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Nitrogen Uptake, Chlorophyll Content and Paddy Yield as Affected by Ordinary Urea and Slow-Release Fertilizer (Meister 10)

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Abstract
The response of rice plants to ordinary urea and slow-release fertilizer were studied in pot experiments at the green house of Tsukuba International Agricultural Training Center, Japan, during 1995. The amount of N in the plants grown under Meister 10 was equivalent to those of basal application of urea. The amount of N in the plants was higher in the post treated with highest dose of ordinary urea (1.5 g N/pot) both as a basal and top dressing application. The brown rice yield of Meister 10 and ordinary urea under the same dose was almost equivalent (11.96 and 11.35 g/plant). The basal application of urea (1.5 g N/pot) increased the brown rice yield (14.723 g/plant), compared with split application under the same dose (11.823/plant). The correlation analysis showed positive relationship between nitrogen content (%) and chlorophyll content r = 0.969 and r = 0.960) at panicle initiation and heading stage.

Introduction
The green plant in general is a biochemical factory in which 19 elements (3 major and 16 miner) have been considered essential in making of all important foods, fibres, enzymes, hormones, vitamins, proteins, carbohydrates etc. Nitrogen in most plants in greater concentration than any other element. Fertilizer trial indicated that the application of nitrogen alone in paddy, contributed 600 kg/ha in average yield of 2595 kg/ha (Wahab, 1967). Rice plant can utilize two most widely available ions i.e. nitrate (NO_3) and ammonium (NH_4^+). The ammonium is however, the main carrier of nitrogen for rice plants. The matter of concern, is how to increase nitrogen absorption at each growth stage. In Japan, intensive farming in upland and paddy fields requires very expensive agricultural materials including fertilizers, cultivation machines, labour cost etc. Hence, the recent demand for the reduction of cost of farming has resulted great change in the system of yield management. The application of slow release fertilizers is one of such trends. The slow release fertilizers are store house for plant nutrients, slowly releasing them for the use of growing plants particularly in warm weather. Although they are expensive but a controlled, efficient uptake of fertilizer has great significance for plant growth and also for the environmental protection, Some slow-decomposing N fertilizer such as isobutylidene diurea (IBDU), Guanylurea (GU) and sulphur-coated urea (SCU) were studied in Japan, American, France and Korea (Wells and Shockley, 1975). Recently Japan developed urea coated polyorefin type resin (PCU) which releases urea by diffusion through small pores on the coat surface. The rate of N release depends essentially on the soil temperature (Fujita and Maeda, 1977). Coated urea is adopted for release and active uptake of nitrogen in paddy fields, Moreover, the losses caused by denitrification, volatilization and immobilization in coated urea are expected to be smaller than other nitrogenous fertilizers (Allen, 1984). Moreover, higher yield per unit of applied nitrogen, less leaching and less volatilization, reduction of luxury uptake of nitrogen and number of fertilization, minimum risk of producing osmotic injury (seedling damage) and high nitrogen efficiency are some of the advantages associated with slow release fertilizer Meister 10 (Anonymous, 1995). To achieve high yields, plants must absorb a large amount of nitrogen after the late stage of spikelet initiation, because the nitrogen absorption that stage of spikelet largely contributes to the ripening with out any risk. Top dressing after spikelet initiation is also beneficial because it increases the amount of nitrogen with out enhancing the vegetative growth period. The present research was investigated to see the pattern of nitrogen absorption in increasing the percentage of ripened grains.

Materials and Methods
The trial was carried out in green house of Tsukuba International Agricultural Training Center (TIATC), Japan during 1995 by using pot cultivation. Completely Randomized Design (CRD) was applied. There were five treatments which were repeated four times. Short duration variety Hatsuboshi (110-115 days) was used. A basal dose of phosphorous and potassium fertilizer (1:1 g as P_2O_5 (18%) and K_2O (60%) were applied basally and top dressing at the rate of 1.0 and 1.5 g to different treatments. Slow release fertilizer Meister 10 (A potent volatilization inhibitor) was used as a thermoplastic resin coated urea having 100 days life period (LP 100) to release 80 percent nitrogen at 25°C under flooded conditions. Each treatment comprised five pots and each pot contained three plants. The following treatments were studied.

