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RESEARCH PAPER

Effect of irrigation and tillage practices on yield and economics of fodder maize (*Zea mays*)

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Abstract : A field experiment entitled irrigation and tillage practices for fodder maize (*Zea mays* L.) in rice fallows was undertaken at the Department of Agronomy, College of Horticulture, Kerala Agricultural University conducted during 2012-2013. The treatments comprised of no irrigation (with residual moisture), irrigation at IW/CPE: 0.4, irrigation at IW/CPE: 0.7, irrigation at IW/CPE: 1.0 in main plots and zero tillage (with herbicide), minimum tillage and conventional tillage in sub plots. The experiment conducted showed that green fodder yield was highest under irrigation at IW/CPE: 1.0 and zero tillage (with herbicide). B: C ratio also followed the similar trend as yield.

Key Words : Yield, Maize, Fodder, Economics

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INTRODUCTION

Agricultural production systems in India are generally based upon mixed farming in which crops and livestock are integrated. Farmers mix these two enterprises to diversify the use of their resources for maximizing family income. However, in Kerala, livestock husbandry as a whole is on the decline. Livestock population in Kerala is decreasing at an alarming rate; it was 34.2 lakhs in 1987, but in 2007, it was just 17.4 lakhs (GOK, 2010). The decline in cattle population affects many other facets of farming besides affecting the supply and availability of milk and dairy products. Although several reasons can be attributed to the drastic decline in livestock population, a major reason is decreased availability of paddy straw because of the dwindling paddy area year after year. Availability of alternative feed resources is also limited as cultivation of fodder crops is not popular among farmers. It is estimated that the present fodder availability from all sources in Kerala is only 5.1 million tonnes when the total requirement is 23.2 million tonnes (Anita *et al.*, 2011).

In the present land use pattern of Kerala, it is very difficult to find new areas for fodder cultivation. However, introduction of short duration fodder crops in the existing cropping systems is a practical solution to this problem. Food-forage based systems provide support to the farmers by adjusting a part of their land or season exclusively for fodder production. Food-fodder based crop rotations have been evaluated for their profitability and were found more remunerative than others in many agro-climatic and management situations (Suneethadevi *et al*., 2004).

The rice fallows, especially during the third crop season, can be utilized in a big way for cultivating short duration fodder crops such as fodder maize. In the third crop season, however, water availability might be a major problem. Farmers would be interested in fodder production system which requires low inputs. Fodder maize is found to be an ideal short

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duration fodder crop for the rice fallows with irrigation (George, 2011).

Fodder maize is a cheaper source of nutrients as compared to concentrates and is useful in bringing down the cost of feeding. It provides all the critical elements in animal nutrition such as digestible protein, carbohydrates, minerals and also a very good source of β-carotene. It can also produce reasonably good herbage yield within a short growing period of 60-65 days.

MATERIAL AND METHODS

The research project entitled irrigation and tillage practices for fodder maize (*Zea mays* L.) in rice fallows was undertaken at the Department of Agronomy, College of Horticulture, Kerala Agricultural University during 2012-2013. The cultivar "African tall", a high yielding fodder maize was used for the study. The soil of the experimental site is sandy loam (Order: Oxisol), and acidic in reaction with a pH of 5.7. The field capacity of the soil was 15.10 per cent and permanent wilting point was 7.69 per cent.

Details of treatments :

Main plots : Irrigation	Sub plots: Tillage
M_1: No irrigation (with residual moisture)	S_1: Zero tillage (with herbicide)
M_2: Irrigation at IW/CPE: 0.4	S_2: Minimum tillage
M_3: Irrigation at IW/CPE: 0.7	S_3: Conventional tillage
M_4: Irrigation at IW/CPE: 1.0	

The field was kept undisturbed for S_1 and glyphosate was applied @ 0.8 kg ai/ha. For S_2, soil was dug in strips (width about 15cm) at a spacing of 30 cm. In the case of S_3, the land was ploughed thoroughly twice and then leveled.

Differential irrigations according to treatments were started immediately after sowing. A pre sowing irrigation of 40 mm with check basin method through hose pipe (after calibration) was given uniformly to all the plots on 28-11-2012. Afterwards, 40 mm irrigation water was applied as and when the respective cumulative pan evaporation values were attained in various treatment plots. Accordingly, 40 mm irrigation was scheduled when evaporation values from a class A open pan evaporimeter readings reached to 100 mm, 57.1 mm and 40 mm to M_4, M_3 and M_2 plots, respectively. During the crop period a total of 20 mm rainfall was received on these days, on 1-12-2012 (0.2 mm); on 2-12-2012 (6.2 mm) and on 29-12-2012 (13.6 mm). This rainfall was accounted in calculating CPE for scheduling irrigation.

Fodder yield :

Green fodder yield from each plot was recorded immediately after cutting and the yield of green fodder in mg/ha was calculated for each plot.

