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Influence of irrigation regime and planting methods on weed flora and performance of puddled lowland rice

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Abstract : Field experiments were conducted during *Kar* and *Pishanam* seasons of 2000-2001 at Agricultural college and Research Institute, Killikulam to find out the effect of irrigation and stand establishment techniques on weeds, grain yield and economics of rice. The result revealed that adoption of continuous submergence with line transplanting recorded lower weed density of 32 and 21 No. m^{-2} and weed DMP (34 and 22 kg ha^{-1}) in *Kar* and *Pishanam* seasons respectively. The significant increase in yield were recorded by irrigation to 5 cm depth on disappearance of previously ponded water either with line transplanting (S_5) or with throwing of seedlings (S_3). Increased net return and B:C ratios of 2.44 and 2.35 were recorded by irrigation to 5 cm depth on disappearance of previously ponded water with throwing of seedlings for *Kar* and *Pishanam* seasons respectively.

Key words: Irrigation, Establishment methods, Weed control, Productivity and Economics.

Introduction

In rice, establishment methods and irrigation managements are location specific and hence it is very difficult to evolve a common management techniques for macro level recommendation. Scarcity of water for irrigation and increased cost of transplanting made many farmers to switch over to direct seeding. Under conditions of scarcity of water, judicious water management is essential in utilizing the water more economically. In wet seeded rice, weed management is one of the most critical factors because, the soil conditions is favourable for simultaneous germination of weed seeds and rice seeds (James Martin, 1995).

Water serves as an effective means of weed control as many weeds cannot germinate under flooded conditions. Too low or too high soil water content prevents the growth and development of lowland rice weeds. Hence, this study was undertaken to find out the best stand establishment method and water management in terms of weed control, productivity and economics of rice.

Materials and Methods

Field experiment was conducted during *Kar* (June, 2000 - Sep., 2000) and *Pishanam* (Oct., 2000- Feb., 2001) seasons of 2000-2001 at Agricultural college and Research Institute, Killikulam. The experiment was laid out in split plot design with three replications. The test varieties were ASD 16 and ADT 39 in *Kar* and *Pishanam* seasons respectively. The treatment combination comprised of three water management practices to a depth of 5 cm *viz.* irrigation on disappearance of previously ponded water - I_1 rotational water supply of 4 days on 3 days off — I_2 and continuous submergence - I_3 in main plots and five stand establishment techniques *viz.*, broadcasting of seeds - S_1, drum seeding - S_2, throwing of seedlings - S_3, random transplanting - S_4, and line transplanting - S_5.

The soil was sandy clay loam with a pH of 6.9. The available nitrogen, phosphorus and potassium were 176.0, 26.8 and 107.0 kg ha^{-1} respectively. A total rainfall of 208.6 and

Table 1. Effect of irrigation and stand establishment techniques on weed density and weed DMP

	Treatments	Weed density (No. m^{-2})				Weed DMP (Kg ha^{-1})			
		Kar (June-Sep)		*Pishanam (Oct-Feb)*		*Kar (June-Sep)*		*Pishanam (Oct-Feb)*	
		20 DAS/DAT	40 DAS/DAT	20 DAS/DAT	40 DAS/DAT	20 DAS/DAT	40 DAS/DAT	20 DAS/DAT	40 DAS/DAT
I_1	Irrigation on disappearance	57.53 (1.75)	45.80 (1.67)	51.67 (1.70)	33.60 (1.53)	55.67 (1.74)	49.20 (1.70)	50.07 (1.69)	35.00 (1.55)
I_2	Rotational Water Supply	67.60 (1.82)	53.73 (1.74)	62.87 (1.80)	43.13 (1.63)	66.00 (1.81)	58.27 (1.77)	61.27 (1.78)	44.53 (1.65)
I_3	Continuous submergence	46.67 (1.66)	39.80 (1.61)	45.07 (1.65)	29.00 (1.47)	51.87 (1.71)	42.20 (1.64)	43.47 (1.63)	30.60 (1.49)
	SEd	0.006	0.008	0.005	0.004	0.005	0.006	0.006	0.005
	CD (P=0.05)	0.017	0.022	0.015	0.012	0.015	0.018	0.015	0.014
S_1	Broadcasting of seeds	86.22 (1.94)	60.78 (1.79)	81.11 (1.92)	54.44 (1.75)	86.89 (1.95)	64.78 (1.82)	80.11 (1.91)	56.44 (1.76)
S_2	Dram seeding	72.56 (1.87)	52.44 (1.73)	68.11 (1.84)	44.44 (1.66)	74.33 (1.88)	56.44 (1.76)	67.11 (1.84)	46.44 (1.68)
S_3	Throwing of seedlings	50.33 (1.71)	41.22 (1.63)	41.44 (1.63)	26.33 (1.45)	50.00 (1.71)	44.22 (1.66)	39.44 (1.61)	27.56 (1.47)
S_4	Random transplanting	42.33 (1.64)	39.89 (1.62)	38.67 (1.60)	25.78 (1.43)	41.78 (1.64)	42.89 (1.65)	36.67 (1.58)	26.44 (1.45)
S_5	Line transplanting	34.89 (1.56)	37.89 (1.60)	36.67 (1.58)	25.22 (1.44)	36.22 (1.58)	41.11 (1.63)	34.67 (1.56)	26.67 (1.45)
	SEd	0.009	0.009	0.008	0.009	0.009	0.006	0.009	0.008
	CD (P=0.05)	0.019	0.018	0.017	0.019	0.018	0.018	0.018	0.016

