EFFECT OF DIFFERENT PLANT SPACINGS ON THE YIELD AND YIELD COMPONENTS OF RICE VARIETY NIUPELA UNDER RAINFED UPLAND FIELD CONDITIONS AT ERAP STATION

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ABSTRACT

Plant spacings did not have any significant (P<0.05) effect on plant heights, panicle length and number of grains per panicle. However, there were highly significant (P<0.01) differences in panicle weights and number of productive tillers between the different plant spacing treatments.

At the closer plant spacing of 7.5 x 15cm, a significantly (P<0.01) higher paddy yield of 9.50 t/ha was obtained compared to the other plant spacing treatments.

Keywords: *Rice variety Niupela, plant spacing, yield, panicle length, 1000 grain weight.*

INTRODUCTION

In transplanted rice, plant spacing is an important production factor (De Datta, 1981). For example, if rice is planted at closer spacing than necessary, the cost of transplanting and the chances of lodging may increase. Under upland rainfed conditions, wider spacing may contribute to increase in weed population and this may further contribute to the cost of weeding.

In Papua New Guinea (PNG), plant population studies indicated that with higher tillering varieties, higher yields were obtained at closer spacings of 20x10 cm, 20x20 cm and 20x30 cm compared to the wider spacings of 20x40 cm and 20x50 cm (Wohuinangu, 1984). Using the E1 low tillering rice variety, Wohuinangu and Moon Kap (1980) also obtained higher yields at closer spacings of 20x20 cm and 20x30 cm.

This experiment was conducted to examine the effect of different plant spacings on the yield and yield component of rice variety *Niupela*, under rainfed upland field conditions at Erap Station 90 metres above sea level in the Markham Valley, Morobe Province.

MATERIALS AND METHOD

The experiment was conducted from November 1992 to April 1993. Six different plant spacing treatments were used as follows (Table 1).

Table 1. **Plant spacing and number of hills on per hectare basis**

Spacing Treatments	Hills/ha
T1 = 7.5x15 cm	888,889
T2 = 15x15 cm	444,444
T3 = 20x20 cm	250,000
T4 = 25x25 cm	160,000
T5 = 30x30 cm	111,111
T6 = 30x50 cm	66,667

The experiment was a randomised complete block (RCBD) with six plant spacing treatments and replicated four times. The plots were 15 m^2 in size and the rice variety used was *Niupela*. The mixed NPK-fertilizer used contained 12% total N, 12% P_2O_5 and 17% K_2O. At sowing time, a basal application of NPK was applied at the rate of 40:50:50 kg/ha. To obtain the correct doses, 357 kg of mixed NPK-fertilizer + 153.7 kg TSP/ha were applied (535.5 g mixed NPK-fertilizer + 230.6 g TSP/plot). The first and second N top dressings were done 20 and 40 days after planting, respectively. At each top dressing, N was applied at the rate of 30 kg N/ha (65.2 kg Urea/ha or 97.8 g Urea/plot).

At harvest time, ten hills were randomly harvested to determine the yield components. The paddy yield was determined by harvesting the hills within an area of 4 m^2 per treatment and the weights were adjusted to 14% moisture using the formula: "Adjusted Grain Weight = AXW", where A is the adjusted coefficient and W is the weight of harvested grains. The Coefficient A was cal-

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culated as A = 100–M divided by 86, where M is the moisture content (percent) of the grain. For each treatment the following number of hills were

***Table 2.* Number of Hills harvested per plant spacing**

Spacing Treatments	No. of hills harvested/Treatment/4m^2
T1 = 7.5x15 cm	353
T2 = 15x15 cm	177
T3 = 20x20 cm	100
T4 = 25x25 cm	64
T5 = 30x30 cm	44
T6 = 30x50 cm	27

harvested (Table 2).

The data collected on the yield and yield components were subjected to the analysis of variance for RCBD and the mean separation for each treatment was determined using the Duncan's Multiple Range Test (DMRT), where treatment effects observed at a probability level of 5% or less are considered significant.

RESULTS

The effect of plant spacings on height, panicle length, panicle weight, 1000 grains weight, filled grains per panicle and the number of productive tillers per hill are presented in Figures 1 to 3. The effect of spacings on paddy yield is shown in Figure 4.

There were no significant ($P<0.05$) differences in plant heights amongst the different plant spacing treatments. However, there was a significant ($P<0.05$) difference in plant height between the spacing treatments of 15x15 cm (129.2 cm) and 30x30 cm (143.7 cm). With panicle length, no significant ($P<0.05$) differences were observed amongst the plant spacings 7.5x15 cm, 15x15 cm, 20x20 cm and 25x25 cm. Amongst the spacings of 25x25 cm, 30x30 cm and 30x50 cm no significant ($P<0.05$) differences in panicle length were obtained (Figure 1).

