The Potential of SRI in the Temperate Climatic Environment in Japan

温帯気候の日本における SRI 農法の可能性

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System of Rice Intensification (SRI) involves the use of certain management practices which together provide better growing conditions for rice plants, particularly in the root zone, than those for plants grown under traditional practices. It is a set of ideas and insights that primarily give major emphasis on the use of younger seedling (< 15 days) singly at wider spacing along with the adoption of intermittent irrigation and organic fertilization (Stoop et al., 2002).

Rice has ever since been the staple food for people in Japan, and it has been the mainstay of Japanese agriculture. Rice is today Japan's staple food that covers 1.67 million hectares with an average productivity 6.54 t/h (IRRI, 2007). Despite the marvelous achievements in rice production over past 100 years, production costs associated with conventional rice farming in Japan are still many times higher than in other tropical Asian countries because of exorbitant land prices and the high opportunity cost of farm labor. Increasing production cost in addition to the scarcity of and competition for natural resources and growing awareness on eco-product has also underscored the scope of using SRI in Japan.

Actually, many of the SRI elements have been tried by Japanese farmers and rice scientists for their effectiveness over the past 50 years. These practices, although, covers important areas of rice crop management however, lack a combined study using different SRI components to assess SRI as a system. Moreover, on-the-field demonstrations in many tropical and sub tropical countries have well revealed the significance of SRI with respect to grain yield and water savings. However, limited attempts are underway to observe the efficiency and productivity of SRI elements in temperate climatic environment.

Hence this experiment was conducted in Chiba, Japan during May to September 2008, using three major components of SRI in split plot design in order to observe the effects of irrigation methods, age of seedling and spacing on crop growth, performance and resource savings. Alternate wet and dry irrigation (AWDI) and continuous flooding were two main plot factors in the experimentation whereas age of seedlings (14 and 21 days old) and spacing (30x30 and 30x18 cm^2) were sub and sub-sub plot factors, respectively. Prime focus was also given not to apply chemicals as a source of fertilizers and plant protection measures to help maintain organic environment.

Overall, water management practices exhibited mixed response over vegetative and reproductive characteristics. Except for the root length, filled grain percentage (FGP), and test weight (1000 grain weight), no significant effects of intermittent irrigation was seen in crop measurements. Instead other parameters observed comparatively better in the continuously flooded plots. However, use of baby seedlings (14 days old) and wider spacing (30x30 cm^2) demonstrated positive effects on crop growth and performance.

Table 1 presents the key vegetative and yield related components measured during experimentation. Although SRI produced fairly more yield (7.41 t/h) as compare to non-SRI (7.37 t/h), however, rice yields were fairly higher in the flooded plots with similar treatment combination. It clearly indicated that the plots with intermittent irrigation took 2-3 days more to begin flowering than in the similar treatment combinations in flooded plot. However, time to maturity was shortened by 3-5 days in intermittent plots, thus supported synchronized flowering and grain maturity. The clear difference was also observed in the plant lodging percentage during maturity/harvesting. On an average, it was 6.67% in SRI in contrary to 93.33% in non-SRI plots.

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Table 1: Mean values as affected by treatments during rice growing season in Chiba, 2008

Irrigation method	Seedling age	Spacing (cm^2)	Plant height (cm)	Root length (cm)	DTF	DTM	Panicles per hill	Panicle length (cm)	Number of filled grains	Test weight (g)	FGP (%)	Grain yield (t/h)	PLP (%)
Intermittent irrigation (AWDI)	14	30x30	122.56	19.33	75	118	23.33	19.76	118.31	23.78	92.31	7.41	6.67
		30x18	119.88	17.27	74.67	118.67	15.43	17.54	111.07	23.04	94.87	7.3	46.67
	21	30x30	119	19.83	72.67	117.67	30.66	18.7	93.53	22.88	90.78	7.29	46.67
		30x18	118.23	18.6	74.33	117	19.22	17.04	84.4	22.74	94.41	6.83	26.67
Ordinary irrigation (Continuous flooding)	14	30x30	129.12	18.83	73.33	122	24.27	20.9	132.32	22.59	92.97	8.06	50
		30x18	125.94	16.9	72	121	18.27	18.91	108.79	21.14	87.3	7.79	80
	21	30x30	124.55	18.48	72	120.67	33.5	18.42	93.79	22.81	90.65	7.95	96.67
		30x18	120.83	18.1	72.67	121	20.08	16.9	86.93	22.77	90.93	7.37	93.33

Note: DTF: Days to flowering; DTM: Days to maturity; FGP: Filled grain percentage; PLP: Plant lodging percentage

The study also revealed the scope of minimizing the incidence of insect-pests and diseases with intermittent irrigation. Pest damage observed more in continuously flooded plot planted with normal seedlings. There were no pests observed in intermittent plot with baby seedlings. Whereas, disease problem observed more in continuously flooded plot planted with baby seedling. Rice leaf folder (*Cnaphalocrosis medinalis)* was a major pest observed during 30-40 days after transplanting whereas seedling blight disease caused by pathogenic fungi (*Fusarium spp.)* observed more in flooded plots.

It is worth noting that there was no extra time requirement for weeding operation in AWDI plot. It might be the combined effects of standing water on the field for a fortnight after transplanting, and single application of herbicide 10 days after transplanting. However, arrowhead (*Sagittaria spp.*) was commonly observed in both of the plots followed by some other narrow leaved weeds. Their population was intense after 40 days of transplanting, however, largely in the plot borders. As the plant had already reached to its peak tillering stage and crop canopies completely shaded the land, there was no visible effect of weeds observed in plant growth and development. With no additional time requirement for weeding, it is estimated that SRI method of management saved 25 to 55% time than non SRI.

SRI with proposed irrigation schedule also saved 28.77% water as compare to the amount of total water required in continuously flooded plot. Rice plant required more amount of water during mid to late vegetative growth stage which increased gradually until flowering stage. An average daily water loss in flooded plot was recorded as 0.96 cm during the cropping season whereas it was 0.93 cm in intermittent plots. The soil surface was observed to crack after 3 continuous days of no surface water. In addition, a remarkable response of water to grain yield was observed by using AWDI. Water productivity was maximum (1.74 g/litre) in SRI plot in contrary to the lowest value (1.23 g/litre) in non-SRI plot.

Hence, it clearly revealed the scope of water levels, age of seedlings and spacing on crop growth, performance and water savings. On top of this, SRI management showed significant effect on crop quality, environment and water-wise rice production. However, some better measurements in continuously flooded plot underscores a need of further investigations in defining an optimum wetting and drying intervals considering local soil properties, prevailing climate, and critical watering stage in rice crop.

References

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