INFLUENCE OF MOTHER BULB NITROGEN ON SUBSEQUENT NITROGEN UPTAKE IN TULIPS

M. Amano
Vegetable and Ornamental Crops Research Station
Ano, Mie,
Japan

Abstract

Influence of the nitrogen concentration of the mother bulb (planting bulb) was investigated by the experiment using ^{15}N tracer technique. Mother bulb nitrogen had no significant effect either on the growth of above-ground parts at flowering or on the bulb yield at lifting. But both nitrate and ammonia nitrogen uptakes significantly decreased with increasing nitrogen concentration of the mother bulb.

Distribution factor of mother bulb nitrogen to each part of plant changed only slightly as nitrogen concentration of mother bulb increased. Regardless of mother bulb nitrogen, about 15 % of nitrogen originated from the mother bulb was transferred into the flower and removed by defloration, and finally 70 % was redistributed into daughter bulb and harvested.

From the above, it was clarified that there might be the inverse correlation between the nitrogen concentration of the mother bulb and subsequent uptake of nitrogen, and high recovery percentage could be obtained for mother bulb nitrogen in tulip.

1. Introduction

Nitrogen fertilization for tulip bulb production has a great influence upon not only the growth and bulb yield during the season's growth but also nitrogen content of daughter bulb used for planting in succesive year (Tsutsui et al.,1967,Amano et al., 1981). It is also important that nitrogen level of bulb is closely related to forcing ability (Cheal et al., 1964, Kabe, 1980, Munk, 1980) and infection of deseases (Tsutsui et al., 1967). Furthermore insecurity of nitrogen application effects is caused by remarkable leaching by nitrification in the soil (Hagiya et al., 1966, Tsutsui et al., 1969, Baba, et al., 1983).

There are few reports which give effects of planting-bulb nitrogen on bulb yield in successive year. The previous investigation showed that there were some cases where there might be the inverse correlation between nitrogen levels in mother bulbs and bulb yields (Amano et al., 1981).

The investigation reported here was designed to clarify the effects of mother bulb nitrogen on the subsequent nitrogen uptake and the distribution of various nitrogens, originated from mother bulb, absorbed from nitrate nitrogen and from ammonia nitrogen, by the experiment using ^{15}N tracer technique.

2. Material and methods

Seed bulbs for the experiment were lifted from five different stocks of tulip Rose Beauty, to which the top dressing of nitrogen with 0, 4,

8, 12, and 16 Kg / 10a were applied in the spring 1979. For each stock, planting mother bulbs of 9 cm in circumstance (9 cm grade) were chosen with bulb weight ranging from 15.5 to 15.8 g. Nitrogen concentration of planting mother bulb selected from each stock was 0.99, 1.22, 1.36, 1.64, and 1.87 % respectively.

Three mother bulbs from each stock were planted into a 1/2000 Wagner pot with sand. These plots comprised five levels of mother bulb nitrogen and each plot was consisted of ten pots.

Sand culture was made in an unheated plastic film house, with a supply of nutrient solution during the periods from 11 March to 31 May. Composition of the nutrient solution used in sand culture was given in Table 1. Sodium nitrate included 4.64 atom % excess ^{15}N as a nitrate form and ammonium sulfate included 2.19 atom % excess ^{15}N as an ammonia form were applied. The solution containing both nitrogen form in the ratio of 1 : 1 was used, and the concentration of total nitrogen element was 100 ppm.

Samples of 12 plants at the flowering time (9 May) and daughter bulbs 18 plants at the lifting time (15 June) were taken for nitrogen analysis(Amano et al., 1984, 1985).

3. Results

3.1. Effects on the growth and the bulb yield

The growth of above-ground parts at flowering only slightly decreased with increasing the nitrogen concentration of mother bulb (Table 2). There was no clear effect on total bulb yield.