There were highly significant ($P<0.01$) differences in panicle weight between the various plant spacings (Figure 2). Higher significant ($P<0.01$) panicle weights were observed at the wider plant spacings of 25x25 cm (53.2 g), 30x30 cm (75.2 g) and 30x50 cm (83.3 g) than at the closer plant spacings of 7.5x15 cm (20.3 g) and 15x15 cm (23.9 g).

At thousand grains weight, no significant ($P<0.01$) differences were observed between the plant spacings 7.5x15 cm, 25x25 cm and 30x30 cm, and between the spacings 15x15 cm, 20x20 cm and 30x50 cm (Figure 2).

No significant ($P<0.05$) effects were obtained amongst the plant spacings 7.5x15 cm, 15x15 cm and 20x20 cm insofar as the number of filled grains per panicle is concerned. However, there was a significant ($P<0.05$) difference in the number of filled grains per panicle between the plant spacings of 7.5 x 15 cm and 15x15 cm with those of 25x25 cm, 30cm x 30 cm and 30 cm x 50 cm (Figure 3).

For number of productive tillers per hill although no significant differences in tiller numbers were observed at the wider spacings of 25x25 cm (18), 30x30 cm (19.6) and 30x50 cm (22.8), these were significantly ($P<0.01$) higher than those at the closer plant spacings of 7.5x15 cm (8.4) and 15x15 cm (10.5) (Figure 3).

For paddy yield, at the closer plant spacing of 7.5x15 cm a highly significant ($P<0.05$) paddy yield of 9.50 t/ha was observed. No significant ($P<0.05$) differences in paddy yield were observed amongst the treatments 15x15 cm, 20x20 cm, 25x25 cm and 30x30 cm with paddy yields of 4.3, 3.94, 3.12 and 3.94 t/ha, respectively. Also between the plant spacings of 25x25 cm and 30x50 cm, no significant ($P<0.05$) difference in paddy yield was obtained (Figure 4).

Though wider spacings have higher numbers of productive tillers (Figure 3), these were not significant to account for the overall yields. It is apparent that at wider plant spacings, the overall paddy yields tend to decrease (Figure 4). However, the only significant yield levels were those between 7.5x15 cm compared to the rest, and that between the widest spacing (30 x 50) to the rest except the 25 x 25 cm spacing.

DISCUSSION

It appears that at the closer plant spacing of 7.5x15 cm, *Niupela* tends to have higher paddy yield (9.50 t/ha) compared with the other spacing treatments (Figure 4). Using the rice variety E1 which is low tillering, Wohuinangu and Moon Kap (1980) reported that at the closer plant spacings of 20x20 cm and 20x30 cm, higher yields were obtained. *Niupela*, which was selected from E1 variety by pureline selection method seems to exhibit the same trend. It also appears that at plant spacings between 15x15 cm and 30x30 cm, the paddy yields of *Niupela* are similar but significantly lower than at 7.5x15 cm plant spacing (Figue 4). De Datta (1981) indicated that at closer plant spacings, the yield per plant is usually small but this is compensated for by greater number of plants per unit area. Therefore, it can be deduced that the higher yield obtained at the

Figure 1. **Effect of spacing on plant height and panicle length of rice variety Niupela.**

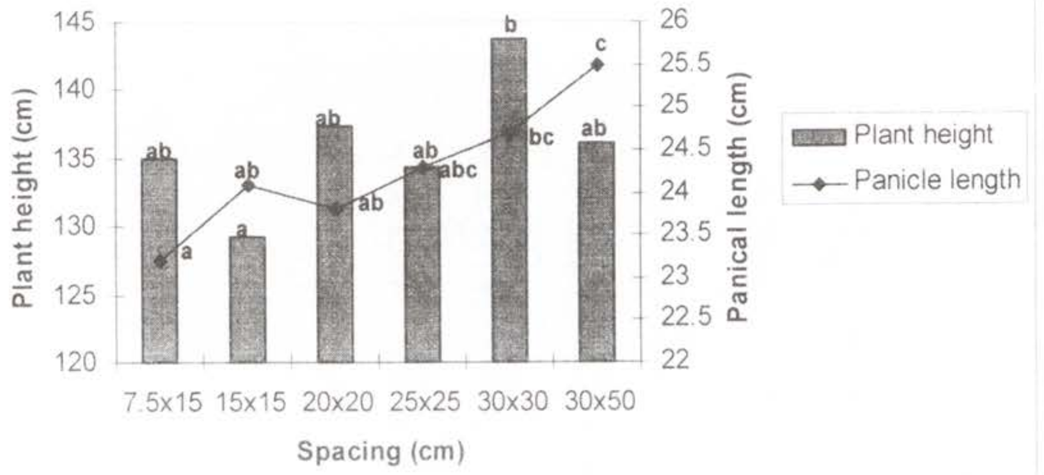


Figure 2. **Effect of spacing on panicle weight and 1000 grains weight of rice variety Niupela.**

