Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 2199-2201
Received: 08-03-2019
Accepted: 09-04-2019

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Effect of irrigation practices on weeds and its impact on yield in different rice establishing methods

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Abstract
The field experiment was conducted to "study the different irrigation practices on weeds in different rice ecosystems at Annamalai University Experimental Farm, Annamalai Nagar during Navarai season of 2016. Nine treatments combinations were studied in RBD with three replications. The treatments comprised of direct dry seeded rice, direct wet seeded rice and manual transplanted rice with flooding throughout the crop growth, saturation up to panicle initiation, and alternate wetting and drying. All treatments significantly influenced the weed biometrics, and yield of rice. The lowest weed population (22.99), weed dry weight of (114.89 g), highest weed control index of 67.05 and grain yield of 5590 kg ha^{-1} were obtained with manual transplanting with flooding throughout the crop growth. The highest weed population, weed dry weight, lowest weed control index and lowest grain yield were recorded with direct dry seeded rice with alternate wetting and drying.

Keywords: Rice, irrigation, weeds

Introduction
Rice is the most important food crop, accounting for about 29 per cent of the total calorie intake of the people in the developing countries. Rice is cultivated in 114 countries of the world over an area of 153.9 (m.ha). According to Department of Agriculture and Co-operative (DAC) the world rice production is 478(m.t) in 2014-2015. In India, rice is the staple food for millions of people and plays a vital role in the economy.

Rice is being grown in an area of 1.93 m.ha with an annual production of 6.61 m.t in Tamil Nadu. The average rice productivity in India and Tamil Nadu were 2.12 and 3.07 t. ha^{-1} as against 6.1 and 3.7 t ha. for china and the world, respectively (Anonymous, 2011). The reasons for low rice yield in India and particularly in Tamil Nadu are many and diverse in nature. The methods of growing rice, heavy infestation of weeds, inefficient utilization of applied nitrogen, ill effects of cloudy weather on the photosynthetic activity of rice plant in monsoon season and adverse soil condition such as salinity and alkalinity are some of the factors that seriously impede the overall production of rice in our country.

DDSR is a faster and easier sowing methodology; reduce the labour, earlier crop maturity by 7-10 days and higher tolerance of water deficit (Balasubramanian and Hill 2002) [2]. A major impediment in the successful cultivation of direct- seeded rice (DSR) in tropical countries is heavy infestation of weeds which often range from 50-91 per cent (Paradkar *et al.*, 1997) [6]. However weeds are the main biological constraints to the production of DSR (Rao *et al.*, 2007) [8], which may causes 60-80 per cent reduction in grain yield of rice.

Rice seedlings under WDSR suffer greatly from weed competition as compared to transplanted rice because of similarity of age and morphological characters of grass weeds and rice seedlings (Singh *et al.*, 2006) [9].

Among the different methods of crop establishment of rice in our country, transplanting has been the major method of establishment in-spite of the fact that it requires more labour about 250-300 man hrs ha^{-1} which is roughly 25 per cent of total requirement of the crop. The common problems associated with the rice transplantation by hired labour are lower plant population per unit area, improper fixation of nursery plants in the soil, a higher per cent of missing plants and uneven transplantation in paddy fields, i.e., dense and thin planted patches in the field (Umar Farooq *et al.*, 2001) [11]. Further, due to rapid industrialization and migration to urban areas, the availability of labour become very scarce and hike in the wages of labour, manual transplanting found costly leading to reduce the profits to farmers.

Yield reduction in transplanted rice to weed has been reported to be 28-45 per cent. Water is a scare, precious and costly input in agriculture.

Water management is an important management practice of the rice production system. In India, 60 per cent of the total available water is utilized for rice cultivation and it is still higher in Tamil Nadu (86 per cent). Efficient management of water is an utmost important factor for sustaining and increasing rice yield. Rice production can be more economical and profitable if the application and field losses of water are minimized. Irrigation management is one of the important factors that determine the productivity of rice.

Materials and Method

The field experiment was conducted to study irrigation practices on weeds in different rice ecosystems at Annamalai University Experimental Farm, Annmalai Nager, during Navarai season of 2016. Nine treatment combinations were studied in RBD with three replications. The rice variety chosen for the experimental was ADT 43 with a spacing of 15×10cm. Statistical analysis was carried out as per the procedure suggested by Panse and Sukhatme (1978) [10].

Flooding the plots throughout the crop growth were irrigated to maintain an uniform standing water column of 5 cm throughout the crop duration, saturation upto panicle initiation plots were maintained with 5 cm water column upto panicle initiation stage, alternate wetting and drying plots were irrigated to maintained 5 cm alternately. Irrigation was with held and water from the field was drained for 10 days before harvesting in all the treatments.

Result

Among the different treatments with different irrigation practices in different planting techniques compared, the lowest weed population of 22.99 was recorded on 60 DAT/DAS in the treatment T_7-Manual transplanting with flooding throughout the crop growth. The highest weed population of 61.57 was recorded in the treatment T_3- Direct dry seeded rice with alternate wetting and drying.

