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Short communication

The Effect of Different Rates of Nitrogen Fertilizer Application on the Growth, Yield and Postharvest Life of Cauliflower

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ABSTRACT. *A Field experiment was conducted to compare the effect of urea as a fertilizer on growth, yield and post harvest life of cauliflower (Brassica oleracea L). Four levels of urea were compared with the recommendation of the Department of Agriculture (DOA), using a Randomized Complete Block Design. Other cultural practices and crop protection were done according to the recommendations of the DOA. The plant height at one week after transplanting and 50% flowering, number of leaves at 50% flowering, total leaf area at time of flowering, total number of days to flowering, and time period for curd maturity were recorded in each treatment. The average cauliflower curd yield in the field varied between 90 - 125 g/plant (3.6 – 5.0 t/ha). The results revealed the possibility of increasing N dosage up to 125% of the DOA recommendation for obtaining larger curds and a higher curd yield. Significant difference was not observed ($p>0.05$) among the treatments in any of the curd quality parameters measured. Even though no significant difference was observed among the post harvest quality, curds of the 50% nitrogen fertilizer treatment stored at room condition and in polythene bags could be kept 6 days & 9 days longer than other treatments, without decay.*

INTRODUCTION

Nitrogen is an essential plant nutrient, which is involved in physiological processes and enzyme activities. Farmers use urea excessively as a nitrogen fertilizer, to enhance flowering, curd set and increase curd size in cauliflower (*Brassica oleracea* L). Nitrogen could increase production of cauliflower, but the curd quality is affected. Cauliflower is a perishable and tissue deterioration occurs during cold storage. High nitrogen contents with deficits of other nutrients could reduce the storage life of cauliflower (Kirthisinghe, 2006). Therefore, the present study was carried out to determine the effect of different rates of N fertilizer application on the growth, yield and post harvest life of cauliflower variety 'Conpra F1 Hybrid'.

MATERIALS AND METHODS

A field experiment was carried out using cauliflower (*B. oleracea*), in a Randomized Complete Block Design (RCBD) with five treatments and four replicates, at the University

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Experimental Station at Dodangolla, which is located in the mid country Intermediate zone. The recommendation of the Department of Agriculture (DOA; T1) with 50% (T2), 75% (T3), 125% (T4) and 150% (T5) of the nitrogen recommendations of DOA were the treatments imposed (Table 1). Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MOP) were used to supply N, P and K, respectively. The rate of application of TSP was 125 kg / ha while that of MOP was 90 kg/ha.

Table 1. Treatment combinations for the field experiment at University experimental station, Dodangolla.

Treatment	N (kg/ ha)	N:P	K:N
T1- DOA recommendation	150	1.2	0.6
T2 - 50% N	75	0.6	1.2
T3 - 75% N	113	0.9	0.8
T4 - 125% N	188	1.5	0.5
T5 -150% N	225	1.8	0.4

During the vegetative stage, plant height (the highest point of the plant above the soil surface) was measured one week after transplanting and at 50% flowering, total number of leaves per plant were counted at flowering, the total leaf area per plant was measured at flowering, time taken for anthesis was recorded, and the time period for curd maturity were determined for each treatment. Leaf area was measured using a portable leaf area meter (model LICOR, LI 3000C, Inc., USA).

The curds were harvested at commercial maturity. The curd weight of each plant was recorded soon after harvest. Fresh and dry weights of plant and curd yield, total yield per plot, market value measurements *viz*. average size (diameter) of the curd and diameter of the florets, were recorded. The firmness of the curd was measured using a hand held penetrometer (model Bishop, Fruit pressure tester FT011, USA).

The assessment of keeping quality of the curd was done using four randomly selected curds from each fertilizer treatment. Among these four curds,

1. Two curds were kept open at room temperature (28$\pm$2 ^{o}C)
2. Two curds were stored in 150 gauge low density polythene bags at a relative humidity of 93$\pm$3% and at room temperature (28$\pm$2 ^{o}C)

The weight loss of curd during storage was measured. The storage life was measured as a quality parameter by counting the number of days to show initial signs of deterioration, (*i.e.* change in colour). The percentage of weight loss of each treatment was determined at 2, 4, 6 and 8 days of storage.

The data were analysed with the Statistical Analytical Software (SAS, 1998) package using General Linear (GLM) and Log Linear Models. Analysis of Variance (ANOVA) was performed and the Duncan Multiple Range Test (DMRT) was conducted for normally distributed data. Data recorded using indices *viz*. the colour and compactness of the curd, were analysed using Kruskal Wallis Test, which is a non-parametric test in MINITAB computer software (MINITAB, 1999).

RESULTS AND DISCUSSION

The average curd yield of cauliflower under Sri Lankan conditions is 6 t/ha (DOA, 1993). The average curd yield for the DOA recommendation of the present study was 4.6 t/ha (Table 2). Cauliflower requires a high amount of N, P and K to produce a profitable curd yield (Sparks, 1988). In the present study the lowest yield of 3.6 t/ha and the highest yields of 5.0 t/ha were recorded in plots treated with 50% N and 125% N, respectively. A yield gain of 9.7% from the plots treated with 125% N, and a yield loss of 21% from those treated with 50% N were observed when compared to the DOA recommendation. A significant difference ($p<0.050$) was observed in the dry weights among the fertilizer treatments (Table 2). The highest dry weight was recorded in the 125% N treatment while the 50% N treatment gave the lowest dry weight. This could be due to the low rates of N when compared to the DOA recommendation.