Figures in parentheses are log (x +2) transformed values

Note: DAS- Days After Sowing; DAT - Days After Transplanting ; Interaction between the treatments was absent

Table 2. Effect of treatments on yield attributes and grain yield of rice*

Treatments		DMP at harvest (kg ha^{-1})		Productive tillers at harvest (No. m^2)		Grain yield (kg ha^{-1})	
		Kar	*Pishanam*	*Kar*	*Pishanam*	*Kar*	*Pishanam*
I_1	Irrigation on disappearance	10587	10475	460	578	5135	4988
I_2	Rotational Water Supply	10180	10005	419	550	4656	4544
I_3	Continuous submergence	10450	10412	443	570	5117	4976
	SEd	29.7	20.2	1.85	1.89	58.7	57.4
	CD (P=0.05)	82.5	56.0	5.13	5.26	163.0	159.4
S_1	Broadcasting of seeds	9842	9640	407	538	4255	4150
S_2	Drum seeding	10155	9913	424	552	4574	4394
S_3	Throwing of seedlings	10678	10663	448	581	5358	5238
S_4	Random transplanting	10516	10518	459	576	5164	5148
S_5	Line transplanting	10836	10752	465	583	5496	5251
	SEd	79.2	53.9	4.38	5.35	158.1	156.4
	CD (P=0.05)	163.5	111.2	9.03	11.04	326.3	322.7

*Interaction between the treatments was absent

372.2 mm were received during *Kar* and *Pishanam* seasons respectively. The crop received common irrigation to a depth of 2 cm upto 7 DAS/ DAT and beyond that treatments were imposed. Irrigation water was measured by using 'Parshall' flume of 7.5 cm throat width. The recommended management practices were followed uniformly for all the treatments studied.

Results and Discussion

Effect of treatment on weed flora (Table 1)

The weed flora in the experimental fields were ascertained in both seasons and presented in Table 1. The weed flora were grouped into grasses, sedges and broad leaved weeds. Among the grass weeds, *Echinochloa colona* was dominant followed by *Cynadon dactylon.* Among the sedges, *Cyperus iria* and *Cvperus rotundus* were the weeds. Under broad leaved weeds, *Ammania baccifera, Eclipta alba, Ludwigia parviflora, Marsilea quadrifoliata* and *Monochoria Vaginalis* were observed. Adoption of continuous submergence (I_3) registered lower weed density of 46.6 and 39.8 Number m^{-2} at 20 and 40 DAS / DAT in *Kar;* 45.07 and 29.00 Number m^{-2} in *Pishanam* in the same period. Similarly lower weed dry matter production was recorded by the same treatment due to reduced population caused by possible inhibition of germination of weed seeds under anaerobic conditions. Highest

Table 3. Economics (Rs ha^{-1})*

Treatments	Cost of cultivation		Gross income		Net income		B:C ratio	
	Kar	*Pishanam*	*Kar*	*Pishanam*	*Kar*	*Pishanam*	*Kar*	*Pishanam*
I_1 Irrigation on disappearance	14189	14564	33196	32336	19007	17772	2.34	2.22
I_2 Rotational Water Supply	14005	14424	30205	29514	16199	15090	2.15	2.04
I_3 Continuous submergence	14875	15189	33066	32205	18191	17016	2.20	2.11
S_1 Broadcasting of seeds	13394	13867	27660	27095	14266	13228	2.07	1.95
S_2 Drum seeding	13211	13684	29680	28566	16470	14882	2.22	2.09
S_3 Throwing of seedlings	14653	14956	34584	33877	19931	18921	2.36	2.26
S_4 Random transplanting	15121	15477	33391	33293	18270	17816	2.21	2.15
S_5 Line transplanting	15403	15645	35463	33927	20060	18282	2.30	2.17

Data not statistically analyzed

number of weeds m^{-2} and weed DMP were registered by rotational water supply (I_2), which provided better aeration and exposure of soil surface favorable for weed seed germination (Prusty *et al.* 1999).