3.2. Effects on nitrogen content in each part of plant at flowering

There were downward trends in nitrogen contents of flowers, 1st leaves and roots and on the contrary upward trends in those of daughter bulbs and mother bulbs, with increasing mother bulb nitrogen. Mother bulb nitrogen resulted in having no clear effect on total nitrogen contents of whole plant at flowering (Table 3).

3.3. Effects of subsequent nitrogen uptake

The partition of nitrogen content between various nitrogens ; originated from mother bulb, absorbed from NH_4-N and from NO_3-N, were indicated in Figure 3. The percentage of nitrogen from mother bulb consistently increased in all parts of plant with increasing mother bulb nitrogen and there were outstanding decrease in nitrogen from both NH_4-N and NO_3-N. Absorption of NO_3-N was generally more than that of NH_4-N, which was more influenced by mother bulb nitrogen.

With regard to the whole plant at flowering, the nitrogen uptake from NO_3-N significantly decreased with increasing mother bulb nitrogen , as from NH_4-N (Table 4 , Figure 1). With regard to the daughter bulb at lifting, the nitrogen content from NO_3-N significantly deceased with increasing mother bulb nitrogen, but there was only a small effect on that from NH_4-N (Table 4, Figure 2).

3.4. Recovery of mother bulb nitrogen

Distribution factor of mother bulb nitrogen to each part of plant changed only slightly as nitrogen concentration of mother bulb increased. Each mean percentage of distribution to flower, leaves, stem, daughter bulbs, roots or mother bulb was 15, 36, 10, 26, 8, or 6 res-

pectively (table 5). Recovery rate of mother bulb nitrogen into lifted bulbs was around 70 % regardless of mother bulb nitrogen.

4. Discussion

It was consistent with the results reported by Nishii (1963),Cheal (1963), Tsutsui (1967, 1969) and many other workers that there were clear effects of nitrogen supply on bulb weight and bulb nitrogen content in propotion to nitrogen level in that year.

However, various results were seen on those effects in the following year, despite the generally considered view that tulips have aftereffect of the nitrogen fertilization in the previous generation. Amaki (1960) found that in the large seed bulb, the yield of bulb was varied depending on the amount of nitrogen fertilizer supplied to the previous generation, but in the small seed bulb, such an aftereffect was not recognize. Tsutsui (1967) reported that the nitrogen supply at later stage had no aftereffect and Amano (1981) reported that there were the inverse correlation between nitrogen levels in mother bulb and bulb yields. It was reported by Sekher (1981) that the application of nitrogen in the spring significantly increased the nitrogen content of bulbs, but, once again the application of nitrogen in the autumn had no effect. The results in this investigation showed that mother bulb nitrogen had no clear effect on the growth and bulb yield, nevertheless both nitrate and ammonia nitrogen uptakes significantly decreased with increasing nitrogen concentration of the mother bulb.

It is likely that such disagreement for aftereffect of nitrogen application as in the previous papers is caused by the inverse correlation between mother bulb nitrogen and subsequent nitrogen uptake. Furthermore, aftereffect might be also influenced by the later absorption as described by Tsutsui (1967).

It was proved that distribution factor of nitrogen originated from mother bulb to each part of plant changed only very slightly as nitrogen level of mother bulb increased, and 15 % of those was transferred into the flower which removed by defloration and finally 70 % was redistributed into daughter bulbs.

Large quantities of nitrogen originated from mother bulb would be subsequently redistributed into daughter bulbs at the lifting time, as the similar studies by Irobe (1966) and Schmalfeld (1965).