Table 2. Mean curd yield (t/ha) and percentage of yield loss of cauliflower at different levels of nitrogen

Treatments	Mean yield (g/plant)	Mean yield (t/ha)	Yield loss/gain %	Mean dry weights (g)
T1 DOA recommendation	114 ab	4.6 ab	0.0	22.2 ab
T2 50% N	90 c	3.6 c	-21.0	17.4 c
T3 75% N	102 b	4.1 b	-10.5	19.8 b
T4 125% N	125 a	5.0 a	+9.7	24.1 a
T5 150% N	117 ab	4.7 ab	+2.6	22.7 ab

Means with same letters were not significantly different within each column ($p \leq 0.05$) using DMRT.

Average diameter of the curd

The plots treated with 125% N gave a significantly higher ($p<0.05$) mean curd diameter than the rest of the treatments. The mean curd diameter of the plots treated with 125% N was 12.0 cm, varying from of 11.8-13.0 cm, while the mean curd diameter in the 50% N treatment was 9.5 cm, varying from 9.1- 10.2 cm. Wenqiang *et al.,* (2004) reported that nitrogen application increases curd weight and diameter, as observed in the present study. No significant difference was observed between the DOA treatment and 75% or 150% N treatment in relation to the average diameter of the cauliflower curd.

The number and the percentage of market grade curds per treatment

The number of marketable curds showed no significant difference ($p>0.05$) among the nitrogen treatments. Even though there were 16 plants in each plot, some plants did not produce a marketable curd due to insect attacks or diseases. Therefore, the mean number of marketable curds per plot ranged from 14 to 16.

The firmness and compactness of the curd

Firmness, which indicates the compactness of the curd, showed no significant differences ($p>0.05$) among the nitrogen treatments. All treatments showed a curd riciness ranging from 4-7% with loose compactness and small flower buds on the surface.

Mean height and total leaf area per plant of the cauliflower at flowering

A significant difference was observed in the mean height of the cauliflower plant among the rates of nitrogen fertilizer applied. The highest mean height of the cauliflower plant was obtained in the plots treated with 125% N (10.16 cm), while those with 50% N gave the lowest (8.88 cm). A significant difference was observed in total leaf area per plant among the fertilizer treatments ($p<0.05$). The highest leaf area per plant was obtained in the plots treated with 125% N (2753.9 cm^2) while those with 50% N gave the lowest leaf area per plant (2201.3 cm^2).

Shelf life of curd

No significant differences were observed ($p>0.05$) among the rates of nitrogen fertilizer application on shelf life of cauliflower curd stored under different conditions. Curds from plots treated with 50% N and 75% N stored at high relative humidity conditions (in polythene bags) had the longest storage life (Fig. 1). The 125% N and 150% N applications had the shortest storage life in both environmental conditions.

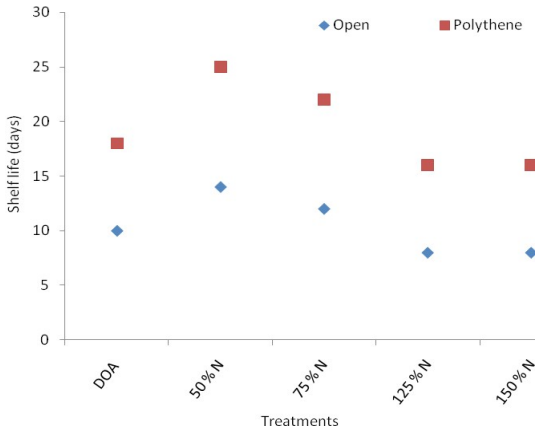

Fig. 1. Storage life of cauliflower curds stored at 28 ºC in open and in polythene bags.

The results of the present study revealed that the cauliflower curds stored in polythene bags with a relative humidity of 93±3% had the highest storage life of 25 days (Fig. 1). Curds stored in polythene bags may have a reduced respiration rate due to low oxygen levels and high carbon dioxide, thus resulting in the highest storage life when compared to the other environmental conditions. There were no significant differences ($p>0.05$) among the N fertilizer treatments on the shelf life of cauliflower curd. However, curds obtained from 50% N treatment and stored at room temperature showed an additional 6 days of storage, and those from the 50% N treatment and stored in polythene bags showed an additional 9 days of storage when compared to the curds from the T1 (DOA recommendation) stored under respective conditions. This would give the farmers a considerable economic advantage.

Weight loss of the curd during storage

A significant difference ($p<0.05$) was observed between the cauliflower curds kept under open conditions and in 150 gauge low density polythene bags, but no significant differences ($p>0.05$) were observed among the N treatments on the weight loss of cauliflower curd during storage. The effect of modified atmosphere packaging (MAP) on reducing weight loss may be due to the limitation of water vapour pressure inside the polythene packages.

CONCLUSIONS

Increase in the rate of N application up to 125% of the DOA recommendation formed larger and heavy cauliflower curds under field conditions, contributing to a 10% increase in curd yield. The reduction in the N application rates to 50% of the DOA recommendation was found to be uneconomical due to the lower dry matter accumulation and hence, the yield reduction. Adjustment of N fertilizer application within a range of 50-150% of the DOA recommendation could be done without a significant effect on curd formation, curd quality (VQR firmness) and storability. The additional 6 days of storage life observed in the curds obtained from plots treated with 50% N would provide a considerable advantage, over the other treatments.

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