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Yield Attributes of Conventional Rice Ratoonings and Lock Lodged Ratooning Under Varying Nitrogen Levels

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Abstract: Increased levels of nitrogen fertilizer showed positive response to PSBRc8 rice variety in Locklodged ratoon (LLR) by increasing tillers, productive, panicle and seed length, and 1000 grain weight. However, in conventional ratooning (CR) nitrogen fertilizer poorly contributed to number of filled spikelets, total tillers, productive tillers. The grain yield was maximum at the fertilizer level of 60 kg^{-ha} applied to LLR. The shortest panicles were recorded in unfertilized plots.

Key Words: Rice- Ratooning – Locklodging- Yield-Growth

Introduction

Rice ratooning offers an opportunity to increase cropping intensity per unit of cultivated area because, a ratoon crop has a shorter growth duration than main crop Samson, (1980); Saran and Prasad, (1952). In addition, ratoon crop may be grown with 50-60% less labour, neither land preparation nor planting is needed and the crop uses 60% less water than the main crop Elias, (1969); Zhang Jing-guo, (1991). Ratoon yield was recorded as high as 4 t^{-ha} Tripathi and Pandya, (1988); Zhang Jin- guo, (1991); and is achievable by 50% of the main crop Srinivasan, (1988). It is suggested that under most conditions, a ratoon is more cost-effective than double cropping at both micro and macro level. Zhang Hongsong and Gou Xiaohong (1990) estimated that rice production from 2.0 million hectares of rice fields could increase as much as 4.5 million tons, if ratoon rice fields are conservative at 2.2 t^{-ha}. Considering all these aspects, this research was an attempt to assess the yield attribution of rice ratoon under different levels of nitrogen fertilizer and ratooning methods.

Materials and Methods

Field experiment was conducted under irrigated lowland conditions during wet season (WS) at the Philippine Rice Research Institute(PhilRice) located at Maligaya, Munoz, Nueva Ecija, Philippines. PSBRc8 rice variety, the potential ratooner with high ratoon rating and vigor was taken for growth and yield under three ratooning methods and five nitrogen levels. These factors were laid down in Randomized Complete Plot Design and replicated three times. Among ratonning methods the stubbles of main crop in conventional ratooning methods CR (1-2 cm) and CR (10 cm) were cut at 1-2 cm and 10 cm above surface level respectively, whereas, lock lodged ratoon (LLR) received 30-35 cm. These all ratooning methods were tested under varying levels of nitrogen fertilizer ie. 0N^{-ha}, 30 kgN^{-ha}, 60 kg N^{-ha}, 90 kg N^{-ha}, and 120 kg N^{-ha}.

Making Locklodging:The stubbles were braided in pair by bending the straw from each hill forwarded either to the left or right. They were pressed flat to the ground surface. The straw from each pair of adjustment formed an X, as viewed directly from above. The lock lodging process was pursued across the field, permanently locking the straw of each hill into a prone position Calendacion *et al.*, (1991)

The main crop was harvested 30 days after heading and more specifically at the start of yellowing of culm, Saran and Parasad, (1952); Parago, (1963b).

Basal fertilizer for the main crop 30-30-30 kg NPK^{-ha} were applied at final harrowing, the remaining 30 kgN^{-ha} was top dressed in two splits at tillering and at panicle initiation stage. In ratoon crop, N fertilizer was applied in two equal splits, one at harvest of main crop as basal N and the other at 20 days after harvest of main crop. The fertilizer doses used in the ratoon crop are integrated in the treatment combinations.

The flooded condition (4-5 cm) was maintained for 10 cm cutting height of straw. In case of lock lodged ratooning and 1-2 cm cutting height of straw, a water depth of one cm or soil saturation condition was maintained in each plot up to maximum tillering of the ratoon crop. After maximum tillering, flooded condition was maintained in all plots of the experiment.

