Madras Agric. J., 85(10-12): 521 - 527 October - December 1998
https://doi.org/10.29321/MAJ.10.A00788

WATER FRONT ADVANCE AND WATER USE EFFICIENCY UNDER-COST FREE SURGE IRRIGATION IN SUNFLOWER (I)

ARUNA RAJAGOPAL and N.K. SATHYAMOORTHY

Water Technology Centre
Tamil Nadu Agricultural University
Coimbatore 641 003

ABSTRACT

A study was taken up to evaluate the performance of cost-free surge irrigation including two amendments viz., Raw Coconut Fibre Waste (RCFW) and Farm Yard Manure (FYM) @ 12.5 t ha^{-1}, in Sunflower (Co.2). The flow rate was 1 lps with an 'ON-OFF' time of 10 minutes. The total distance was 100 m. The spacing was 60/2 = 30x30 cm under double row planting. The cost-free surge irrigation involved inlet pipes of 52 cm length and 6.0 cm diameter from head channel to the furrows and manually operated. The over all trend was that higher number of surges to start with, decreasing in between and increasing at the end. There was a water economy (44.3-44.7 per cent) and labour economy (48.1-51.5 per cent) due to surge irrigation. Next ranking in labour economy was surge irrigation with RCFW. Labour saving was relatively lesser in continuous irrigation. Water use efficiency was higher for surge irrigation as compared to continuous irrigation except sector three (51-75 M) due to 'penultimate depression'. Also continuous irrigation suffered from penultimate depression.

KEY WORDS : Cost-free Surge Irrigation, Double row planting, Sunflower

Sunflower as an important oilseed crop with quality oil responds to irrigation efficiently. Basin and basin-furrow methods are commonly adopted for this crop. With varieties involved a row spacing of 30-45 cm are raised in basin irrigation layout and varieties requiring 60 cm are raised in basin-furrow with a length of 5-10 M. Few modifications like alternate furrow, skip furrow, double row furrow were introduced and later given up due to lack of feasibility and more labour involved. Surge irrigation is a dialectical demand to save land and to economise water and labour under furrow irrigation of surface method. Automated and semi-automated surge devices are cost prohibitive under Indian conditions. A cost-free surge method was designed and tested in Tamil Nadu Agricultural University. Cost-free surge method involves inlet pipe to draw the water into the furrow adopting Bulgarian Farmers' technique for continuous irrigation (Rajagopal, 1992) used for surge irrigation under the conditions of the experiment.

The manually operated method is found useful, meaningful and purposeful. The water front advance, water requirement and labour requirement in relation to surge irrigation with two moisture conserving amendments viz., Raw Coconut Fibre Waste (RCFW) and Farm Yard Manure (FYM) are discussed in the present paper.

MATERIALS AND METHODS

Field experiments were conducted during February to May and July to October, 1996 at Eastern block of Tamil Nadu Agricultural University which comes under Western Agro-climatic Zone of Tamil Nadu at 11° latitude and 77° E longitude at an altitude of 426.7 meters above mean sea level. The climate is tropical monsoon with mean annual rainfall of 640 mm received in 43 rainy days. The mean maximum and minimum temperature were 31.5° C and 21.2° C respectively. Relative humidity ranged from 45 to 91 percent during forenoon and afternoon respectively. The texture of the experimental field was sandy clay loam. The field capacity was 24 per cent and wilting print was 10 percent. The bulk density was 1.46 cc gm^{-1} estimated by brass ring method. The soil chemical analysis recorded an EC (dSm^{-1}) of 0.30 and pH of 8.3. Irrigation water recorded an E.C. of 0.8 dSm^{-1} and a pH value of 7.65. Irrigation treatments included surge, continuous flow in combination with two amendments of raw coconut fibre waste (RCFW) and Farm Yard Manure (FYM) @ 12.5 t ha^{-1}. There were four sectors of 0-25, 26-50, 51-75 and 76-100 M. A farmer's control of basin-furrow method was also maintained measuring

