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EFFECT OF SPLIT DOSES AND TIMES OF NITROGEN APPLICATION ON THE CONTENT UPTAKE AND UTILISATION EFFICIENCY FOR DIRECT SOWN RICE IN PUDDLED SOIL

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Nitrogen management of rice is of paramount importance from the point of view of cost as well as the efficiency of applied nitrogen. It has therefore become imperative to switch over to proper agrotechnique for sustained production over a large part of the country. For efficient utilisation of fertiliser nitrogen, skipping basal application at the time of planting or delayed application till maximum tillering or panicle initiation stage has been recommended (Shastri, 1974). The fact that 70—75 per cent of the rice crop in India is sown broadcast and the lack of information about the nitrogen management of the direct seeded rice crop warrants urgent action in the field of Agronomy of direct seeded rice crop.

Materials and Methods

A trial was laid out at the College of Agriculture, Vellayani to study the effect of nitrogen as influenced by different rates and timings of application for a short duration rice cv. *Triveni* sown broadcast in puddled soil. The experiment was conducted in the third crop (*puncha*) season in 1975-76 during December-April in a sandy clay soil. Nitrogen was applied in two levels L_1 = (50 kg N/ha) and L_2 = 70 kg N/ha). Rates of split doses of nitrogen were 0, $\frac{1}{4}$, [illegible] and [illegible]. Times of application of nitrogen were Basal, active tillering phase and panicle initiation stage. Th re arc 12 combinations of split applications at three times under each level of nitrogen viz. (T_1) o, $\frac{1}{4}$, I, (T_2) 0, $\frac{1}{2}$, 2, (T_3) O, f, $\frac{1}{4}$, (T_4) $\frac{1}{4}$, O. I (T_5) $\frac{1}{4}$ $\frac{1}{4}$, $\frac{1}{2}$, (T_6) $\frac{1}{2}$ $\frac{1}{2}$, $\frac{1}{4}$, (T,) $\frac{1}{4}$ I, O (T_8) 1 (T_9) $\frac{1}{2}$, $\frac{1}{4}$, i (T_{10}) i, i. o (T,,) f, O, i and (T_{12}) $\frac{3}{4}$, i, O.

The experiment with 24 treatment combinations was laid out in Randomised Block Design and replicated thrice. The nitrogen applications were made as per the various treatments. A seed rate of 100 kg/ha was used and sown on 27-12-1975. The crop was harvested 100 days after sowing.

Observations were taken from the plots at 3 random locations earmarked by the frame of size 25 x 25 cm (Gomaz, 1972). The plant samples were analysed for total nitrogen at active tillering, panicle initiation, flowering and at harvest and also the nitrogen content of the grain samples of individual plot was estimated by micro-kjeldahl method (Jackson, 1967). Nitrogen uptake was found out from the percentages of nitrogen in straw and grain and the total nitrogen uptake at harvest was worked out and expressed in kg/ha.

Nitrogen utilisation efficiency (NUE) was calculated as grain yield (kg/ha). N uptake at harvest (kg/ha). This was used as a measure of the quantity of grain produced per kg of nitrogen absorbed by the plant.

Results and Discussion

Plant Nitrogen content. From the analysis of plant nitrogen at harvest it was noted that the treatment T_1 recorded the maximum plant nitrogen which was on par with T_2. The treatment T_{10} recorded the lowest value. The higher level of nitrogen L_2 (70 kg/ha) was significantly superior to lower level L_1 (50 kg/ha).

The above result suggests that £ nitrogen given at panicle initiation had resulted in the highest plant nitrogen at harvest. A similar trend was seen in the plant nitrogen content at flowering. Ii could also be noticied that the protein content of grain (Table 1) of the treatments which received $\frac{3}{4}$ nitrogen at panicle initiation stage was also maximum. Regarding levels, the superiority of L_2 over L_1 does not require any further explanation.

In general the highest plant nitrogen content of 2 per cent and above was observed at active tillering stage and from then onwards there was a gradual decline at harvest (Table 1) suggesting that at later stages the plant nitrogen might have been used for grain production. Araki and Suzuki (1964) found higher nitrogen in plants during seedling stages in direct sown rice.