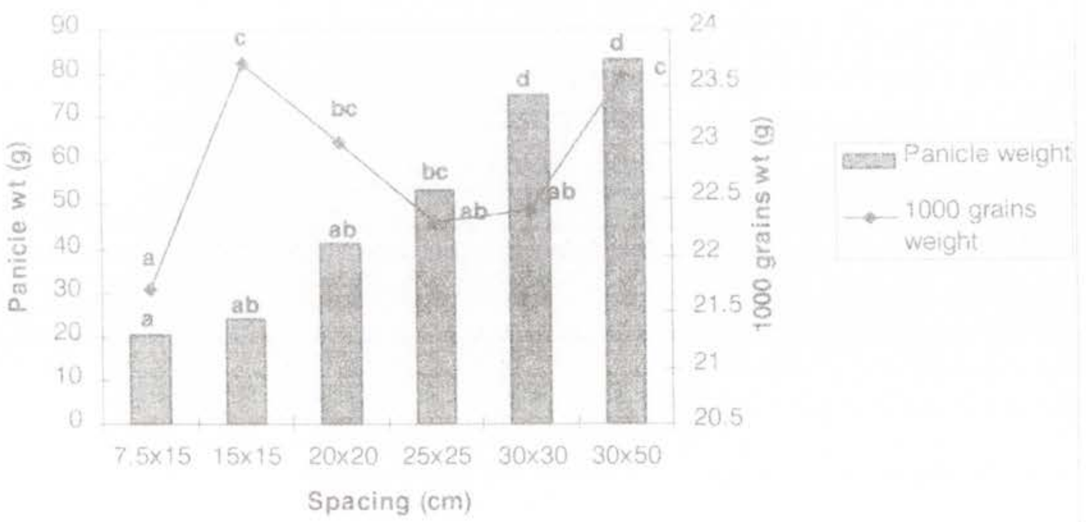


Figure 3. **Effect of spacing on the number of filled grains and number of productive tillers of rice variety Niupela**

