahore, Pakistan

2010

ABSTRACT

Ever increasing population requires production of more and more food. Planners in agriculture are mainly focusing on increasing the crop productivity by using different techniques of enhancing crop yield. Fertilizer application is one of the most important operations in crop production to increase the crop yield. Fertilizer is typically applied by broadcast method followed by field irrigation. The fertilizer after mixing with the water makes a nutrient rich water, a part of which enters into the root zone with the infiltrating water and a part flows forward along the advancing water. The net distribution of N nutrient along the field remains unknown but is assumed to be uniform.

The study was undertaken to determine the solubility rate of urea both in still and flowing water, checking the nutrient distribution in soil profile along the field length from the traditional method of application of fertilizers (broadcast followed by irrigation) and evaluation of irrigation event with SIRMOD model.

The solubility rate of urea was determined in both still and flowing water. Irrigation performance and nutrient distribution was tested in a 60X5 m plot. Two infiltration tests were done at the head and tail of the field before the irrigation using double ring infiltrometer. The field was marked at 5 m intervals by stakes. The soil samples were taken from all marked point from the 30 cm deep root zone before and after fertilization for N analysis. Three (3) Kg urea, equivalent to 1.75 bags of urea per acre, was applied to the field by broadcast method. Irrigation water at the rate of 7.5 lps was applied to the field from a tube well. Time of cut-off was 50 minutes.

Water samples were taken as advancing tip reached the marked point and at T = 65 min and T = 95 min. Maximum advance and recession time was noted to be 50 and 93 minutes. Intake opportunity time and infiltration depth were calculated from the water advance and recession data. All the water and soil samples collected were analyzed in Govt. of Punjab`s Soil & Water Testing lab, Thokar Niaz Beg, Lahore using Kjeldhal method. The irrigation event was analyzed using SIRMOD model to determine the irrigation event parameters.

The solubility rate of urea was found to be 1.3 gm/min for still water and 12.5 gm/min for flowing water. The average Kostiakov's infiltration parameters were as k = 0.0095 $ft^3/ft/mn^a$, a = 0.36 and f_o = 0.00041 $ft^3/ft/mn$. The soil N contents before application of urea showed that N-content in the soil varied between 1052 and 1754 grams with an average of 1383 grams having a downward increasing trend. The trend shows N-content of 1368 gm at head of the field and 1383 gm at tail of the field. The N-content in the soil after application of urea varied from 1443 to 1760 grams with an average of 1617 gm showing a downward increasing trend. The trend showed N-content of 1403 gm at head of the field and 1617 gm a tail of the field. Considering the nutrient distribution trend before and after application of urea the net N-content in the soil increased from 35 gm at head of field to 360 gm at tail of the field with an average increase of 169 grams. The pre, post and net increase of N-content has an increasing trend from head towards the tail of field.

The water advance followed a power relationship $x = at^b$ (a = 1.78 and b = 0.89). The intake opportunity time varied between 93 minutes at head to 47.3 min at tail of the field with an average of 71.67 min. The infiltration depth varied from 8.7

cm at head of field to 5.75 cm at tail of field with an average infiltration depth of 7.3 cm. SIRMOD model parameters were found as n = 0.08 and s = 0.0001. The irrigation, application and distribution efficiencies were found as 99.6, 99.6 and 87.9 % respectively.

Manning`s roughness coefficient for SIRMOD modeling is 0.08 for the first irrigation event. Traditional method for application of urea by broadcast method results uneven distribution of nutrients in the field. Further research may be carried out to determine ways and means to ensure uniform distribution of fertilizer nutrients in the soil profile along the field length.