Table.1 Water front advance in raw coconut fibre waste applied treatment Crop 1

Time in minutes	Distance in Metres							
	Irrigation Cycle I		Irrigation Cycle III		Irrigation Cycle V		Irrigation Cycle VII	
	Surge	Continuous	Surge	Continuous	Surge	Continuous	Surge	Continuous
10	32.3	28.3	36.8	45.3	40.2	35.0	33.8	32.7
20	50.1	47.8	63.2	69.7	80.9	65.3	51.4	59.4
30	60.9	60.4	78.0	82.2	93.1	83.5	70.2	80.5
40	72.9	69.5	93.0	88.0		95.2	85.7	90.7
50	82.3	79.1		96.6		100.0	98.1	98.2
60	92.4	87.2		100.0				100.0
70		95.4						
80		100						

Table.2 Water front advance in FYM applied treatment CROP I

Time in minutes	Distance in Metres							
	Irrigation Cycle I		Irrigation Cycle III		Irrigation Cycle V		Irrigation Cycle VII	
	Surge	Continuous	Surge	Continuous	Surge	Continuous	Surge	Continuous
10	33.6	30.0	37.4	43.0	43.1	43.3	40.9	30.3
20	52.3	51.0	68.0	70.2	81.0	68.8	68.6	54.8
30	65.5	69.0	94.6	86.8	97.0	89.7	86.1	79.4
40	82.3	81.0		94.0		98.2	97.3	96.2
50	93.7	92.0		100.0		100.0		100.0
60		97.0						
70		100.0						

Table.3 Water front advance in Raw Coconut Fibre Waste Applied Treatment CROP II

Time in minutes	Distance in Metres							
	Irrigation Cycle I		Irrigation Cycle III		Irrigation Cycle V		Irrigation Cycle VII	
	Surge	Continuous	Surge	Continuous	Surge	Continuous	Surge	Continuous
10	28.8	28.8	29.4	29.3	39.8	32.3	34.3	33.2
20	42.3	39.6	45.6	44.9	79.6	67.6	50.7	56.3
30	56.8	52.0	65.7	62.8	93.2	86.8	70.8	74.9
40	74.6	71.8	79.6	77.8		96.7	86.6	85.6
50	86.6	79.9	94.6	90.8		100.0	97.2	92.3
60	95.5	86.6		98.4				100.0
70		93.0		100				
80		100.0						

Table.4 Water front advance in FYM applied treatment CROP II

Time in minutes	Distance in Metres							
	Irrigation Cycle I		Irrigation Cycle III		Irrigation Cycle V		Irrigation Cycle VII	
	Surge	Continuous	Surge	Continuous	Surge	Continuous	Surge	Continuous
10	31.2	39.3	43.4	39.7	42.6	46.3	44.6	30.2
20	42.2	65.0	60.0	57.6	82.3	67.6	64.7	66.3
30	69.7	69.4	79.4	71.6	96.3	89.3	70.2	75.8
40	87.0	75.0	95.0	82.3		100.0	92.8	92.0
50	100.0	84.5		84.8				100.0
60		90.0		100.0				
70		100.0						

