Development of an experimental technique for rice transplanting by using "twisted rice straw ropes"

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Abstract

A series of experiments were conducted to introduce a new transplanting method using twisted rice straw ropes, with rice (Oryza sativa) variety AT 306.

Four treatments were tested in the first trial, namely the SRI method (T_1), dapog (T_2), broadcasting (T_3) and twisted straw rope method (T_1). Size of the straw rope was tested using three treatments in experiment 02, namely 5cm (T_1), 7.5cm (T_2) and 10cm straw ropes (T_3). Urea application on straw ropes was tested in experiment 03, with urea treated (T_1) and without urea treated (T_2) straw ropes. There were three treatments and the control (T_1, conventional planting method), seeds of cowpea incorporated into twisted straw ropes and placed in the field (T_2), seeds incorporated into twisted straw ropes and kept for 2 days on a floor and then placed in the field (T_3). Growth performances like plant height, number of leaves, number of tillers and shoot dry weight were continuously increased in twisted straw rope method than broadcasting and conventional row transplanting method. Yield performances also gave similar results as growth parameters. Results of experiment. 01 revealed that twisted straw rope method was an effective and beneficial method for lowland rice. From experiment 02, it can be concluded, that 10cm straw ropes (T_3) were better than other two sizes of ropes. Results of experiment 03 proved that the application of urea solution for twisted straw ropes before they were placed in the field had beneficial effects on growth and yield of rice.

Introduction

Rice is the staple food for a large number of people on the earth. Rapid growth of population has caused an urgent requirement for increasing the rice yield while cost of rice production is also parallely increasing, especially in under developed countries. Scientists conduct their experiments using two approaches to fulfil this requirement by improving the genetic make up of rice plant and introducing more effective cultural practices to enhance the productivity. Some advantages of the twisted straw rope technique are minimize transplanting shock, protect seeds from birds or ants, reduce seedling dislocation due to run-off water compared to broadcasting methods, minimize the labour required for land preparation, transplanting and chasing birds etc, reduce the weed incidence and produce vigorous plantation (Datta,1981).

Materials and methods

The experiments were conducted at the research farm of the Faculty of Agriculture at Mapalana. Three experiments were conducted as lowland experiments and used the rice variety of AT 306. Newly harvested straw was twisted to make ropes. The crop was maintained following recommended cultural practices.

Lowland Experiments

Pot size of 11 litre (30cm diameter) were used. Each pot was filled up to 25cm height of paddy soil. Experimental design was Randomized Complete Block Design (RCBD) with 5 replicates.

Experiment 01

Four treatments such as three different nursery practices followed by different transplanting methods and broadcasting were tested in relation to their growth and yield parameters.

T_1 -Wet bed nursery, field planting as SRI (transplanted 5 days old seedlings)

T_2 – Dapog nursery, normal transplanting, giving recommended spacing (transplanted 12 days old seedlings)

T_3 – Broadcasting

T_4 – Twisted straw rope method giving recommended spacing.

Experiment 02

Size of the straw rope was tested using three treatments such as

T_1 .5cm

T_2 - 7.5cm

T_3 – 10cm diameter of twisted straw ropes.

Experiment 03

The two treatments were tested as

T_1 – Twisted straw ropes with urea treatment

T_2 – Twisted straw ropes without urea treatment

Half of the amount of urea in the basal dressing was used to treat straw ropes.(Basal dressing of urea 0.29108g/pots)

Plant height, number of leaves/plant, number of tillers/plant or number of branches/plant and shoot dry weight were measured as growth parameters. Number of panicles/plant, number of spikelets/panicle, filled grain %, 1000 seed weight and yield (t/ha) were measured as yield parameters. In addition soil chemical properties (EC and pH) were measured up to 9 weeks after planting.

Results and discussion

Growth and yield performances of rice

Experiment 01: Comparision of existing transplanting techniques with newly developed technique in relation to growth and yield performances

Table 01: Plant height at 2, 4, 6, 8 and 10 weeks after planting.

Treatments	Plant height (cm)				
	2 weeks	4 weeks	6 weeks	8 weeks	10 weeks
T_1	20 ^{b}	45 ^{b}	74 ^{a}	92 ^{a}	108 ^{a}
T_2	14 ^{c}	39 ^{c}	64 ^{b}	86 ^{a}	104 ^{a}
T_3	27 ^{a}	51 ^{a}	76 ^{a}	86 ^{a}	87 ^{b}
T_4	19 ^{b}	42 ^{c}	63 ^{b}	88 ^{a}	106 ^{a}
C.V (α=0.05)	7.388	5.172	6.438	8.106	5.294

In 2 weeks and 4 weeks after planting, plant height of T_3 treatment (broadcasting) was significantly higher than T_1, T_2 and T_4 treatments. T_3 might give the highest plant height because it had no transplanting shock. T_2 (Dapog) gave the lowest height during first month compared to the height of T_1 (SRI) and T_3. T_4 (twisted straw rope method) showed similar results as T_2. These plants would have nitrogen deficiency in the first 2 weeks of transplanting as straw had started to decompose, and where microbial growth was high. At the 8th week, plant heights were not significantly different among treatments; proving that all plants gradually recovered from transplanting shock and nitrogen also has become no more deficienent. In the 10th week, the opposite results were observed i.e. T_3 has given the lowest height while other three treatments gave significantly higher plant heights. In T_3 plant density was high compared with others and this high density would have developed a competition effect among plants resulting lower plant height. Number of leaves and number of tillers showed a similar patterns.

