Journal of Agrometeorology 7 (1) : 95-100 (June 2005)

Resource capture mechanisms– An aid to promote nursery growth in paddy for higher yields in winter*

V.RADHAKRISHNA MURTHY, SHAIK MOHAMMAD, P.V.V.PRASAD and V.SATYANARAYANA

Department of Agronomy, College of Agriculture, Rajendranagar, Hyderabad

ABSTRACT

"Resource capture – storage – utilization mechanisms" were studied at Rajendranagar, Hyderabad through artificial modifications for 7 years to overcome the ill effects of cold injury in nurseries and low seed yield of rice grown in winter season. Temperature increase of 2 - 3 ^{0} C was recorded by impregnating the soil surface with coal dust @ 0.25 kg m^{-2} , and spreading stones to cover 25% nursery area. This enabled the rice seedlings to grow tall to a height of 20.3 to 21.0 cm as compared to 15 cm in the control. The harnessing of natural resources were more beneficially evident by allowing smoke to settle, irrigating the nursery with fresh water every day in the evening and sparse broadcast of sprout rice seed in the nursery in addition to the aforesaid artificial methods. This strategy further increased the ambient air temperature up to 3.4 ^{0} C in the night. This technology promoted the rice seedlings to attain the tall height of 30.3 to 31.7 cm and when transplanted produced higher seed yield of 3005 to 3183 kg ha $^{-1}$ and increased the mean production from 2032 to 3119 kg ha^{-1}. The stability parameters confirmed that the artificial management of rice nursery has a stable influence on growth of rice seedlings and its production, as the **Bi** values were significantly more than unity.

Key words : Nursery, rice growth, rice yield, temperature

The paradigm "resource capture – storage – utilization mechanisms" is one of the practices for enhancing crop growth, development and production. This has a critical impact on rice culture in the winter season (Venkateswarlu, 1977 and Tang and Zhang, 1993). Rice nurseries are often subjected to cold injury, especially by the low night temperatures leading to stunted vegetative growth and poor root development with low vigour (Venkateswarlu and Srinivasan, 1978, Shah *et al.* 2000, and Yoshida 1973). SKUAST report (1992) emphasized the need for artificial methods to conserve

* Paper presented in the national seminar on " Agrometerological Research for sustainable agricultural production" held at GAU, Anand during 27-28 Sept. 2001

more radiant energy and temperature of water as well as the ambient temperature of crop canopy to circumvent the poor growth of rice seedlings in the nursery. This improvement could serve as a milestone to increase the rice seed yield. This background hypothesis was the base to attempt artificial mechanisms through the capture of natural resources in promoting the nursery seedling growth and production of rice in the winter season.

MATERIALS AND METHODS

The test site was Students Farm of the Agricultural College, Rajendranagar, Hyderabad and the plot size was 10 m^2, with three treatments replicated thrice. The textural classification of soil was alfisol. The treatments were

T_1– Farmers method of broadcasting the sprouted seed after 3 days of soaking in water.

T_2 – Sprinkling of coal dust @ 0.25 kg m^{-2} before seed broadcast; and spreading stones within the plot surrounded by raised bunds of 0.5 m. height and then broadcasting the sprout seed.

T_3 – Nurseries raised as in T_2 with additional mechanisms of allowing the smoke (on alternate days) to settle down on soil and crop surface, changing of water in the evening everyday and sparse broadcasting of the sprout seed.

For practical relevance of treatment management the plots were isolated at reasonable distances. The experiment was conducted with rice cultivar Tellahamsa.. Treatments were imposed in the 3rd week of November each year from 1990 through 1997 barring 1995. The seedlings were allowed to grow for 35 days and growth differences were measured in terms of plant height at this stage. They were then transplanted to evaluate their production trends by following the normal crop husbandry.

Thermohygrograph and screen temperatures were recorded each day during the nursery period. Ambient temperatures were monitored using highly sensitive temperature sensors attached to data logger at the crop canopy height, in each treatment on all the 35 days, in each season. The plant height and yield were subjected to statistical analysis following Panse and Sukhatme (1978) and Eberhart and Russel (1966).