Results and Discussion

Tiller number at harvest:Tiller number was highly significant in terms of nitrogen levels, ratooning methods and their interaction with each other (Table 3). Maximum tillers were recorded in LLR under different nitrogen levels. Ratooning methods did not show any rapid response for tillering beyond 60 kg N^{-ha}. Nitrogen improved tillering capacity since tiller number gradually increased by increasing nitrogen levels (Table 1). The results fully confirmed the findings of Palchamy *et al.* (1988). The results also revealed that higher cutting height of stubbles i.e. LLR and CR (10 cm) had maximum number of tillers. As reported by Ichii and Sumi (1983), may be that ratoon tiller development depended on the amount of carbohydrate remaining in the stubble and roots after main crop harvest. Further more the report of Calendacion *et al.* (1991) on LLR showed that the act of flattening of straw stimulated the basal nodes placed higher on culm. The concentration of tiller production at the culm base seemed to be related to superior synchrony observed in tillering and ripening. It is possible that since the practice does not remove much of the upper culm, the carbohydrate reservoir remains larger than when the culm is cut low. The flattening process may affect plant hormone production and translocation in the positive way. On the other hand,

Table 1: Summary table of grain yield and yield components as affected by interaction of ratooning methods and nitrogen levels

Treatment	Grain yield t/ha	Tillers/ Hill	Productive tiller/hill Cm	Panicle Length	Filled spikelets/ panicle	Seed size mm
Conventional Ratooning (1-2 cm)						
0 kg N/ha	0.98d	12.00b	10.00a	15.10b	31.30d	8.45b
30 kg N/ha	1.20c	13.00b	9.67a	15.80b	31.58d	8.53b
60 kg N/ha	1.58a	13.32b	11.00a	18.63a	22.80c	9.25a
90 kg N/ha	1.45b	17.00a	11.33a	18.63a	33.33b	9.32a
120 kg N/ha	1.41b	18.00a	10.67a	19.10a	34.16a	9.39a
Mean	1.32	14.67	10.53	17.45	32.63	8.99
Conventional Ratooning (10 cm)						
0 kg N/ha	1.83c	12.33b	9.56d	14.28b	29.37b	8.30b
30 kg N/ha	1.41b	14.67b	11.93c	14.50b	29.73b	8.43b
60 kg N/ha	1.81a	21.00a	18.01a	17.47a	31.80a	9.23a
90 kg N/ha	1.76a	21.00a	16.96b	17.43a	31.93a	9.37a
120 kg N/ha	1.68a	21.00a	10.67a	18.10a	32.10a	9.47a
Mean	1.57	18.00	10.53	16.35	30.98	8.96
Locklodged Ratooning						
0 kg N/ha	1.17c	14.67c	13.94d	14.23c	29.70c	8.30b
30 kg N/ha	1.82b	19.00b	16.36c	16.33b	31.30b	8.50bc
60 kg N/ha	2.31a	23.33a	20.32a	18.48a	33.67a	8.56b
90 kg N/ha	3.29a	24.00a	19.38b	19.30a	33.63a	9.16a
120 kg N/ha	3.30a	24.00a	19.41b	19.10a	33.90a	9.30a
Mean	2.58	21.00	17.88	17.29	32.44	8.76
S.E.D	0.066	1.143	1.175	0.457	0.199	0.110
LSD(5%)	0.135	2.342	2.406	0.936	0.407	0.225
LSD(1%)	0.192	3.153	3.246	1.263	0.549	0.303

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT
Comparision 2-N*M means

Table 2: Correlation coefficient values of crop characters studied for three rice ratooning methods over five nitrogen levels

	Grain Yield	1000 Grain wt.	Seed Length	Panicle Length	Number of panicles	Tillers at Harvest
Grain Yield	1.00					
1000 Grain wt	0.88**	1.00				
Seed Length	0.65**	0.88**	1.00			
Panicle Length	0.69**	0.84**	0.86**	1.00		
Number of Panicles	0.84**	0.58**	0.33*	0.44**	1.00	
Tillers at Harvest.	0.89**	0.71**	0.49**	0.55**	0.96**	1.00

*= Positive correlation

Table 3: Analysis of variance for yield and yield components of three ratooning methods and five nitrogen levels

S. V	D.F.	Mean Square Grain	Mean Square tillers	Mean Square productive	Mean Square panicle	Mean Square filled	MS Seed size
Replications	2	0.00520^{ns}	2.2222^{ns}	1.6889^{ns}	0.1396^{ns}	0.0987^{ns}	1.49674^{ns}
Treatment	14	1.94632**	57.0794**	49.6603**	9.9574**	7.4456**	0.63591**
Nitrogen(N)	4	2.27465**	109.1667**	55.1444**	31.4824**	18.5463**	1.95495**
Methods(M)	2	6.66817**	150.5556**	201.6889**	5.2722**	12.1527**	0.22094**
N x M	8	0.60169**	7.6667**	8.9111**	0.3661**	0.7185**	0.08014**
Error	26	0.00654	1.9603	2.0698	0.3334	0.0591	0.01807
CV(%)		4.4	7.8	0.14	3.31	0.81	1.51

** = Significant at 1% level ns = not significant stubble cutting close to ground level CR (1-2 cm) increased tiller mortality and poor ratoon crop stand density as reported by Chauhan *et al.* (1985).

