Journal of Tropical Agriculture 34 (1996) : 108-111

EFFECT OF PLANT DENSITIES AND NITROGEN ON THE YIELD AND QUALITY OF KEW PINEAPPLE

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Abstract: Reduction in individual fruit size was resulted with increased plant density in Kew pineapple. However, the estimated yields indicated a reverse pattern owing to the increased number of plants under high density systems. Increased nitrogen levels favourably influenced the fruit measurements and estimated yields. The quality attributes were not influenced by plant densities whereas, nitrogen levels showed significant effects on quality parameters also.

Key words: Canning ratio, crown, dry matter accumulation, harvest index.

INTRODUCTION

One is ultimately concerned with the improvement of yield and quality character while manipulating the cultural practices of a crop. In pineapple, the fruit size, shape, total yield per hectare, and quality attributes are the most important such factors. On examining the low productivity, the density of planting stands to he as one of the most important factors in pineapple cultivation. In India, the conventional plant density was only 12,00 per hectare whereas, in Philippines it has been as high as 62,000. This wider planting results in low yields leading to high cost of production per unit area. Accordingly it is of utmost importance to increase the plant density, so as to reduce the cost of production and to increase productivity. But, when the plant density increases there will be obvious competition of plants for manures and fertilizers. Hence there exists necessity to pinpoint the level of plant density up to which one can go for a particular crop, under specific agro-climatic conditions without reduction in yield or quality. Dosage and method of application of the major nutrient nitrogen are also factors influencing the growth, yield and quality of a crop. This paper deals with the effect of plant densities, levels and methods of nitrogen application on the productivity of Kew pineapple.

MATERIALS AND METHODS

The investigations were carried out at the Indian Institute of Horticultural Research, Bangalore with a view to study the effects of varying levels of plant densities, applied nitrogen and methods of nitrogen application on pineapple variety Kew.

The experiment was laid out in split plot design with the combination of three levels of plant densities (44400, 53333 and 63758 plants ha^{-1}) and nitrogen (8, 12 and 16 g/plant) as main plot treatments and three methods of nitrogen application (full soil application, 25% and 50% as foliar sprays after flowering the remaining to soil before flowering) as sub plot treatments. The treatments were replicated thrice.

Data on yield and fruit characters were recorded at the time of harvest. Ten fruits from each replication were utilised for recording observation and the mean values were calculated. Physical characters of the fruits observed were length (1), breadth (b), l/b ratio, taper ratio (circumference of fruit at the bottom / circumference at the top), weight of the fruit and crown. Estimated yield per hectare and harvest index (HI= [economic yield / total biological yield] x 100) were calculated from the observations. The fruits were subjected to

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chemical analysis to elucidate the influence of treatments on total soluble salts (TSS), acidity, ascorbic acid and sugar contents. The data were tabulated and subjected to statistical analysis .

RESULTS AND DISCUSSION

The data on yield and fruit characters as influenced by different treatments are presented in Table 1 and 2 and Fig. 1 and 2. In the present study, the length of the fruits varied from 9.9 to 15.2 cm, breadth from 9.9 to 12.04 cm and weight ranged from 1.05 to 1.68 kg with the crown and the crown weight from 185.7 to 273.2 g in general.

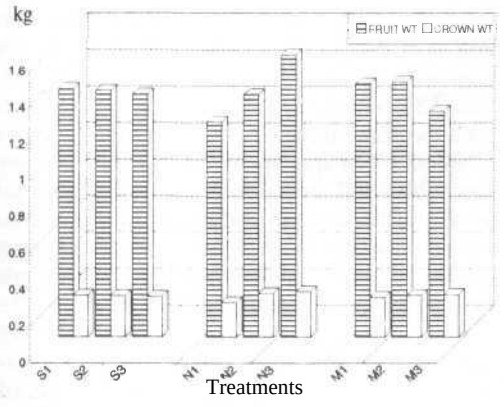

Fig 1. Fruit weight and crown weight as influenced by treatments

Reduction in individual fruit size as a consequence of increasing plant population in pineapple had been reported by a number of early workers (Chadha *et al.*,1975; Dass *et. al.*, 1978 and Mwaule, 1985). The present study revealed that the weight of the fruit as well as that of the crown reduced with the reduction in spacing adopted. However, close perusal of the results indicated that the length of fruit and canning ratio got influenced adversely when the planting density was beyond 53333 plants ha^{-1} and the breadth of the fruit was better under this plant population level. The better results at this spacing level could be due to the favourable influence of this treatment on dry matter production in plant parts and other growth parameters indicating lack of much competition between plants.