RESULTS AND DISCUSSION

The mean maximum temperature ranged from 28.7 to 30.4 ^{o} C during 35 days of rice nursery in seven years (data not furnished). The night ambient air

Table 1 : Night mean ambient air temperatures (mean ± SD)as modified by the treatmental effects in different years (^{o} C).

Treatment	1990	1991	1992	1993	1994	1996	1997
Screen	13.1 ± 1.25	13.4 ± 1.3	14.0 ± 1.3	14.2 ± 1.3	14.2 ± 1.3	14.8 ± 1.3	13.2 ± 1.3
T1	13.2 ± 1.16	13.9 ± 1.2	14.1 ± 1.3	13.2 ± 1.2	13.9 ± 1.4	13.9 ± 1.3	13.4 ± 1.2
T2	15.2 ± 1.24	15.3 ± 1.3	15.6 ± 1.3	16.1 ± 1.4	16.5 ± 1.5	16.2 ± 1.4	15.9 ± 1.3
T3	17.3 ± 1.23	17.3 ± 1.3	17.4 ± 1.4	17.0 ± 1.3	17.0 ± 1.4	17.0 ± 1.3	17.8 ± 1.3

Table 2 : Mean plant height (cm) and Eberhart and Russels stability parametersof rice seedlings at 35 DAS in response to modified management strategies.

Treatments	1990	1991	1992	1993	1994	1996	1997	Mean	bi	Sdi^2
T_1	14.9	15.3	15.3	14.9	14.8	15.3	15.2	15	-0.003	-0.1641*
T_2	20.3	20.7	20.3	20.7	21.0	21.0	20.8	20	1.1559	-0/0894
T_3	31.0	31.0	30.3	30.3	31.7	30.3	30.3	30	1.8432**	-0.0892

Table 3 : Pooled analysis of variance on plant height of rice as influenced by modified management strategies

Source	df	Sum of Squares	Mean squares
Rep. within env.	14	2.1	0.15
Treatments	2	863.2	432.0**
Env. + (Trt. * Env.)	18	2.3	0.13
Environments	6	1.0	0.17**
Treatments * Env.	12	1.3	0.11*
Environments (Lin.)	1	1.0	1.02
Trt * Env. (Lin)	2	0.6	0.29
Pooled Deviation	15	0.7	0.05
Pooled Error	28	4.8	0.17
Total	20	865.5	43.28

temperatures were remarkably modified by the artificial mechanisms (Table 1). It ranged between 13.1± 1.3 to 17.8 ± 1.3in different years. The standard deviations were similar for night time ambient air and screen temperatures in all the 7 years.

The enhanced canopy air temperature in T_2 by a mean of about 2

^{0}C over T_1 i.e., farmers method is of consequence in promoting the growth of rice seedlings. The radiant energy reflection during day time owing to raised bunds could probably be the vital factor in contributing a large amount of energy to the seedlings both through the soil and air. The increase in temperature due to coal dust and stones were the additional beneficial factors. This strategy of resource capture, and its induction in increasing the ambient air temperature enabled the rice seedlings to be vigorous and tall (Table 2). The plant height of rice seedlings ranged from 20.3 to 21.0 cm. In different years. Conversely, the nurseries raised in traditional practice(T_1) had a low growth of 14.9 to 15.3 cm.

On an average the mean increase in night ambient air temperature was by 3.4 ^{0}C by this artificial modification(T_3) as compared to the traditional method of raising rice nurseries(T_1). Reflecting beneficial effects, the mean plant height increase in T_3 was (Table 2) almost two fold (15 to 30 cms.) through artificial modifications of natural resources. Rang and Zhang (1993) and SKUAST (1992) also emphasized that water temperature is much more significant than air temperature for early growth and development of low land rice, since the growing point of the plants are under water. Shah *et al*. (2000) confirming the present results inferred that the vegetative phase of rice was regulated by minimum temperatures prevailing during the night.