Productive tillers: Lock lodged ratooning method with various nitrogen levels was best in producing maximum number of panicles per hill followed by conventional ratooning cut at 10 cm at 60 kg N^{-ha} (Table 1). The possible reason behind maximum panicle number per hill in LLR was the maximum number of tillers. less percent missing hills, higher ratoon vigor and ratoon rating.

Unproductive tillers: Among the ratooing methods, LLR produced the minimum number of unproductive tillers resulting in maximum number of productive tillers. The overall result proved maximum number of unproductive tillers under low stubble cuttings of conventional ratooning method CR (1-2 cm). It was also observed that as the nitrogen levels increased from 0 to 120 kg^{-ha} unproductive tillers also increased. The possible reason for this is the maximum initiation of vegetative growth of plant as result of heavy nitrogen application, less translocation of assimilates from source to sinks at maturity.

Panicle length and filled spikelets per panicle: Among ratooning methods, CR (1-2 cm) and LLR were found best methods concerned panicle length. Irrespective of ratooning methods, the length of the panicle increased as the level of N-fertilizer increased. But, beyond 60 kg N^{-ha} a insignificant increase was observed. The minimum and maximum length was recorded in control plots without N-fertilizer and 120 kg N^{-ha} respectively (Table 1). Filled spikelts also followed the same pattern as in panicle length of producing maximum panicle length under lower cutting of conventional ratooning (1-2 cm) and under LLR. These results agreed with the findings of Bahar and De Datta (1977), Chaterjee et al. (1982), Quddus (1981), and Samson (1980) who reported that lower stubble cutting heights produced maximum filled spikelets per panicle compared to higher stubble cuttings. The interaction effect of nitrogen levels and ratooning methods on seed length and 1000 grain weight was significantly different (Table 3). Among the three practiced ratooning methods under five nitrogen levels, the length of seed increased with the additional application of each N-level. The shortest seeds were recorded in the unfertilized plots of LLR, whereas longest seeds were recorded in CR (1-2 cm) receiving higher dose of N-fertilizer.

A significant increase from 14.43 to 23.77 grams of 1000 grain weight was found with increased application of nitrogen levels from 0 to 120 kg N^{-ha}, respectively. On the other hand, ratooning methods did not significantly contribute in 1000 grain weight, but the performance of CR (1-2 cm) was noticed better in producing heavier grains. The results do not confirm the findings of Bahar and De Datta (1977), Chaterijee *et al.* (1982), Quddus (1981), and Samson (1980) who reported that lower stubble cuttings produced heavier grains.

Grain yield: The grain yield was found maximum at 60 kg N^{-ha} under LLR but beyond 60 kg N^{-ha} slight reduction in grain yield was noticed. For maximum grain yield, the optimum nitrogen response was recorded at 60 kg N^{-ha} for all ratooning methods (Table 1).

Stubble cutting heights close to the ground surface produced less grain yields due to few tiller number and less productive and effective tillers. These results agreed with the findings of Samson (1980), Quddus (1981), and Chaterjee *et al.* (1982). The results also revealed that 60 kg N^{-ha} was optimal contradicting those of Bahar and De Datta (1977) who reported that grain yield significantly increased as N-levels increased.

Overall results also revealed that lock lodged ratooning method proved efficient than others in maximum fertilizer use efficiency by producing maximum grain yield. The results agreed with the findings of Calendacion *et al.* (1991) who reported that lock lodged ratooning method out-yielded conventional ratooning practices. Thus, grain yield is correlated with main crop stubble cuttings. Lock lodged ratooning method involves upper culm cutting in which TAC is high. Act of flattening straw stimulates the basal nodes and auxiliary sprouting buds to tiller due to maximum plant hormone production and translocation at the place where straw is being banded. Moreover, upper node tillers produced by higher cuttings CR (10 c) has fewer leaves than lower node tiller thereby affecting photosynthetic efficiency. Finally, upper node tillers mature faster and produce less effective tillers.

Grain yield of ratoon crop showed strong positive correlation to ratoon rating, total tillers, panicles, panicle length, filled grains, grain size and 1000 grain weight (Table 2).

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