The treatment manual transplanting with flooding throughout the crop growth was effective in reducing the weed dry matter production among the various treatments tested. The above treatment (T_7) recorded lowest weed dry matter production of 114.89 kg ha^{-1} at 60 DAS/DAT. The next best treatment was T_8- Manual transplanting with saturation upto panicle initiation. The highest weed dry matter of 348.71(T_3) was recorded in the treatment direct dry seeded rice with alternate wetting and drying.

Among the various treatments compared the treatment (T_7) manual transplanting with flooding throughout the crop growth recorded the highest grain yield of 5590 kg ha^{-1}. The next best treatment was manual transplanting with saturation upto panicle initiation (5371 kg ha^{-1}) and it was on par with the treatment direct wet seeded rice with flooding throughout the crop growth (5226 kg ha^{-1}). The lowest grain yield of 3970 kg ha^{-1} was recorded in the treatment direct dry seeded rice with alternate wetting and drying.

Among the various treatments, the treatment Manual transplanting with flooding throughout the crop growth which reduced the highest weed control index of 67.05 at 60 DAS/DAT. The next best treatment was manual transplanting with saturation upto panicle initiation of 65.27 at 60 DAS/DAT which was on par with treatment T_4- Direct wet seeded rice with flooding throughout the crop growth recorded (56.56) at 60 DAT/DAS.

Discussion

Manual transplanting with flooding throughout the crop growth (T_7) performed well by registering lowest individual weed count, total weed count, total weed dry weight and highest weed control index. This might be due to the fact that three weeks old seedlings of 15-30 cm height are generally used during the time of transplanting. This takes the competitive advantages and provides lesser space, light, nutrient and moisture for the weeds that have just emerged. In addition to that, application of continuous submergence of irrigation water restricted emergence of all types of weed flora *viz.*, grasses, sedges and broad-leaved weeds due to inhibition of weed seeds germination under anaerobic conditions lead to record lowest total weed population and there by total dry weight and highest weed control index.

The integration of transplanting the rice seedlings with better irrigation practice of continuous submergence achieved a programmed and prolonged depletion of weed seed bank, reserves of propagules of weeds in soil and there by total weed population and it's dry matter production (Murugan, 2012) [4]. Wherein, the exposure of soil surface provides better aeration that favour weed seeds to germinate in case of application of alternate wetting and drying (Patel, 2000) [7].

Manual transplanting the rice seedling along with application of flooding recorded highest yield attributes and yield of rice (Murugan *et al.* 2019) [5]. This may be due to efficient weed control throughout the critical period of competition and sustained nutrient availability leads to better uptake of NPK by the crop might have contributed to synchronous tillering and spikelet formation leading to higher number of panicles m^{-2} and higher post flowering photosynthesis and assimilating partitioning to the sink, ultimately contributing to production of higher number of filled grains panicle^{-1}. It is logic to postulate that the increased yield attributes had a favourable effect on source and sink capacity resulting in increased grain and straw yields. Hence, the yield level of grain and straw fell in line with treatments that performed well in the earlier days.

Table 1: Effect of irrigation practices on total weed population, weed dry matter and weed control index in different rice ecosystem

Treatments	Total weed population on 60 DAS/DAT	Weed dry weight on 60 DAS/DAT	Weed control index on 60 DAS/DAT
T-1 Direct dry seeded rice with flooding throughout the crop growth.	(49.3) 7.05	262.84	(24.62) 3.42
T-2 Direct dry seeded rice with saturation upto panicle initiation.	(50.11) 7.11	294.38	(15.58) 3.11
T-3 Direct dry seeded rice with alternate wetting and drying.	(61.57) 7.87	348.71	-
T-4 Direct wet seeded rice with flooding throughout crop growth.	(30.71) 5.58	151.47	(56.56) 6.41
T-5 Direct wet seeded rice with saturation upto panicle initiation.	(40.2) 6.37	198.56	(43.05) 5.12
T-6 Direct wet seeded rice with alternate wetting and drying.	(40.97) 6.43	224.32	(35.67) 4.83
T-7 Manual transplanting with flooding throughout the crop growth.	(22.99) 4.84	114.89	(67.05) 8.29
T-8 Manual transplanting with saturation upto panicle initiation.	(30.02) 5.52	121.08	(65.27) 6.92
T-9 Manual transplanting with saturation upto panicle initiation.	(31.47) 5.61	174.38	49.99 (5.84)
S.Ed	0.06	3.17	0.66
CD(P=0.05)	0.13	6.34	1.33

Table 2: Effect of irrigation practices on the grain yield of rice

Treatments	Grain yield
T-1 Direct dry seeded rice with flooding throughout the crop growth.	4398
T-2 Direct dry seeded rice with saturation upto panicle initiation.	4257
T-3 Direct dry seeded rice with alternate wetting and drying.	3970
T-4 Direct wet seeded rice with flooding throughout crop growth.	5226
T-5 Direct wet seeded rice with saturation upto panicle initiation.	4835
T-6 Direct wet seeded rice with alternate wetting and drying.	4694
T-7 Manual transplanting with flooding throughout the crop growth.	5590
T-8 Manual transplanting with saturation upto panicle initiation.	5371
T-9 Manual transplanting with saturation upto panicle initiation.	5089
S.Ed	92.5
CD(P=0.05)	185

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