Well developed and vigorous rice seedlings have an active photosynthetic apparatus for better utilization of assimilates translocated to the sink. The crop raised from seedlings grown in winter season with the traditional practice produced 2013 to 2053 kg ha^{-1} (range for seven years) with a mean of 2032 kg ha^{-1}. Modifications of environmental resource (T_2) of nursery not only produced robust seedlings but also enabled them to produce 2512 to 2570 kg ha^{-1} in different years with a mean production of 2545 kg ha^{-1}. Thus, these modifications enhanced the mean production by 5 quintals ha^{-1}. Further modifications by replacing the cold stagnated water (T_3) in the rice nurseries produced a maximum of 3005 to 3183 kg yield ha^{-1} in different years with a mean of 3119 kg ha^{-1}. The results confirmed that significant increase in rice could be attained by capturing the resources and storing them within the canopy for increased ambient canopy temperature through modified nursery management (Table 5).

The pooled analysis of variance established that the treatments had a highly significant effect on plant height

Table 4 : Mean yield of rice and Eberhart and Russels stability parameter in response to modified management strategies.

Treatments	1990	1991	1992	1993	1994	1996	1997	Mean	bi	Sdi^2
T_1	2025	2022	2013	2040	202	2053	2048	2032	0.353**	-83.8*
T_2	2547	2512	2570	2527	2542	2537	2557	2545	0.148**	-49.3
T_3	3005	3117	3140	3132	3107	3150	3183	3119	2.506*	-149.5

Table 5 : Pooled analysis of variance on yield of rice as influenced by modified management strategies

Source	df	Sum of Squares	Mean squares
Rep. Within Env.	14	5260	376
Treatments	2	4135396	2067698
Env. + (Trt. * Env.)	18	21358	1187
Environments	6	8732	1455
Treatments * Env.	12	12626	1052
Environments (Lin.)	1	8732	8732
Trt * Env. (Lin)	2	9927	4963
Pooled Deviation	15	2700	180
Pooled Error	28	6257	223
Total	20	4156752	207838

and seed yields. Although the year to year differences in the performance of rice seedlings varied significantly, its environment (Lin.) component was not significant. The stability parameters established that the management of rice seedlings by treatments T_2 and T_3 was the most promising technology. The mean maximum plant height and seed yield, their regressions were significantly different from unity, while the deviations from regressions were not significantly different from zero. The modifications in treatment 2 indicated the increased plant height of nursery and seed yield of crop to be stable in different years, while this treatment ranked next to T_3 both in plant height and mean seed yield.

REFERENCES

Eberhart, S.A. and Russell, W.A. 1966. Stability parameters for comparing variables. *Crop Sci.*, 6 : 36-40

Panse, V.G., Sukhatme, P.V.1978. Statistical methods for agricultural workers, ICAR Publication, New Delhi.

Shah M H, Amarjit S-Bali, Bali-A.-S and Singh K. N. 2000. Studies on sowing dates and systems of rice nursery raising to combat cold injury in temperate Kashmir. *Oryza,* 37(1) : 96-99.

SKUAST 1992. Protected paddy nursery. Sher E Kashmir University of Agricultural Sciences and Technology, News Bulletin 4(3) : 1-2.

Tang, G H and Zhang S D 1993. The effect of bioenergetic green house on the growth and development of rice. *Transaction Chinese Soc. Agric. Engg.,* 9(3) : 85-89.

Venkateswarlu B 1977. Influence of low light intensity on growth and productivity of rice [*Oryza sativa* (L.)]. *Plant Soil,* 46 : 713-719.

Venkateswarlu B , Srinivasan T.E. 1978. Influence of low light intensity on growth and productivity in relation to population pressure and varietal reaction in irrigated rice [*Oryza sativa* (L.)].. Indian]. *Plant Physiol* . 21(2) : 162-170.

Yoshida S, 1973. Effects of temperature on growth of the rice plant [*Oryza sativa* (L.)]. in a controlled environment. *Soil Sci. Plant Nu.,* 19 : 299-310.