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Effect of sources of irrigation water on growth and arsenic content in different fodder crops

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Green fodder is an important component of livestock feed and nutrition. The cost of feed constitutes about 80% of the total cost of animal production. India accounts for 15% of the world's livestock population and only 2% of world's geographical area resulting in tremendous animal pressure on the limited land resources (Pathak, 2003). On the other hand, less than 5% of total cultivated land in India is under fodder production (Anonymous, 2001). Accordingly, the availability of green and dry fodder is in deficit on an average to the extent of 53 percent (Hazra, 1998) which may further increase to the extent of 65 percent in 2025. The forage utilized to feed domestic herbivores that provide milk and meat and their products play an important role in food production (Chatterjee and Das, 1989). In India hardly 4 % of the feed energy for ruminants comes from pasture and wasteland (Fitzhugh *et al.*, 1978). Arsenic also found in cow milk with a range of 4.522 - 5.312 µg l^{-1} (Huq and Naidu, 2003). Cow milk is generally fed to the peoples. This was very dangerous for the peoples. Arsenic found in milk can prove that cows are agent of arsenic pathway. Through water, fodder and some arsenic additive arsenic enter into the cow and transfer in to the milk, so concentration of arsenic may be reduced through applying pond water as well as the fodder crop which uptake low amount of arsenic. In case of drinking water in Bangladesh, India and several other countries as well as the WHO guideline value is 10 ppb (PHED, 1993; Ghosh *et al.* 2004).

The experiment was carried out in farmer's field, village Dakshin Panchpota, Chakda Block, Nadia district, West Bengal, India which is situated at latitude 23°N and longitude 89°E throughout the year of 2008-2009. The soil of the experimental field was clay loam alluvial soil. The soil pH was 6.9 and the initial nitrogen, phosphate and potassium content of the soil were 0.046%, 47 kg ha^{-1} and 230 kg ha^{-1} respectively. The cropping history in study area were i) fallow- rice- mustard in 2007 ii) sesame- rice- mustard in 2006. The study was done in a Factorial Randomized Block Design (FRBD) where each treatment was replicated thrice. Ten treatments were allocated in each plot measuring 5 m x 4 m. The treatments were- A) source of irrigation with two levels viz. I_1-shallow tube well water and I_2 -pond water and B) crops with five levels viz. C_1-oat; C_2-lucerne; C_3-cluster bean; C_4-chinese cabbage, C_5-berseem. The data were analysed statistically for comparing the treatments means.

The plant height of fodder crops was recorded at harvest stage of growth (75 DAS). The data were analyzed and presented in table 1. Sources of irrigation had no significant effect on plant height recorded at harvest i.e. at 75 DAS. On the other hand different fodder crops had significant influence on plant height at harvest because they are genotipically and phenotipically different. Significantly higher plant height (168.83 cm) was obtained at C_1 (Oat) over C_5 (Berseem). The lowest plant height (72.90 cm) was recorded in C_4 (Chinese cabbage) treatment.

Two sources of irrigation had no significant influence on leaf area index of fodder crops at various stages of growth (Table 1). At harvest stage of growth under study, different fodder crops had significant effect on leaf area index (Table 1). Leaf area index was recorded highest (3.74) significantly with the 75 days after sowing of growth at C_1 (oat) followed by C_2 (lucerne) and C_5 (berseem). At 75 DAS the lowest leaf area index was found in the C_3 (Cluster bean) (2.87) which were significantly lower than crops.

Dry matter accumulation of fodder crops at various growth stages was not influenced significantly by source of irrigation (Table 1). With the advancement of crop growth, an increasing trend in dry matter accumulation was found in oats fodder (C_1) which was highest (181.35 $g.m^{-2}$) at 75 DAS. Various fodder crops significantly influenced dry matter accumulation at harvest stage (Table 1). The lowest (67.12 $g.m^{-2}$) dry matter accumulation was obtained at C_3 (berseem) while significantly the highest dry matter accumulation was recorded in the C_1 (oat) (181.35 $g.m^{-2}$).

Green forage yield was not influenced significantly by source of irrigation (shallow tube well and pond water) (Table 2). Green forage yield was

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influenced significantly by different fodder crops. Green forage yield was obtained highest in treatment C_1 (320.87 q.ha^{-1}) followed by C_2 (315.94 q.ha^{-1}), C_3 (272.30 q.ha^{-1}) and C_4 (247.33 q.ha^{-1}) at harvest stage (75 DAS). The lowest dry matter yield was obtained during harvest stage (75 DAS) in C_5 (242.26 q.ha^{-1}) treatment.