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Table 1 - Composition of the nutrient solution used in sand culture

Element	Conc. of element	Chemicals used
N	100 ppm	$Na^{15}NO_3$ + $(NH_4)_2SO_4$
		$NaNO_3$ + $(^{15}NH_4)_2SO_4$
P	30	$NaH_2PO_4.2H_2O$
K	100	K_2SO_4
Ca	80	$CaCl_2 \cdot 2H_2O$
Mg	50	$MgSO_4 \cdot 7H_2O$
Mn	0.5	$MnSO_4 \cdot 4H_2O$
B	0.5	H_3BO_3
Zn	0.1	$ZnSO_4 \cdot 7H_2O$
Cu	0.01	$CuSO_4 \cdot 5H_2O$
Mo	0.01	$(NH_4)_6Mo_7O_{24} \cdot 4H_2O$
Fe	0.55	Fe-EDTA

pH : 5.8-6.0

Table 2 - Effect of nitrogen concentration of mother bulb on the growth at flowering (9 May) and bulb yield at lifting in tulip, Rose Beauty (9 cm grade planting bulb)

N % of mother bulb	Growth of tops (cm)			Bulb yield (g/plant)		
	Stem length	1st leaf length	1st leaf width	Main bulb	Lateral bulb	Total
0.99	30.9	13.1	10.0	26.0	6.9	32.9
1.22	29.5	13.6	10.2	25.9	7.3	33.2
1.36	28.7	13.0	9.8	22.9	8.8	31.8
1.64	28.4	13.2	9.6	24.4	9.0	33.4
1.87	24.1	12.8	9.0	22.1	9.2	31.3

Table 3 - Effects of nitrogen concentration of mother bulb on nitrogen content (mg/plant) in the parts of plant of tulip , Rose Beauty at flowering (9 cm grade planting bulb)

N % of mother bulb	Flower	Leaf				Stem	Daughter bulb	Root	Mother bulb	Total
		1st	2nd	3rd	Total					
0.99	33	28	19	16	63	21	41	14	6	178
1.22	31	27	18	18	63	20	43	13	7	177
1.36	32	26	19	19	64	21	48	13	7	185
1.64	30	26	19	20	65	20	54	10	9	188
1.84	27	24	16	17	57	18	54	11	9	176

Table 4 - Effects of nitrogen concentration of mother bulb on the contents of various nitrogen ; originated from mother bulb, absorbed from NO_3-N and NH_4-N, in tulip, Rose Beauty

N % of mother bulb	N mg / whole plant at flowering				N mg of daughter bulbs/plant at lifting			
	Mother bulb N	NO_3-N	NH_4-N	Total	Mother Bulb N	NO_3-N	NH_4-N	Total
0.99	65	67	46	178	53	49	48	150
1.22	80	56	41	177	71	47	32	150
1.36	112	53	20	185	84	36	34	153
1.64	128	46	13	188	104	36	39	179
1.87	124	36	14	176	100	31	36	167

Table 5 - Partition of mother bulb nitrogen between the parts of plant at flowering and recovery of mother bulb nitrogen at lifting in tulip, Rose Beauty

N % of mother bulb	% of mother bulb N at flowering							% of N recovered into lifted bulb
	Flower	Leaf	Stem	Daughter bulb	Root	Mother bulb	Whole plant	
0.99	16	37	10	20	10	7	100	74
1.22	14	38	9	23	9	7	100	72
1.36	15	36	10	25	8	6	100	75
1.64	16	34	10	29	5	6	100	71
1.87	15	32	10	31	6	6	100	56
Mean	15	36	10	26	8	6	100	70