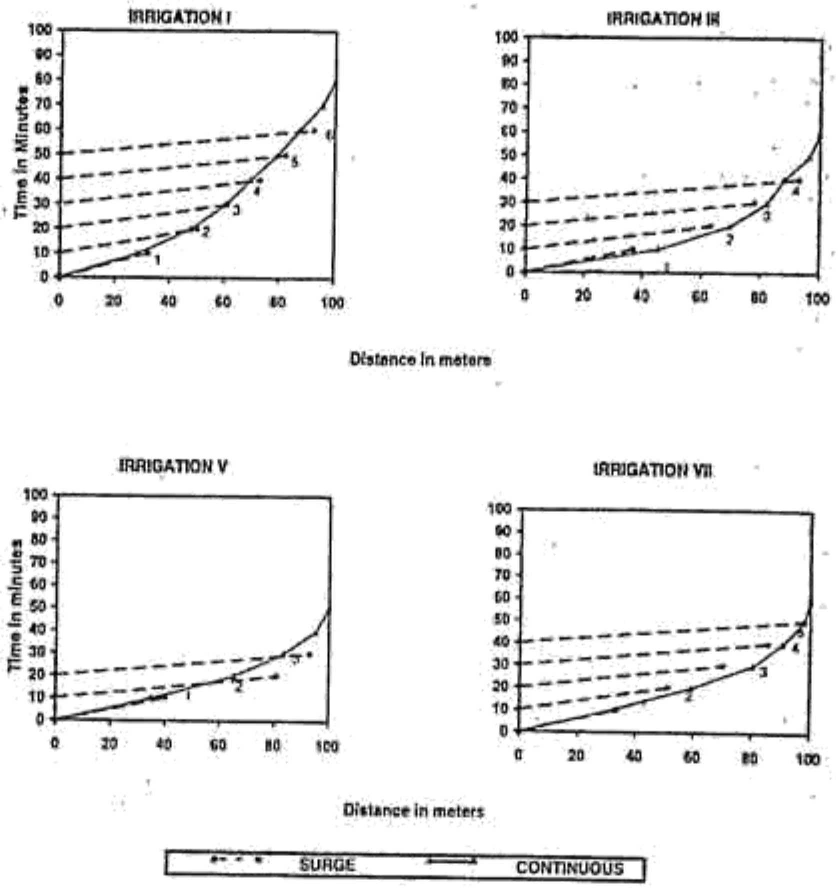

Fig .1 Water front advance in raw coconut fibre waste applied treatment Crop I

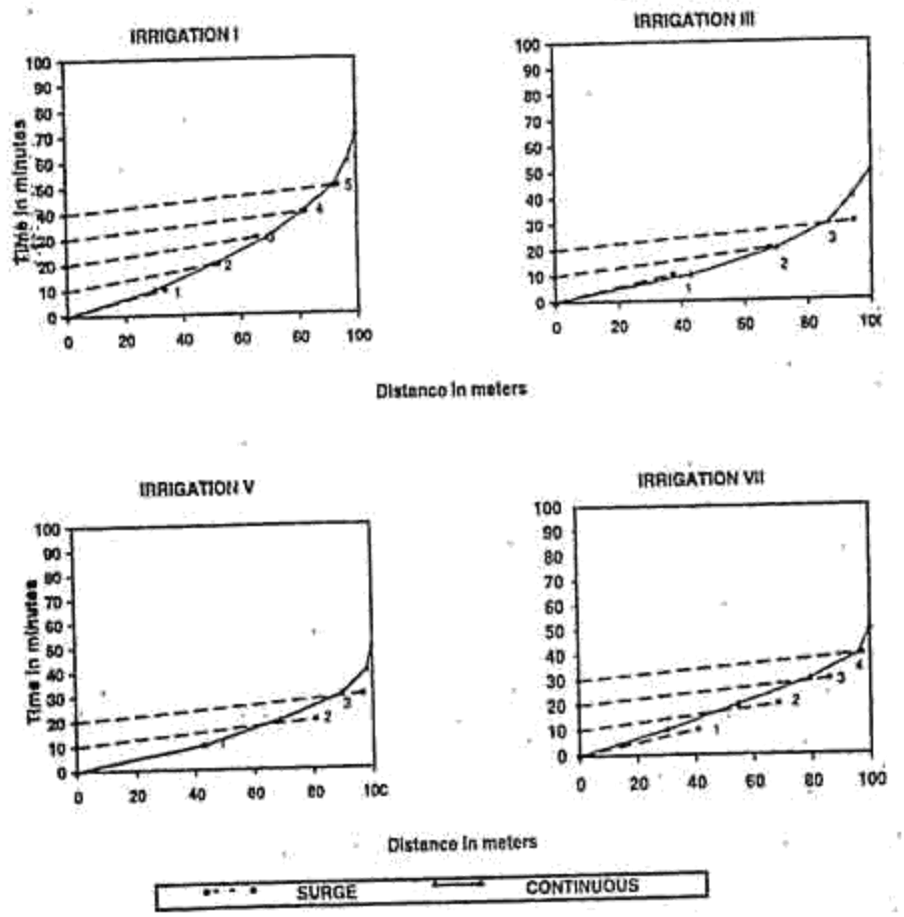

Fig .2 Water front advance in FYM applied treatments Crop I

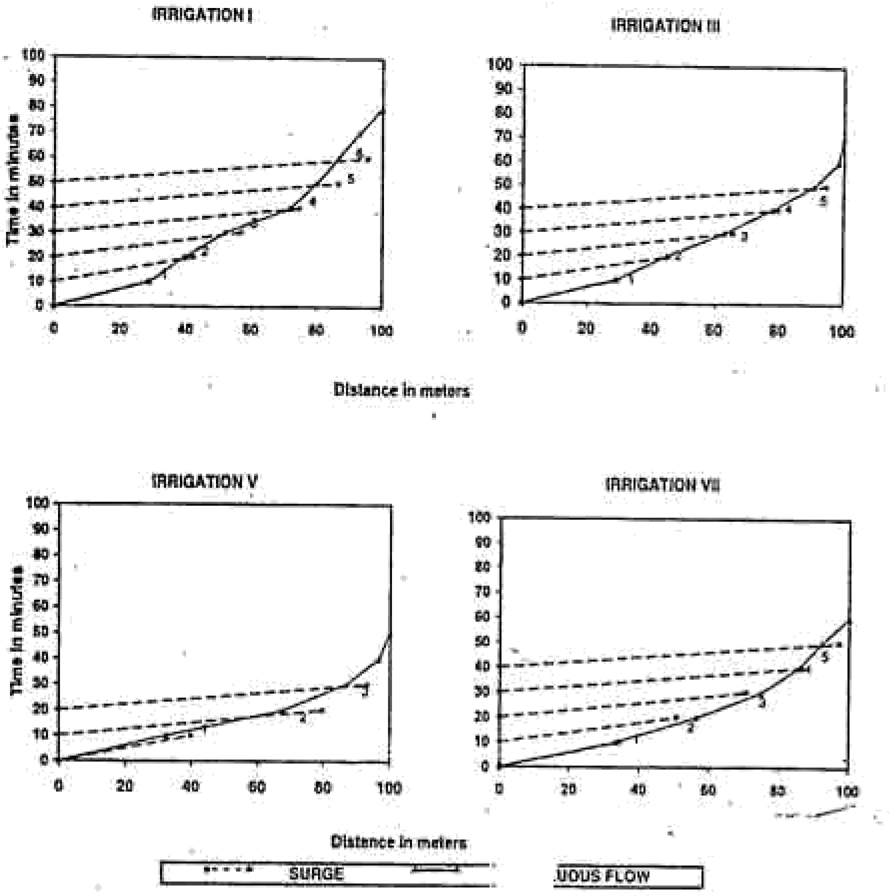

Fig .3 Water front advance in raw coconut fibre waste applied treatment Crop II

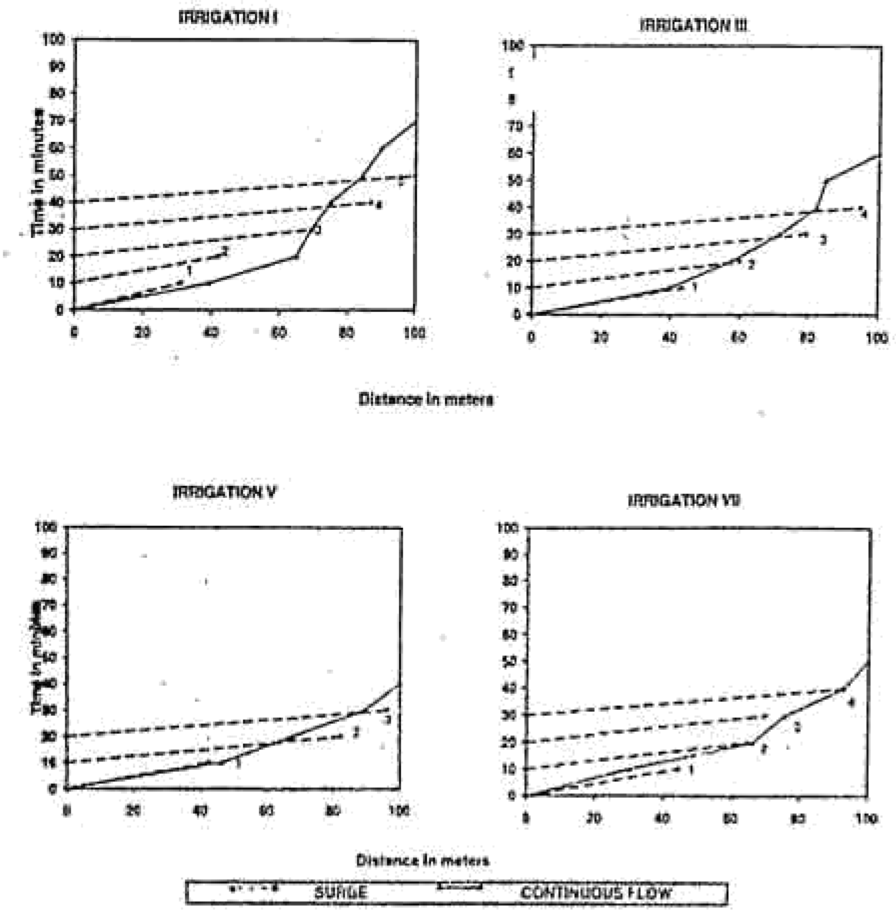

Fig .4 Water front advance in FYM applied treatments Crop I

Table.5 Water economy and labour under Surge Irrigation and other methods

Treatment	Crop I: Total water requirement (mm)	Yield (Kg ha^{-1})	Yield (Kg ha^{-1} mm^{-1})	Water economy (%)	Labour economy (%)	Crop II: Total Water Requirement (mm)	Yield (Kg ha^{-1})	WUE (Kg ha^{-1} mm^{-1})	Water economy (%)	Labour economy (%)
$I_1A_1S_1$		1381	3.55				1482	3.97		
$I_1A_1S_2$	389	1367	3.51	36.12	39.27	373	1474	3.95	38.03	41.23