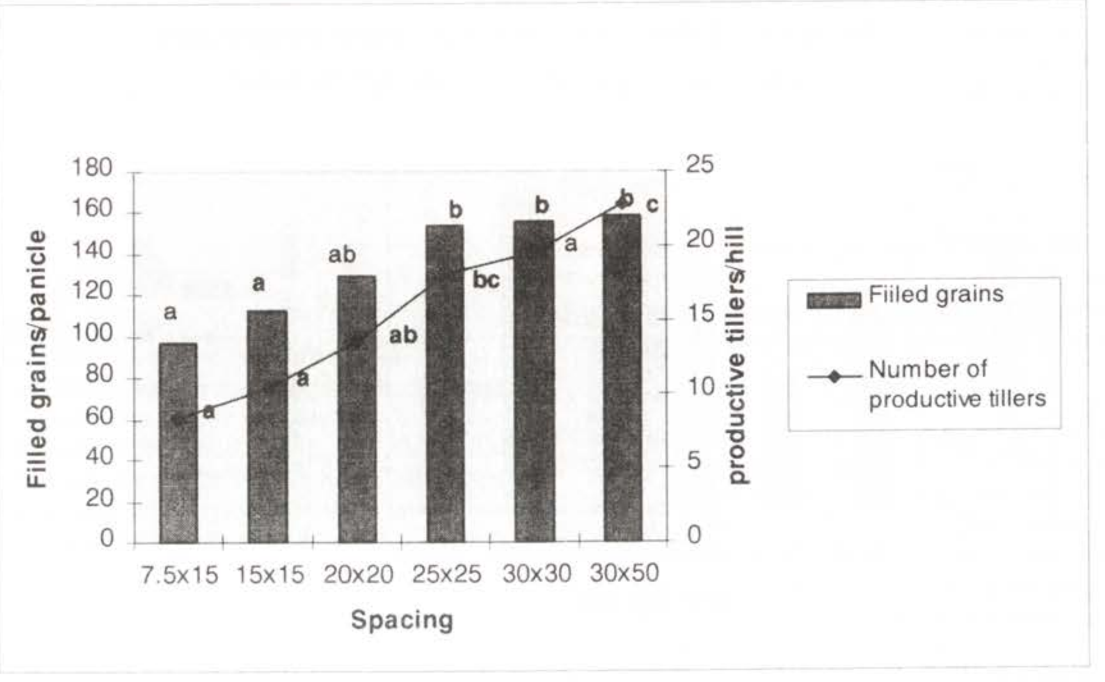
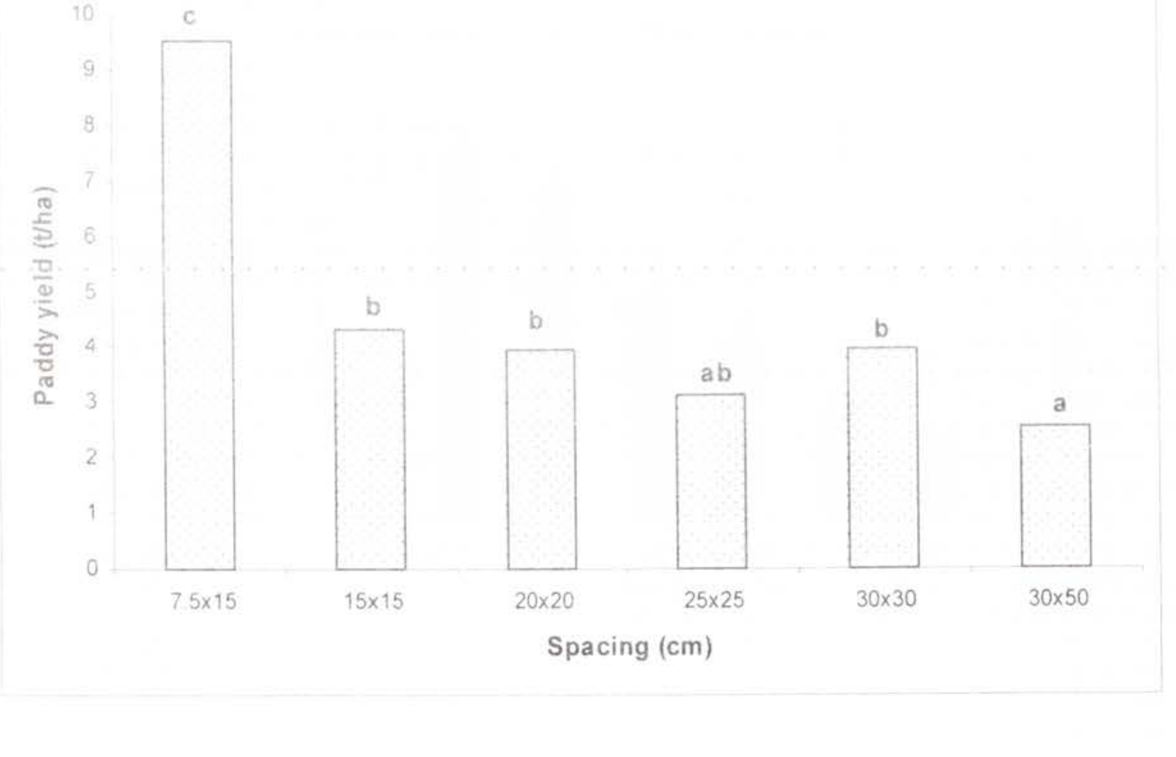


Figure 4. Effect of spacings on the paddy yield of rice variety Niupela.



closer spacing of 7.5x15 cm was due largely to the large number of rice hills harvested. (Table 2).

Despite the higher paddy yield obtained at the closer plant spacing of 7.5x15 cm, the number of filled grains per panicle and the number of productive tillers per hill were lower at this plant spacing as well as at 15x15 cm spacing (Figure 3). This could mean that closer plant spacings have a negative effect on tiller production. This is clearly shown in Figure 3 where under wider spacings, the number of productive tillers were observed to be significantly higher than at closer plant spacing. According to De Datta (1981), the tiller number per unit area in rice population is a function of plant density. The fact that the number of filled grains per panicle was higher at the wider spacings (Figure 3) indicates that the size of individual grains may be bigger. This is shown in Figure 2 where at the wider spacing of 30x50 cm, the 1000 grains weight was higher (23.6 g). However, Yosida (1972) showed that unlike other cereals, grain yields of rice are improved to a very limited degree by increasing grain size, which is largely restricted by the size of hulls. Tanaka (1973), reported that the number of grains per unit area plays a major part in determining the grain yields. He further pointed out that the number of grains per unit area can be raised by either increasing the plant density (closer spacing) or by increasing the number of grains per panicle and panicles per plant. It is obvious that in the current case, increasing the plant density (closure spacing) has contributed significantly to the higher grain yield (Figure 4).

Furthermore during the experimental period it was observed that weed population was very high at the wider spacings than at closer plant spacings. However, weeding was timely and maintained throughout the experimental period. Nevertheless, it must be noted that under large scale commercial situations, increased weed growth could be a demerit of wider plant spacings. This further suggests that it may be undesirable to plant rice at wider spacings as this would promote the problems of weed infestations. However, in a mixed cropping system wider spacings may be desirable.

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