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EFFECT OF INCREASING LEVELS OF NITROGEN ON GROWTH PATTERN, YIELD COMPONENTS AND YIELD OF HIGH YIELDING DWARF INDICA RICE — RATNA.

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A solution culture experiment was conducted during the Kharif season of 1972 to study the effect of the levels of N on high yielding dwarf indica rice variety - Ratna. Increasing levels of N increased shoot length but reduced root length and root spread. Root growth is impaired at high N levels with short thick roots and less root hairs indicating less absorptive area. The grain yield is decreased above 60 ppm N due to less number of productive tillers> less number of grains per panicle less 1000 grain weight and low fertility percentage.

Available reports on the fundamental aspects of rice culture come from Japanese workers and most of them are confined to Japonica varieties. Tanaka *et al* (1958, 1959 a, b, c) gathered a lot of informations on the fundamental aspects of tall indica varieties. However much informations are not available on the growth pattern yield components and yield of rice for high yielding dwarf indica varieties. For recommending a rational dose of fertilizers for any crop it is necessary to determine the contribution of each nutrient on the growth characters of the plant. The contribution of each nutrient can best be studied under solution culture excluding extraneous soil influences.

Materials and Methods

A solution culture experiment was conducted at CRRI, Cuttack during the Kharif season of 1972 with high yielding rice variety Ratna receiving 0, 5, 10, 20, 40, 60, 100, 150 and 200 ppm N levels. The nutrient solution contained in 6 litre pots had the following composition $NaH_2PO_4 . 2H_2O$. 10 ppm P Kcl - 25 ppm K. Ca Cl_2 ·(Fused) - 20 ppm Ca. Mg $cl_2 . 6H_2O$. 20 ppm Mg. Fe. EDTA - 2 ppm Fe. Sodium Silicate - 5 ppm Si. Micronutrients - According to the formulation of Johnson et al (1957). The initial pH of the culture solution was adjusted to 4.8 to 5.2 with normal sulphuric acid with the aid of bromocresol green indicator.

Twenty days old seedlings raised in shallow pans were transfered to bamboo baskets kept on porcelain pots containing culture solution having 1/5th the normal concentration. The plants got established in about a week, after which nitrogen treatments through NH4 No, were started along with the normal supply of other nutrients. Two plants were kept per pot after establishment.

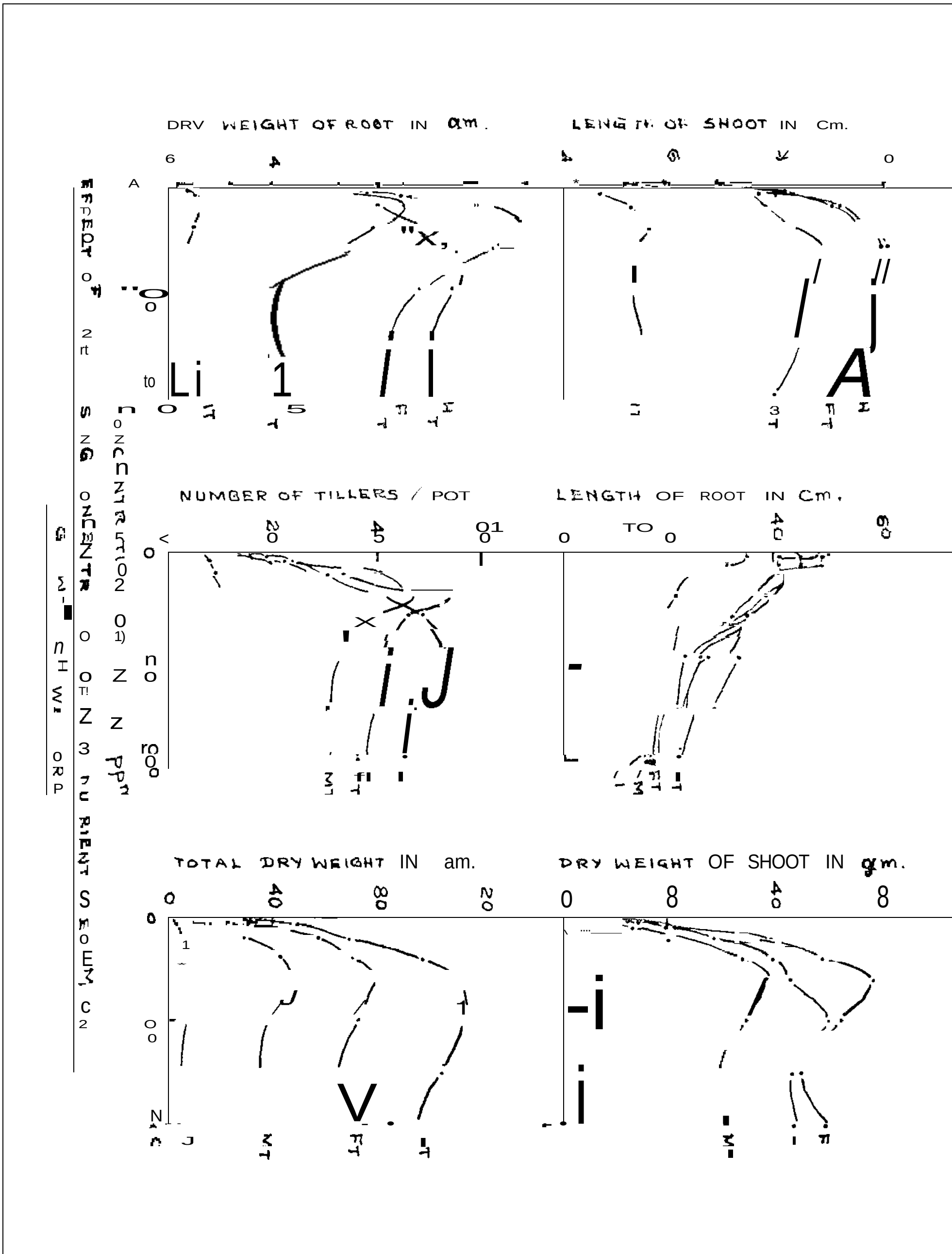
DRY WEIGHT OF ROOT IN gm.
LENGTH OF SHOOT IN Cm.
NUMBER OF TILLERS / POT
LENGTH OF ROOT IN Cm.
TOTAL DRY WEIGHT IN gm.
DRY WEIGHT OF SHOOT IN gm.