$I_1A_1S_3$		1235	3.17				1428	3.82		
$I_1A_1S_4$		1353	3.48				1431	3.84		
$I_1A_2S_1$		1298	3.83				1430	4.29		
$I_1A_2S_2$	339	1290	3.81	44.33	48.07	333	1426	4.28	44.68	51.50
$I_1A_2S_3$		1152	3.40				1376	4.13		
$I_1A_2S_4$		1277	3.77				1406	4.22		
$I_2A_1S_1$		1365	2.72				1484	3.07		
$I_2A_1S_2$	502	1356	2.70	17.57	19.35	484	1481	3.06	19.6	23.51
$I_2A_1S_3$		1215	2.42				1438	2.97		
$I_2A_1S_4$		1359	2.71				1462	3.02		
$I_2A_2S_1$		1285	2.88				1447	3.43		
$I_2A_2S_2$	446	1276	2.86	26.76	29.21	421	1440	3.42	30.06	34.68
$I_2A_2S_3$		1195	2.68				1417	3.36		
$I_2A_2S_4$		1263	2.83				1421	3.37		
Farmer's Practic	609	1270	2.09			602	1464	2.43		

I_1 : Surge; I_2 : Continuous; A_1 : Raw coconut fibre waste (RCFW); A_2 : Farm Yard Manure (FYM); S_1 : 0 - 25 M; S_2 : 26 - 50 M; S_3 : 51 - 75 M; S_4 : 76 - 100 M

5.0x3.6 M. The experiment was laid out in factorial randomized block design with three replications. Normal package of practices was adopted. An additional dose of 25 percent NPK was added to RCFW applied treatments so as to have a meaningful comparison with FYM applied treatments. This is to compensate the NPK contribution from FYM. The depth of irrigation was 5.0 cm. The irrigation scheduling was at an IW/CPE ratio of 0.75. The 'ON-OFF' time was 10 minutes. The flow rate was 1 litre per second (lps). Four lps were drawn with the use of Parshall flume and delivered into four furrows from head channel through inlet pipes made of aluminium sheets measuring 52 cm length and 6.0 cm diameter. During OFF time the inlet pipes were closed by using the polythene bag tied with rubber band. The water front advance was measured and presented.