Economics :

Cost of production of fodder maize under various levels of irrigation and tillage practices were calculated on the basis of labour charges of the locality, cost of inputs and treatment costs. The net returns per hectare and benefit cost ratio was worked out by dividing the gross return with total expenditure per hectare.

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented in Table 1 and Fig. 1.

Fodder yield :

Levels of irrigation had significant influence on fresh forage yield of fodder maize. The highest green herbage yield (31.84 mg/ha) was recorded in IW/CPE=1.0 (M_4) which was statistically superior to others and control plot (M_1) recorded the lowest green herbage yield (3.43 mg/ha).

The observed increase in forage yield with increase in soil wetness can be attributed to more or less similar trend in yield attributes like plant height, leaf number, leaf length, leaf width and leaf area. Rostamza *et al.* (2011) reported that a significant decrease in fresh forage yield was observed at each level of water supply reduction.

There is significant difference between tillage methods with respect to fresh forage yield. The highest fresh forage yield was recorded in herbicide based zero tillage (S_1) (18.07 mg/ha) followed by conventional tillage (S_3) (14.74 mg/ha)

Table 1 : Economics of fodder maize in various irrigation schedules and tillage

Irrigation schedules	Herbicide based zero tillage				Minimum tillage				Conventional tillage			
	Total cost (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio	Total cost (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio	Total cost (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
No irrigation	25086	11680	-13406	0.46	25716	4800	-20916	0.18	27516	9460	-18056	0.34
Irrigation at IW/CPE=0.4	25566	24180	-1386	0.94	26196	19640	-6556	0.75	27996	20720	-7276	0.74
Irrigation at IW/CPE=0.7	26286	44260	17974	1.68	26916	27800	884	1.03	28716	33480	4764	1.16
Irrigation at IW/CPE=1.0	27246	72920	45674	2.67	27876	56000	28124	2.01	29676	61740	32064	2.08

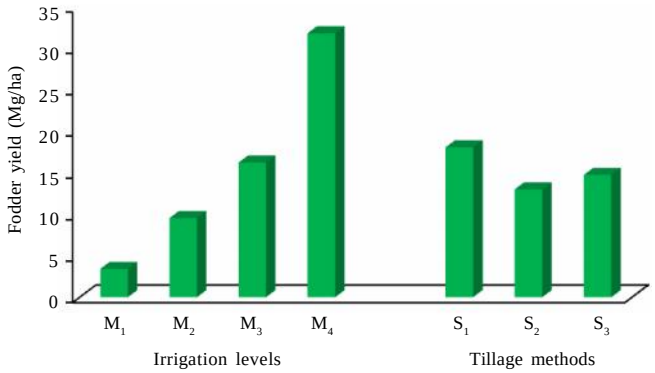

Fig. 1 : Fodder yield (Mg/ha) as influenced by irrigation schedules and tillage

and the lowest in minimum tillage (S_2) (12.99 mg/ha). The reduction in yield in minimum tillage (S_2) can be attributed to competition from weeds which resulted in poor plant growth. It could be seen that the weed dry matter production in minimum tillage (S_2) plots was significantly higher (108.20 g/m^2) compared to other treatments. Normal tillage may not be required for getting good crop yield. Lal (1989) noted that no till farming systems are successful for production of row crops in the tropics.

Although herbicide application is not advocated in the context of environmental safety and residual toxicity, in the present case, it seems to be safe. Glyphosate is a post emergence broad spectrum herbicide which normally enters the plants through the green aerial parts, mainly the foliage. It is usually sprayed prior to sowing of the crop on the emerged weeds and the crop is harvested about 60 days after sowing. A characteristic of glyphosate is that its herbicidal activity through soil is low. This has been attributed to its easy adsorption to soil constituents. It has also been reported to be fairly immobile in soil, and in soil its degradation is brought about by microflora (Grossbard and Atkinson, 1985). Hence, the chance of herbicide residue problem and the resultant toxicity in livestock fed with fodder raised in a field treated with glyphosate is minimal.

Economics :

The data indicated that total cost, gross returns, net returns and B:C ratios were significantly influenced by different treatments in the experiment.

Costs of production as well as the net returns (negative) were lower in plots with no irrigation (M_1). The highest gross return of Rs. 72,920 per hectare was obtained for fodder maize in the treatment IW/CPE ratio 1.0 (M_4) with herbicide based zero tillage (S_1) and it gave the highest B:C ratio of 2.67. Irrigation at IW/CPE ratio 1.0 with conventional tillage (M_4S_3) and minimum tillage resulted in a B:C ratios of 2.08 and 2.01. The B:C ratios calculated for irrigation at IW/CPE ratio 0.7 with herbicide based zero tillage, conventional tillage and minimum tillage were 1.68, 1.16 and 1.03, respectively. However, B:C ratios were less than 1.0 in the case of treatments, IW/CPE 0.4 (M_2) and no irrigation (M_1).

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