Source	N/Pot(g)	Time of application
T1 Control	-----------	-----------
T2 Urea (46%)	1.0	Basal
T3 Urea (46%)	1.5	Basal
T4 Meister 10	1.0	Basal

T5 Urea (46%)	1.0 + 0.5	Basal & top dressing

A weekly tiller count was done to determine the intensity of green leaf colour by the content of pigments especially chlorophyll. A chlorophyll meter (SPAD-502), soil plant Analysis Development section (Anonymous, 1989) was used for chlorophyll content determination after 14, 21, 28 and 41 days after transplanting (DAS). Plant samples were collected from pots at maximum tillering and after heading stages. These materials were then dried in an oven at 80°C for 48 hours and total nitrogen and carbon were determined using Nitrogen and Carbon Analyzer (High Sensitivity Nitrogen and Carbon Analyzer, NC, Sumigraph NC-90A).

The data obtained were analysed by techniques as outlined by Steel and Torrie (1980) and then subjected to Duncan's Multiple Range Test (Duncan, 1955) to know the least significant difference among the treatment means.

Results and Discussion

The data pertaining to panicles and spikelets per plant are presented in Table 1. There were significant difference among the treatments. As for as the mean values are concerned, T1 produced lower number of panicles (3.3) and spikelets (155.95) as against higher number of panicles (11.3) and spikelets (877.79) per plant recorded in T3. Slow-release fertilizer did not respond as desired and produced least number of panicles (9.3) and spikelets (736.98) as compared to fertilized treatment. A lack of responses of coated urea was probably due to waxes and shellac (coating materials) which were used with the idea that release of N would last longer. The release of nitrogen from coated urea was although continuous but not consistent and sufficient as required at each growth stage (Bronson *et al.*, 1994). The rice plant require maximum availability of nitrogen at tillering and panicle initiation stage and that is why the split application of ordinary urea resulted in more panicles and spikelets and spikelets per plant.

A positive correlation has been observed between the SPAD values and the nitrogen content (%) of paddy rice leaves. The data given in Table 1 indicated that the relationship between nitrogen and SPAD values was very close (r = 0.969 & r = 0.960) at panicle initiation and heading stages. The nitrogen content (%) increased in the leaf blade with increase in the dose of nitrogen. Addition of ordinary urea gave significant increase in fertilizer-derived N uptake compared with coated urea (Bronson *et al.*, 1994). At panicle initiation stage the nitrogen content increased simultaneously i.e. T1 (3.16%), T3 (4.10%), T4 (2.66%) and T5 (4,10%) respectively and the SPAD values also increased. At heading stage nitrogen content decreased in all treatments, T1 (2.25%), T3 (2.91%), T4 (2.01%) and T5 (2.67%). The control pot (T1) showed lost nitrogen content 1.48 and 1.40 percent at two growth stages, respectively. The nitrogen plays a vital role two growth stages, respectively. The nitrogen plays a vital role in normal metabolism of plants and absorption of light energy needed for photosynthesis. As no nitrogen was applied to control pot therefore chlorophyll contents as a whole were low and low quantities of light were absorbed. As a result the middle portion of leaf blade became yellowish green and low nitrogen content (%) was produced. The lack of response of Meister 10 rnay be influenced by soil pH, soil temperature, soil microbial activities and soil water content (Anonymous, 1995).

The ripened grains (%) and grain yield per plant (g) responded positively to nitrogen application. The highest percentage of ripened grains was observed in T3 (83.66) followed by T2, T4 and T5 with 81.11, 79.89 per cent of ripened grain respectively. The lowest ripened grain (%) was recorded in T1 (67.50) without nitrogen application. An increase in grain yield per plant was also observed with urea T3 (14.723 g), T4 (11.960 g), T5 (11.823 g), T2 (11.353 g) verses control T1 (1.965 g) respectively. The split application of urea at both tillering and panicle initiation stages increased the ripened grains and grain yield of rice due to the instant availability of nitrogen. More accumulation of nitrogen happened in protoplasm and chlorophyll which has boosted the carbohydrate level and consequently grain yield raised favourably.

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Table 1: Panicles, spikelets per plant, total nitrogen, ripened grains (%), grain yield (g) as affected by ordinary and coated urea

Treatments	Panicles/ plant (No.)	Spikelets/ plant (No.)	Panicle stage	Heading stages	Ripened grains (%)	Grain yield/ plant (g)
T1 Control	03.6b	155.95c	1.48*	1.40**	67.50b	01.965c
T2 Urea (46%)	10.5a	692.48b	3.16	2.25	81.11a	11.353b
T3 Urea (46%)	11.5a	877.70a	4.10	2.91	83.66a	14.723a
74 Meister 10	09.3a	736.98b	2.66	2.01	79.89a	11.960b
T5 Urea (46%)	10.3a	771.20ab	4.10	2.67	79.07a	11 .823b

Means in a column having similar letter(s) do not differ significantly at 1% level of significance using DMRT

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