RESULTS AND DISCUSSION

Water front advance (Table 1-4, Figures 1-4)

The first irrigation took six surges under raw coconut fibre waste (RCFW) applied treatments whereas it took five surges under Farm Yard Manure (FYM) for both the years. There was only one surge for life saving second irrigation. The third irrigation for RCFW applied treatment took four surges as compared to three surges for FYM applied treatments in the first crop. The number of surges was five and four for RCFW and FYM treatments, for the second crop. The number of surges were same for both the crops for RCWF and FYM treatments respectively for fourth (4/3), fifth (3/3), sixth (4/4) and seventh (5/4) surges. In the first crop a total number of eight irrigations were given under surges for FYM and RCFW treatments. In the second crop there were seven irrigations only.

Surge recorded lesser water front advance time as compared to continuous flow. The magnitude of difference is lesser between continuous and surge, gradually increased, recording no difference upto sixth irrigation and lesser difference at the end under FYM treatment. In the case of RCWF treatments a similar trend was noticed except that there was a minor difference between surge and continuous flow at the sixth surge. In the second crop almost similar trends were recorded between continuous flow and surge flow with FYM and RCFW treatments.

The difference in water front advance time between FYM and RCWF treatments was due to roughness created under RCWF resulting in higher opportunity time to reach the tail end of the furrow. Under the conditions of the experiment RCFW has been applied after the formation of furrows as against application before the ploughing under field conditions for bulk crop in which complete incorporation has been ensured. Thus the exposed RCFW on the surface impeded the advance of water front considerably at the early stage of the crop.

The magnitude of difference between surge and continuous flow was higher during initial irrigation and it was declining in subsequent irrigations. It was due to the fact that tillage operations of the soil resulting in loose conditions with higher infiltration and hydraulic characters culminating into increased quantum of water applied. Similar findings were reported by Dhanapal (1996) in maize crop.

On comparing continuous flow, the time taken for water front to reach the tail end was lesser in surge flow. It is attributed to the removal of soil particles, reorientation, deposition and surface sealing in the furrow bed. Surge irrigation accelerated the water front advance and thereby reduced the total opportunity time and total volume of water required for an irrigation. Podmore *et al.*, (1983) reported that the potential benefits using surge irrigation include faster advance, an increase in infiltration uniformity and reduction in total volume of water required for an irrigation besides reduction in the total irrigation time. In barren furrow, the water front adance was more when compared to cropped furrows. This was due to resistance offered by the crop roots, stems and weeds to water front advance. This might be the reason for taking more time in the last two or three irrigations as compared to previous irrigations.

Water requirement and water economy (Table.5)

Among irrigation methods continuous flow recorded higher water requirement than surge flow. RCFW treatment registered increased water requirement than FYM treatment. Water saving was higher for surge irrigation with FYM ranging from 44.3-44.7 percent. It was 19.4-19.6 percent for continuous flow-RCFW treatments and 29.2-30.1 percent for continuous-FYM treatment as compared to basin-furrow method. Farmers' method recorded a water requirement of 609 mm as compared to surge-FYM (339 mm), surge-RCFW (359 mm), continuous-FYM (446 mm) and continuous RCFW (502 mm) treatments in the first crop. Similar trends were observed in the second crop also. Water use efficiency was higher for surge FYM treatments followed by surge-RCFW treatments. It is worth mention that the third sector (51-75 M) recorded relatively lesser water use efficiency among the surge and continuous irrigation methods. Higher water requirement for continuous flow as compared to surge is due to higher opportunity time for water front advance to tail end. Higher water requirement for RCFW was due to roughness created by the surface exposure as compared to FYM. Farmers' practice registered a water requirement of 602 to 609 mm for second and first crop respectively due to lesser water application efficiency. Dhanapal (1996) registered similar results in maize at Coimbatore. Penultimate depression was recorded in sunflower in summer season (Rajagopal and Dhanapal, 1997).