Table 02: Effect of Rice Plant Establishment Methods on Shoot dry weight, Number of panicles/plant and Yield. (t/ha)

Treatments	Shoot dry weight (g)	Number of Panicles/plant	Yield (t/ha)
T_1	37.96 ^{a}	24 ^{a}	2.46
T_2	22.12 ^{b}	11 ^{c}	1.97
T_3	12.86 ^{c}	7 ^{d}	2.45
T_4	37.27 ^{a}	17 ^{b}	2.24
C.V (α=0.05)	7.5	5.6	9.9
LSD			0.3

Shoot dry weight of plants of SRI method (37.9g) was not significantly different from the shoot dry weight of plants of twisted straw rope method. The lowest shoot dry weight was observed in the T_3 treatment (broadcasting) (Table 02). Number of panicles, was significantly different among four treatments. The lowest number of panicles/plant was recorded in T_3 treatment (broadcasting method). SRI method had the highest panicle number (24/plant) comparing that of other treatments, the second highest value (17) was observed in T_4 (twisted straw rope method) (Table 02).

The yield of dapog planting method was significantly different from yield of SRI method as well as broadcasting. The lowest yield was observed in T_2 treatment. T_4 (twisted straw ropes method) gave comparatively higher yield than dapog planting method (Table 02).

Experiment 02: Effect of size of straw rope on performances of rice crop

Table 03: Number of Leaves at 2, 4, 6, 8 and 10 weeks after Planting

Treatment	Number of leaves			
	4 weeks	6 weeks	8 weeks	10 weeks
T_1 (5cm)	10 ^{a}	34 ^{a}	62 ^{a}	80 ^{a}
T_2 (7.5cm)	10 ^{a}	30 ^{a}	60 ^{a}	80 ^{a}
T_3 (10cm)	10 ^{a}	26 ^{a}	54 ^{a}	88 ^{a}
C.V(α=0.05)	2.6	9.6	8.3	8.7

There was no significant difference in number of leaves among T_1, T_2 and T_3 treatments from 2 to 10 weeks. But in early stages of the establishment, the lowest number of leaves was showed in the T_3 treatment (10cm diameter of straw ropes). As T_3 treatment had more straw than other two treatments, the

microbial activity in the early stages might be higher in T_3 treatment and it resulted nitrogen deficiency in the soil than other treatments. But after the decomposition of straw at later stages (10 week) T_3 treatment gave a higher leaf number due to correcting the nitrogen deficiency.

Table 04: Number of Panicles/plant, Filled Grain %, 1000 Seed Weight

Treatments	Number of Panicles/plant	Filled grain %	1000 seed weight (g)
T_1	16 [a]	83.76 [a]	22.04 [a]
T_2	17 [a]	84.41 [a]	21.46 [a]
T_3	16 [a]	85.04 [a]	22.06 [a]
C.V (α=0.05)	4.3	1.3	4.6

Panicle number showed, that there was no significant difference between T_1, T_2 and T_3 treatments. The highest number of panicles was recorded in T_3 (10cm diameter) than other two treatments (Table 04).

Filled grain % and 1000 seed weight were also not significantly different among three treatments (Table 04).

Experiment 03: Effect of application of urea solution for twisted straw ropes

Table 05: Plant Height up to 6 weeks, Number of tillers/plant 4 and 6 weeks after Planting, Shoot dry weight at 6 weeks after Planting

Parameters	Treatments	Time		
		2 weeks	4 weeks	6 weeks
Plant height (cm)	T_1	33 [a]	62 [a]	84 [a]
	T_2	30 [a]	46 [b]	64 [b]
C.V (α=0.05)		3.0	4.1	5.6
Number of tillers/plant	T_1		3 [a]	11 [a]
	T_2		3 [a]	10 [a]
C.V (α=0.05)			8.1	8.2
Shoot dry weight (g)	T_1			5.04 [a]
	T_2			3.50 [b]
C.V (α=0.05)				4.2

Two weeks after planting, there was no significant difference in plant height between T_1 (urea treatment) and T_2 (without urea treatment). After 4 weeks and 6 weeks, plant height of urea treated straw ropes was significantly different from that of non urea treated straw ropes. The highest plant height was observed in T_1 at the 4^{th} and 6^{th} weeks after planting. Non-urea treated plants would suffer from N deficiency. In T_1 (treated with urea) microbial density may be high and straw decomposition would have occurred done quicker than in T_2 (without urea). So there was no nitrogen deficiency in T_1 treatment. This reason would cause higher plant height after two weeks of planting in T_1 treatment than T_2 treatment (Table 05). There was no significant difference in number of tillers between urea treated straw ropes and no urea treated straw ropes (Table 05). Shoot dry weight of T_1 (urea treatment) differed significantly from that of plants without urea treatment straw ropes. The highest shoot dry weight was given by the urea treated straw ropes (Table 05).

Soil chemical properties (pH and EC) up to 9 weeks after planting

pH and EC values were not significantly different among treatments. But 9 weeks after planting pH in twisted straw rope method was somewhat higher than the others. When straw was decomposed, pH values increased and gradually reached to 7.

Conclusion

Twisted straw rope method was an effective planting method for lowland rice. Straw ropes with a diameter of 10cm ropes were better than the ropes of 5cm and 7.5cm diameters. Application of urea solution for twisted straw ropes before placing in the field has shown a beneficial effect on the growth of rice seedlings compared to that of rice seedlings grown on non urea treated ropes.

References

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