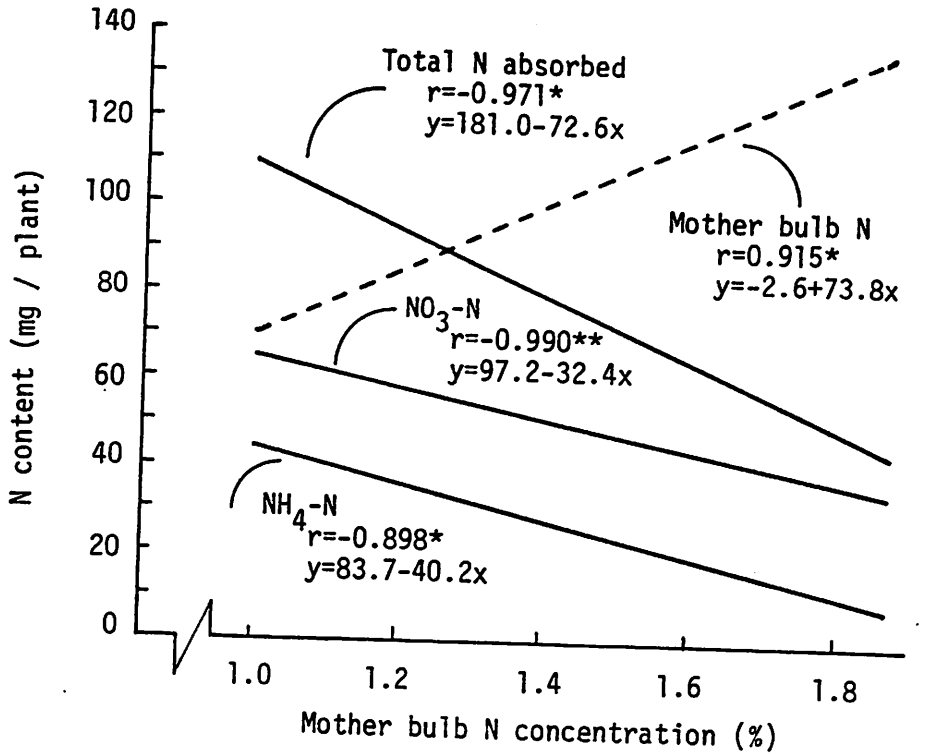

Figure 1 - Relation between nitrogen concentration of mother bulb and absorbed nitrogen content in whole plant of tulip, Rose Beauty,at flowering

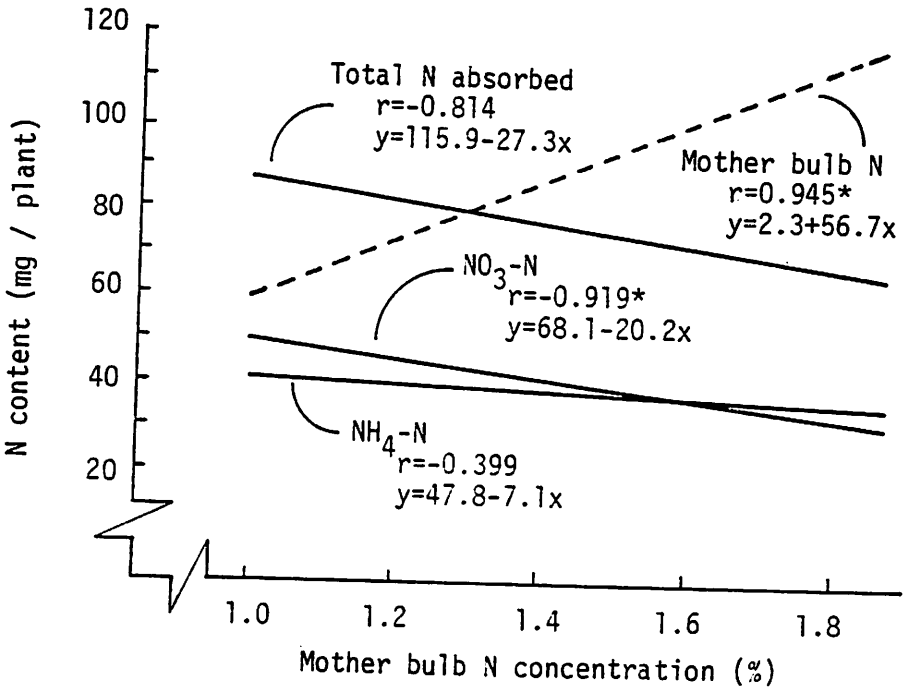

Figure 2 - Relation between nitrogen concentration of mother bulb and absorbed nitrogen content in daughter bulb of tulip, Rose Beauty, at lifting