PLATE I

EFFECT OF NITROGEN ON GROWTH PATTERN OF HIGH YIELDING RICE

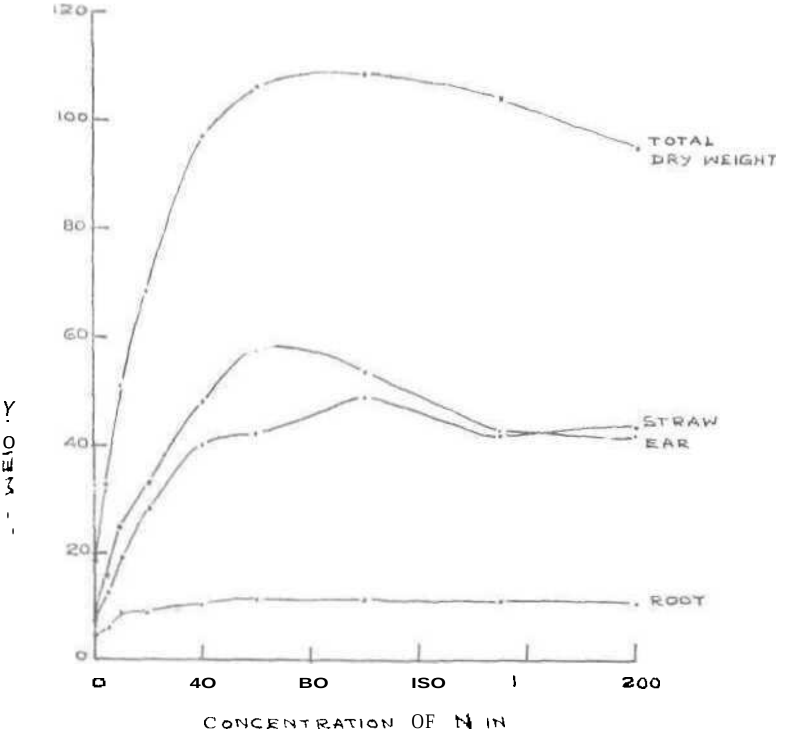

PLATE II

Table 1

Effect of increasing levels of N on Yield Components and yield of High Yield Variety of Rice - Ratna

Yield Components	N Treatments								
	0	5	10	20	40	60	100	150	200
Productive tillers	8	9	15	18	30	35	32	30	31
Panicle weights/plant (g)	0.86	1.7	1.6	1.8	1.6	1.6	1.6	1.4	13
Total panicle weight (g)	6.9	15.2	24.3	32.2	47.5	57.5	53.1	42.2	41.9
Fertility Percentage	62.6	84.4	84.7	83.1	79.8	72.8	74.2	76.6	77.3
1000 grain weight (g)	21.8	22.0	22.3	23.7	23.2	22.4	20.8	21.6	19.1
Number of grains/panicles	307	636	987	1224	1888	2241	2255	2190	2387
Grain yield/pot (g)	5.7	14.0	22.0	29.0	43.8	50.2	46.9	47.3	45.6
Straw yield/pot (g)	6.7	12.1	18.5	27.9	39.9	42.4	49.1	41.7	42.8

duplicate pots were removed at the four major growth stages of initial tillering maximum tillering, flowering and at harvest. Observations on length and dry weight of shoot and root and number of tillers were taken at different growth stages. On harvesting, observations were taken on productive tillers. panicle weight, number of grains per panicle, 1000 grain weight and fertility percentage.