The total weed density and DMP were higher under broadcasting followed by drum seeding in both seasons. The reason attributed might be due to weeds emerged simultaneously along with the emergence of the crop (Pathi, 1999) and also due to exposure of more land during the initial growth stage till the rice seedlings established to provide canopy cover (Moorthy and Dubey, 1979). Adoption of line transplanting recorded significantly lower weed DMP of 36.22 and 41.11 at 20 and 40 DAS / DAT in *Kar*, 34.76 and 26.67 kg ha^{-1} in *Pishanam* in the same period. Weed density was lower in transplanted rice as compared to line sowing and broadcasting of seeds because, first flush of weeds were incorporated in the soil during the field preparation for transplanting which resulted in less crop-weed competition. Because of higher weed density, the consumptive water use (984 and 972 mm) and rate of water use (10.8 and 9.7 mm day^{-1}) were higher in broadcasting of seeds and drum seeding in both season respectively. This might be due to weeds transpire more water for a gram of CO_2 compared to crop. Higher water use efficiency was recorded by line planting (6.0 and 5.7 kg ha^{-1}

mm^{1}) and throwing of seedlings (5.7 and 5.6 kg ha^{-1} mm^{1}) due to reduced weed population in *Kar* and *Pishanam* respectively.

Effect of treatments on growth and yield attributes and yield of rice (Table 2)

Irrigation practices had significantly influenced the DMP of rice in both seasons. Adoption of irrigation to 5 cm depth on disappearance of previously ponded water (I_1) produced maximum dry matter of 10587 and 10475 kg ha^{-1} in *Kar* and *Pishanam* seasons respectively. Maintenance of continuous standing water at active vegetative growth phase inhibited tillers, thus resulting in lower DMP and yield in continuous submergence (I_3) than I_1. Adoption of line transplanting produced higher DMP in both seasons. This might be due to maintenance of optimum plant population and uniform spacing favoured the growth and yield of crop (Esther Shekinah *et al.* 1999). And also restricted weed growth at the critical stages of crop -weed competition (vegetative stage) also benefited the crop rather than the weeds for utilizing resources (De Datta and Buresh, 1989; Dingkuhn *et al.* 1992). Interaction effect between the treatments was absent. Comparable values of DMP and yield attributes were produced by throwing of seedlings and random transplanting and this was due to well distribution of light, moisture and nutrients among the plants in an unit area. Higher tiller production and DMP under recommended irrigation practices (I_1) favoured greater production of panicle m^{-2} and filled grains panicle^{-1}. The reasons attributed were enhanced nutrient availability under higher irrigation regimes and this promoted the supply of assimilates to 'sink'. Among the methods of planting / sowing, line planting recorded the highest number of panicles m^{-2}. Dinesh Chandra (1983) reported that more solar radiation influenced the 'N' absorption by crop resulting in manifestation of favourable yield components. Irrigation to 5 cm depth on disappearance of previously ponded water (I_1) throughout the growing season registered higher grain yield of 5135 and 4988 kg ha^{-1} in *Kar* and *Pishanam* seasons respectively which was comparable with continuous submergence for the two seasons of study. Line transplanting recorded higher grain yield, which was comparable with throwing of seedlings and random transplanting in both seasons. Rice grain and straw yields are the cumulative out-come of all growth and yield attributes. All these parameters were higher under above treatments; hence, the yields were higher.

Economics(Table 3)

Higher net income was realized with irrigation to 5 cm depth on disappearance of previously ponded water (I_1) in *Kar* and *Pishanam* seasons which was 4.5 and 4.4 per cent higher over continuous submergence. Lower cost of cultivation was the reason for higher net income and B : C ratios in the scientific method of water management. Higher net income was realized with line transplanting and throwing of seedlings in *Kar* and *Pishanam* seasons respectively which was 9.13 and 13.53 per cent higher over broadcasting of seeds.

Irrigation to 5 cm depth on disappearance of previously ponded water with throwing of seedlings recorded higher B : C ratio. Eventhough lower out put was obtained in throwing of seedlings compared to line transplanting, the net return and B : C ratio were higher due to reduced cost of cultivation

It can be concluded that adoption of irrigation to 5 cm depth on disappearance of previously ponded water with throwing of seedlings could be the viable and low cost technology for getting maximum grain yield and net return in lowland rice.