Nitrogen uptake at harvest. With regard to split doses and time T, recorded the highest uptake and it was significantly superior to all the rest. The treatment T_{10} recorded the least uptake. The higher level L_2 significantly increased the nitrogen uptake than the lower level L_1.

It showed that more quantity of nitrogen applied at later stages enhanced its uptake at harvest. It suggests that basal skipping of nitrogen and applying at later two stages will aid to increase the nitrogen uptake at harvest. Alberdo (1953) found that the beneficial effect of boot stage application is facilitated by increased absorption of nitrogen. Experiments conducted at Sri Lanka revealed that nitrogen application at flag leaf and heading stages resulted in higher fertiliser nitrogen uptake (Nagarajah *et. al* 1975). The idea that the time at which nutrients are absorbed by plants influences grain yield of rice more than by the absorbed amounts of nutrients was suggested by Kimura &.Chiba (1943).

Table 1

Plant nitrogen content (percentage) at various stages of crop growth.

Treatments	Active tillering stage	Panicle initiation stage	Flowering	Harvest
Split doses and time				
T_1	2.3	1.4	1.1	1.1
T_2	2.4	1.5	0.7	0,9
T_3	2.4	1.6	0.6	0.8
T_4	2.6	12	0.7	0,9
T_5	2.6	1.4	06	0.9
T_6	2.6	1.5	0.6	0.7
T_7	2.6	1.6	0.4	0.7
T_8	2.3	1.2	0.7	1.0
T_9	2.3	1.4	0.9	1.0
T_{10}	2.3	1.5	0.5	0.7
T_{11}	2.4	1.3	0.6	0.8
T_{12}	2.4	1.4	0.4	0.7
F test	N.S	Sig.	Sig.	Sig.
C.D. (0.05)	0.28	0.13	0.14	0.17
Levels (kg/ha)				
L_1 (50)	2.4	1.2	0.6	0.8
L_2 (70)	2.5	1.6	0.7	0.9
F test	N.S	Sig	Sig	Sig
C.D. (0.05)	0.11	0.06	0.06	0.06

Nitrogen *utilisation efficiency*. Data on utilisation efficiency as affected by timings and doses are given in the Table 2. In general, an inverse relation between nitrogen uptake and utilisation efficiency could be observed. Treatments receiving nitrogen at later stages tended to record higher uptake and lower utilisation efficiency. Similarly, application of a

Table 2

Effect of split doses and time of N application on N use efficiency and contribution of N uptake towards grain yield and content

Treatments	Protein content of grain	Grain yield (kg/ha)	Total N uptake at harvest (kg/ha)	Nitrogen efficiency	Incremental N uptake over T_{12} (kg/ha)	Incremental grain yield over T_{12} (kg/ha)	Incremental N uptake contributing to grain yield (kg/ha)	Incremental N uptake contributing to content (kg/ha)
Split doses and time								
T_1	8.87	4061	109	37.26	37	475	4.15	32.85
T_2	7.00	4874	100	48.74	28	1288	11.24	16.76
T_3	6.41	3974	103	38.58	31	388	3.39	27.61
T_4	8 53	3732	92	40.57	20	146	1.27	18.73
	6.15	4209	86	48.94	14	623	5.44	8.56
T_6	6.08	4475	83	53.92	11	889	7.76	3.24
	5.92	3723	75	49.64	3	137	1.20	1.80
T_8	6.44	3877	81	47.86	9	291	2.54	6.46
T	6 24	3811	77	49.49	5	225	1.95	3.04
T_{10}	5.58	3911	65	60.17	7	325	2.84	4.16
T_{11}	6.25	3869	68	56.90	4	283	2.47	1.53
T_{12}	5.46	3586	72	49.81	0	0	—	—
F test	Sig.	Sig.	Sig.	—				
C. D. (0 05)	0.56	438.4	4.9	—				
Levels (kg/ha)								
L_1 (50)	6.45	3867	74	52.26				
L_1 (70)	6.71	4150	94	44.15				
F test	Sig.	Sig.	Sig.	—				
C. D. (0.05)	0.23	177.3	2.0	—				