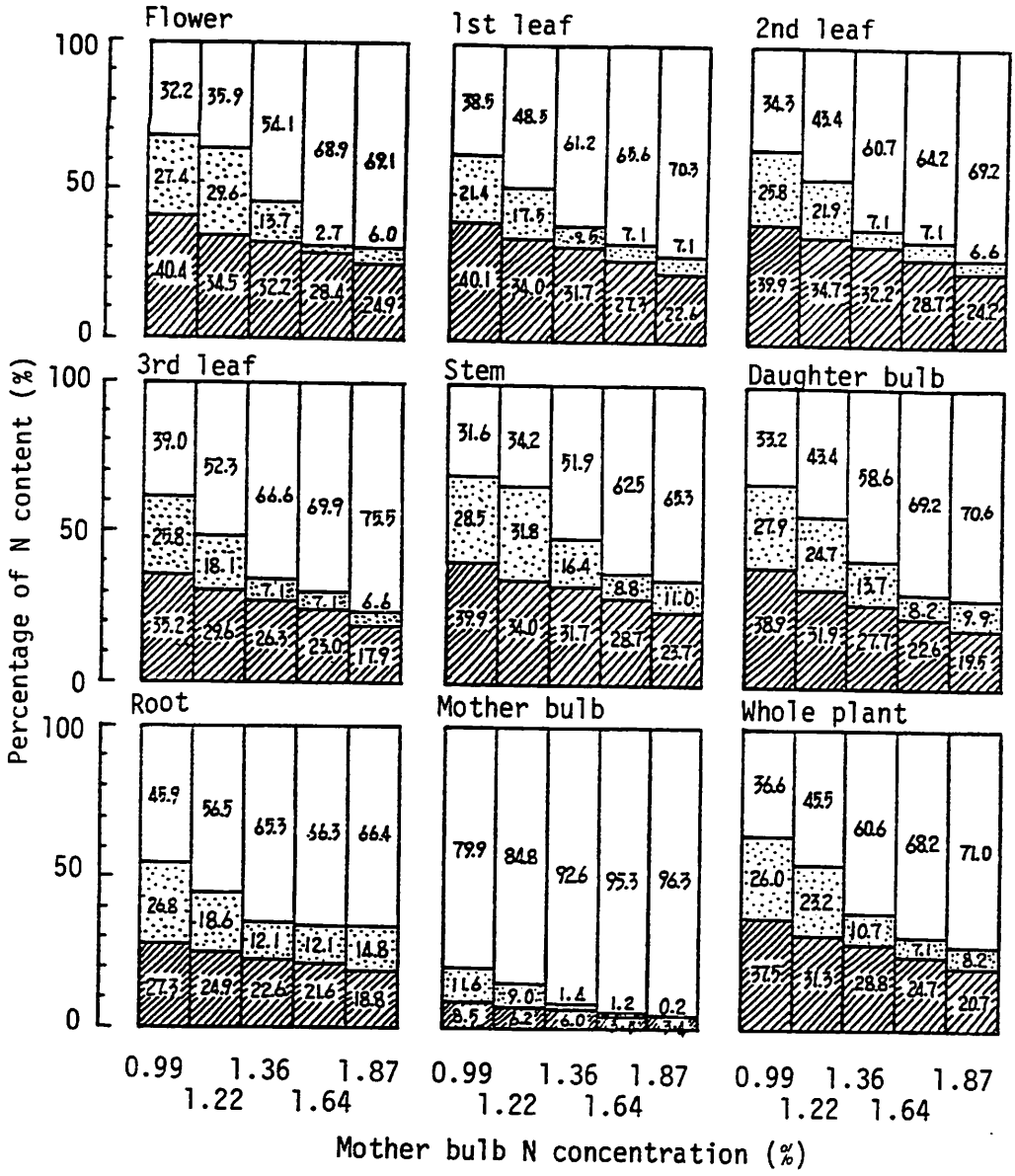

Figure 3 - Influence of nitrogen concentration of mother bulb on the partition of nitrogen content between various nitrogen (originated from mother bulb, absorbed from NH_4-N and from NO_3-N) in the parts of plant of tulip, Rose Beauty at flowering