Table 1: Effect of source of irrigation water on different growth attributes of different fodder crops at harvest stage

Treatments	Plant height (cm)	Leaf area meter (LAI)	Dry matter accumulation (g.m^{-2})
Source of irrigation	**Harvest stage at 75 days after sowing (DAS)**		
STW	93.47	3.23	90.72
PW	93.27	3.02	91.66
S. Em(±)	**1.20**	**0.12**	**3.49**
LSD(0.05)	**NS**	**NS**	**NS**
Crops			
Oat	168.83	3.74	181.35
Lucerne	74.36	3.19	68.43
Cluster bean	75.00	2.87	67.12
Chinese cabbage	72.90	2.87	69.57
Berseem	75.75	2.97	69.47
S. Em(±)	**0.78**	**0.19**	**5.52**
LSD (0.05)	**1.90**	**0.47**	**13.49**

STW: Shallow tube well water; PW: Pond water; DAS: Days after sowing

Table 2: Effect of source of irrigation water on yield components and arsenic content in leaves of different fodder crops at harvest stage

Treatments	Green forage yield (q.ha^{-1})	Dry matter yield (q.ha^{-1})	Crude protein yield (q.ha^{-1})	Arsenic content in leaves (ppm)
Source of irrigation	**Harvest stage at 75 days after sowing (DAS)**			
STW	279.19	68.88	7.40	2.27
PW	280.53	72.58	7.64	2.05
S. Em(±)	**10.91**	**1.89**	**0.54**	**0.07**
LSD (0.05)	**NS**	**NS**	**NS**	**0.19**
Crops				
Oat	320.87	76.60	5.72	2.08
Lucerne	315.94	76.23	9.15	2.40
Cluster bean	272.30	70.71	9.47	2.03
Chinese cabbage	247.33	61.78	5.19	2.01
Berseem	242.85	68.32	8.05	2.27
S. Em(±)	**17.26**	**2.98**	**0.85**	**0.12**
LSD (0.05)	**42.20**	**7.29**	**2.09**	**0.30**

Dry matter yield was not influenced significantly by source of irrigation (shallow tube well and pond water) (Table 2). Dry matter yield significantly changed over the fodder crops. The dry matter yield was obtained highest in C_1 (oat) (76.60 q/ha) followed by C_2 (lucerne) (76.23 q.ha^{-1}),. C_3 (cluster bean) (70.71 q.ha^{-1}) and C_5 (berseem) (68.32 q.ha^{-1}) at harvest stage (75 DAS). The lowest dry matter yield was obtained during harvest stage (75 DAS) in C_4 (Chinese cabbage) (56.67 q.ha^{-1}).

Crude protein yield was also not influenced significantly by source of irrigation (Table 2). Crude protein yields were significantly different in different fodder crops. Crude protein yield was obtained highest in treatment C_3 (cluster bean) (9.47 q.ha^{-1}) followed by C_2 (lucerne) (9.15 q.ha^{-1}), C_5 (berseem) (8.05 q.ha^{-1}) and C_1 (oat) (5.72 q.ha^{-1}) at harvest stage (75 DAS) (Table 2). The lowest crude protein yield was obtained during harvest stage (75 DAS) in C_4 (Chinese cabbage) (5.19 q.ha^{-1}) treatment.

Arsenic content in leaves of fodder crops were significantly influenced by source of irrigation (shallow tube well and pond water) (Table 2). Arsenic content in leaves were obtained highest 2.27 ppm in shallow tube well water treatment where as in pond water) treatment arsenic content were obtained 2.05 ppm. Arsenic content in leaves were significantly influenced by different fodder crops. Arsenic content in leaves were obtained highest 2.40 ppm in C_2 (lucerne) followed by 2.27 ppm in C_5 (berseem), 2.08 ppm in C_1 (oats) and 2.03 ppm in C_3 (cluster bean). Arsenic content in leaves of fodder crops were recorded lowest 2.01 ppm in C_4 (Chinese cabbage) treatment. Arsenic concentration may be reduced through applying pond water as well as the fodder crop which uptake low amount of arsenic.

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