higher dose of nitrogen resulted in lower efficiency. It may also be seen that basal skipping of nitrogen and application at later stages recorded higher yields. This means that nitrogen taken up at earlier stages produced more of grain and nitrogen absorbed at later stages contributed substantially towards increasing the content of the nutrient in the plant. This is also clear from the data on protein content of grain (Table 2) and N content of straw (Table 1). As indicated by the significantly higher yields of treatments of basal skipping and the correspondingly higher uptake of nitrogen, part of the nitrogen also might have contributed towards grain yield in such treatments.

An attempt was therefore made to separate out the effects of nitrogen towards grain yield and nitrogen content. Treatment 12 which recorded the lowest grain yield and nitrogen uptake was taken as the base. The incremental nitrogen uptake was calculated as the difference in uptake between the treatment and treatment 12. Incremental nitrogen uptake contributing towards grain yield was worked out by multiplying incremental yield with the grain nitrogen content of treatment 12. The grain N content of was 0.873 per cent. The difference between incremental nitrogen uptake and incremental nitrogen contributing to grain yield was taken as the nitrogen contributing towards content. The data on these are given in Table 2 These data show that basal skipping of nitrogen gives markedly higher incremental nitrogen uptake than those receiving nitrogen at early stages. In addition to these differences, the relative contribution of nitrogen towards grain yield also varied widely. Treatments 1, 2 and 3 received half of nitrogen at tillering and panicle initiation only, there was an incremetal nitrogen uptake of 28 kg. Out of this 11.2 kg was contributed towards grain yield and 16.8 kg towards content. Though there was a higher incremental uptake of 37 kg in treatment 1, only 4.2 kg went in for increasing yield. Treatments receiving basal application of nitrogen showed lower incremental nitrogen uptake. Though there appears to be a strong relationship between total and incremental N uptake with grain yield the latter showed a strong positive correlation (0.9986*). It is also seen that there was an overall increase in total N uptake at higher yield levels. Thus there appears to be two factors that decide the efficient utilisation of applied N ic. total uptake of N and incremental N uptake contributing to grain yield.

Summary

A field experiment conducted to study the effect of split dose and times of N application on N uptake and utilisation efficiency showed that the skipping basal application of N and applying half at active tillering and the other half at panicle initiation stages gave maximum grain yield

for direct sown rice in puddled soil. This was made possible by a higher total N uptake and a higher incremental N uptake contributting to grain yield.

സംഗ്രഹം

ചെളിപരുവമാക്കിയ നിലത്തിൽ നേരിട്ട് വിത നടത്തുമ്പോഴും നെൽക്കൃഷിക്ക് പലതവണകളിലായി പല അനുപാതങ്ങളിൽ CTsiaosscrJ നൽകുമ്പോഴും, നൈട്രജൻ ആഗിരണത്തേയും പ്രയോജനക്ഷമതയേയും അത് എങ്ങനെ ബാധിക്കുന്നു എന്ന് അറിയുന്നതിനു വേണ്ടി നടത്തിയ ami പരീക്ഷണത്തിൽ, അടിസ്ഥാന വളമായി നൈട്രജൻ ചേർക്കാതെ മററു rasnf roiojsin<ft>glra5, അതായത് ചിനപ്പ് പൊട്ടുന്ന സമയത്തും അടിക്കണ്ണ പ്രായത്തിലുമായി പകുതി വീതം ചേർത്തപ്പോഴാണ് കൂടുതൽ വിളവുണ്ടായതെന്ന് കണ്ടു. കൂടിയ തോതിലുള്ള നൈട്രജൻ ആഗിരണം വഴിയും ആഗിരണം ചെയ്യപ്പെട്ട നൈട്രജന്റെ നല്ലൊരുഭാഗം നെന്മണിയുടെ ഉല്പാദനത്തിന് ഉപയോഗപ്പെടുത്തുകയും ചെയ്യുക വഴിയാണ് ഈ വിളവ് വർദ്ധനയുണ്ടായത്.

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