Labour economy (Table.5)

Among irrigation methods surge flow recorded lesser labour compared continuous flow and farmers' method. RCFW treatment recorded higher man hours than FYM applied treatments. Labour economy was accounting for 48.07 and 39.27 percent for surge flow with FYM and surge flow with RCFW treatments. Continuous flow registered a saving of 29.21 with FYM and 19.35 with RCFW. Labour economy under surge irrigation is due to lesser opportunity time for water front advance as compared to continuous flow even though surge involved 'ON-OFF' operations for every 10 minutes. RCFW recorded higher labour due to roughness. These findings fall in line with the findings of Dhanapal (1996) in his studies with surge irrigation in maize.

REFERENCES

DHANAPAL, R. (1996). Surge irrigation studies on maize. Ph.D. Thesis. Tamil Nadu Agricultural University. Coimbatore.

PODMORE, T.H., DUKE, H.R. and IZUNO, F.T. (1983). Implementation of surge irrigation ASEA paper No. 83-2018 presented at the summer meeting, 1982 Montana State University. Bozeman. M.I.

RAJAGOPAL, A. (1992). Report from participants under the Indo-Bulgarian Cultural exchange programme on conclusion of visit to Bulgaria (25.10 1992 - 01.12.1992) submitted to University Grants Commission. WTC., TNAU., Coimbatore - 641 003

RAJAGOPAL, A. and DHANAPAL, R. 1997. Surge irrigation studies in sunflower **Madras Agric.. J.** 84(8) 504-508.

(Received: May 1998 Revised Aug. 1999).

Madras Agric. J., 85(10-12): 527 - 529 October - December 1998

EFFECT OF INOCULATION OF *Acetobacter diazotrophicus* (ACN) WITH DIFFERENT LEVELS OF NITROGEN ON IT'S POPULATION ON VARIOUS PARTS OF SUGARCANE VARIETY - CoC 92061.

V. MURALIKRISHNAN and SM. MUTHUKARUPPAN

Department of Agrl. Microbiology,
Faculty of Agriculture,
Annamalai University,
Annamalainagar - 608 002.

ABSTRACT

Acetobacter diazotrophicus was multiplied in semi solid LGI medium and mixed with lignite. Then it was inoculated with setts and planted with different levels of inorganic fertilizer nitrogen. The population of *A. diazotrophicus* reached maximum in the treatment where 50 percent N with *A. diazotrophicus* inoculation was given.

KEY WORDS : *Acetobacter diazotrophicus*, Endorhizosphere. Caulosphere. Phyllosphere. Variety CoC 92061. LGI semi solid medium.

Sugarcane is one of the important commercial crops and is the main raw material for producing sweetening agent. Sugarcane responds well to nitrogen in terms of cane and sugar yields. Nitrogen is added to the sugarcane fields through inorganic, organic and biological sources. The use of the potential biological processes in the soil become inexpensive and improves the long term soil fertility in sustainable agricultural farming (Dobereiner and Urquiage, 1992). The new potential nitrogen fixing organism, *Acetobacter diazotrophicus*, has been found to occur in the roots, stems, leaves (Gills *et al.*, 1989, James *et al.*, 1994), rhizosphere soil and cane juice (Muthukumarasamy *et al.*, 1994). A study was conducted to enumerate *A. diazotrophicus* in different parts of the sugarcane plants and rhizosphere.

MATERIALS AND METHODS

Acetobacter diazotrophicus was multiplied in LGI semisolid medium (crystallized cane sugar - *100 g*, K_2HPO_4 - 0.2 g, KH_2PO_4 - 0.6 g, Mg SO_4 $5H_2O$ - 0.2 g, $CaCl_2$ - 0.02 g, $NaMoO_4$ - 0.002 g, Ferric Chloride - 0.01 g, 0.2 N KOH solution of Bromothymol Blue 5 per cent - 5.0 ml. Agar - 1.8 g, distilled water - 1000 ml, pH-5.5) over the shaker at 120 rpm at room temperature for five days to attain 10^9 cells/ml. Then it was mixed with the powdered lignite and after curing for three days, inoculated with setts and planted with different levels of 'N' fertiliser at Annamalai University experimental plots between March '95 and December '95.

The samples viz., rhizosphere soil, endorhizosphere, caulosphere and phyllosphere