Results and Discussion

Effect of increasing concentration of N on growth characters at major growth stages are presented in Plate I. There was a sharp increase in height upto 20 ppm N and gradual increase upto 60 ppm N in all the four major growth stages and at still higher levels, height of shoot either decreased or levelled off. Maximum gain in height by the plant is observed from initial tillering to Maximum tillering.

Root length was reduced considerably with increase in concentration of N upto 60 ppm N and thereafter it was gradual. Ishizuka and Tanaka (1960) working with Japonica varieties found that N deficiency caused lengthening of roots but their number reduced considerably. Tanaka *et al* (1958) working with low responsive indica varieties observed that decrease in root development was more pronounced with low responsive indica varieties. The shortening and weakening of roots might have resulted from an imbalance of energy supply from the shoots to the roots and N absorption. The lower energy supply to the root is considered to be due to mutual shading and by the death of lower leaves at higher concentration of nitrogen. Heavy lodging observed at high N levels above 100 ppm N might be due to top heavy character at high N levels. Imbalance of Photosynthesis and respiration results in decrease of cellulose content of the culm (Kono and Takahashi, (1960) and consequently plants are susceptible to lodging.

Plants attained maximum dry weight by flowering stage. The decreased weight observed from flowering to harvest stage might be due to death of tillers during the period. Decrease was not conspicuous at higher concentration above 60 ppm due to late formed tillers with both root spread as well as length decreased with a consequent reduction in dry weight of root. Ishizuka and Tanaka (1960) found that elongation of roots was stimulated but their number decreased with deficiency of N.

There was a sharp increase in total tillers upto 40 ppm N upto flowering stage and decreased gradually at still higher levels. At harvest stage total tillers increased upto 100 ppm N. The increase in tillers from harvest to flowering might be due to late formed tillers at higher concentrations of N. Total dry weight increased steadily during different growth stages (Plate II). In all the growth stages difference in weight was more prominent between 40 to 200 ppm N. When the contributary factors for total dry weight was considered, ear weight seemed to contribute more than straw weight upto 150 ppm N. Straw weight is slightly more than ear weight at still higher levels. Above 150 ppm N, total plant weight decreased gradually. Tanaka (1958) reported decreased grain to straw ratio with increased N application. High N application favoured high vegetative growth and mutual shading resulting in less effective tillers aad low grain to straw ratio.

Among the yield components the ratio of productive tillers to total tillers increased sharply upto 60 ppm N. The weight per panicle was increased upto 20 ppm N due to greater fertility percentage and 1000 grain weight Total panicle weight was increased upto 60 ppm N mainly due to increased number of productive tillers and numbers of spikelet per panicle. According to Yamada and Ota (1957) high N will increase the number of spikelets formed as well as production of Carbohydrates but the rate of increase of the former will be greater than that of the latter. Therefore inspite of increased yield, 1000 grain weights might be reduced because of the insufficient supplies of carbohydrates to individual grains. 1000 grain weight was increased only upto 20 ppm N beyond which it was reduced. Similar observations was made by Ishizuka and Tanaka (1963) in Japonica rice. There was an increase in grain yield upto 60 ppm beyond which there was a decrease. The reduction in grain yield at high N levels might be due to reduced number of filled grains per panicle as evidenced by low fertility percentage. The reduction in fertility percentage noticed at high N levels might be due to mutual shading and consequent reduction in light received. High sterility at high N levels might also have been caused by inhibition of pollination resulting from incomplete dehiscing of anthers and abnormal behaviour of filaments at the time of flowering there by bringing about decreased seed setting.

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സംഗ്രഹം

അത്യുല്പാദനശേഷിയുള്ള നെല്ലിന്റെ വളർച്ചയേയും വിളവിനേയും നൈട്രജൻ എപ്രകാരം ബാധിക്കുന്നു എന്നറിയാനായി കട്ടാക്കിലെ നെൽ ഗവേഷണകേന്ദ്രത്തിൽ (ഒറീസ്സ) ഒരു പ്രാഥമിക ഗവേഷണത്തിൽ ഈ മൂലകം കൂടുമ്പോഴും നെൽച്ചെടിയുടെ നീളം കൂടുകയും വേരിന്റെ നീളം കുറയുകയും കട്ടിയുള്ള വേരുകളുടെ അനുപാതം നാരുവേരുകളെ അപേക്ഷിച്ച് കൂടുകയും ചെയ്യുന്നതായി കണ്ടു. നൈട്രജൻ വളരെഅധികം കൂടുമ്പോഴും വിളവു കുറയാൻ, കതിരുള്ള ചിനപ്പുകളുടേയും, ഓരോ കതിരിലുമുള്ള നെന്മണികളുടേയും എണ്ണക്കുറവും പതിരിന്റെ കൂടുതലുമാണ് കാരണം.

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