Table 1. Fruit characters in Kew pineapple in relation to levels of spacing, doses of nitrogen and methods of nitrogen application

Treatments	Length, cm	Breadth, cm	L / B	Taper ratio
Spacing				
S1	12.51	10.71	1.162	0.918
S2	12.53	10.80	1.163	0.918
S3	12.47	10.74	1.157	0.918
CD(0.05)	0.02	0.02	0.002	NS
Nitrogen				
N1	10.90	9.97	1.093	0.910
N2	12.40	10.59	1.168	0.920
N3	14.41	11.70	1.231	0.927
CD(0.05)	0.02	0.02	0.002	0.001
N appln				
M1	13.41	11.17	1.200	0.920
M2	12.91	10.84	1.186	0.920
M3	11.38	10.25	1.107	0.917
CD(0.05)	0.03	0.02	0.003	0.002

The estimated yield per hectare increased significantly with the increase in plant population. This fact had been reported by many early authors (Singh *et al.*, 1974; Chadha *et al.*, 1975; Kore *et al.*, 1982). Eventhough, the maximum total yield was obtained from the closest spacing level, due to the tremendous increase in number of plants accommodated per unit area, this was at the expense of individual fruit weight. Hence, while considering the fruit and yield characters we could make out that the plant population density of 53333 plants ha^{-1} was the most desirable level. This conclusion is in conformity with the observations of Dass *et. al.*, 1978.

Increased fruit size and yield as a consequence of added nitrogen is an established fact in pineapple (Rao *et al.*, 1974; Singh *et al.*, 1977; IIHR, 1984). A positive relationship between the quantity of applied nitrogen and the fruit measurements and estimated yield could be made out from the results. The favourable influence of added nitrogen on the dry matter accumulation and all the vegetative growth

parameters might be the possible reason for its influence on the fruit characters also.

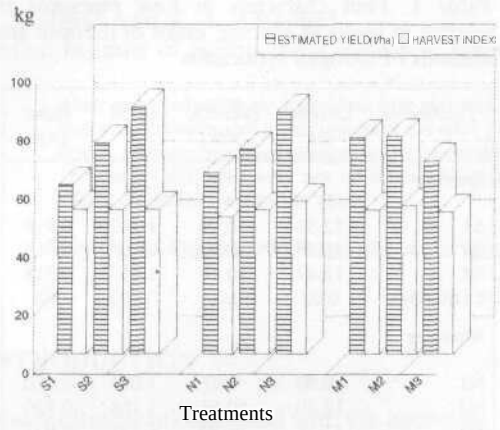

Fig 2. Estimated yield and harvest index as influenced by treatments

Though the fruit length, canning and taper ratios were higher when all the nitrogen was applied in soil during pre-flowering period, the individual fruit weight was more when 25 per cent of the nutrient was sprayed on the foliage during the post-flowering stage. However, the disadvantage of spraying more nutrient solution to the extent of half the dose after flowering, was the extensive crown development at the expense of fruit weight. The estimated yields were almost similar when the nitrogen was applied either fully in soil or 25 per cent into foliage. The close perusal of the results indicated that at 16 g nitrogen level and application of 25 per cent as foliar sprays would be more advantageous in a crop planted at a density of 53333 plants ha^{-1}.

An attempt has been made to compare the harvest indices (HI) for pineapple receiving different treatments (Fig. 2). In general, the values ranged from 46.58 to 55.73 which indicate the percentage of total biological yield partitioned to the economic part of the plant viz., the fruit, in terms of dry matter. This parameter is widely used in comparison of the crop efficiency, since it highlights the net return per unit input incurred. In the present investigation, the HI was not found to change in pineapple grown under different planting densities. The parity observed in this aspect between the levels of spacing thus clearly uphold the fact that pineapple is highly adaptable to high density plantings. Harvest index was also observed to be influenced favourably by the applied nitrogen, which could be accounted to the culminated effects of the nutrient on various growth aspects. The application of 25 per cent of nitrogen as foliar sprays after flowering was again proved to be the best in recording higher HI values. In nutshell, under high density planting, application of 25 per cent of the nitrogen to leaves after flowering with a level of 16 g / plant can be considered as the best to get higher HI values.

In general, the total soluble solid content of the fruits ranged from 13.08 to 16.81 per cent and acid constituents from 0.77 to 1.002 per cent with a TSS / acid ratio of 16.77 to 18.15. The TSS and acid content of the fruits expressed the same trend under different treatments (Table 2). The spacing levels did not exert any significant influence on any of the quality aspects, in the present study. The literature also pointed out the lack of influence of planting densities on the quality aspects of pineapple (Kore *et al.*, 1982 and Mwaule, 1985).

Nitrogen nutrition in pineapple had been reported to have impact on the quality aspects of the fruits also. In the present study, both the TSS and acidity of the fruits were reduced by increasing levels of nitrogen. The findings were in accordance with the reports of early authors (Singh *et al.*, 1977). However, the TSS / acid ratio which represents the ultimate quality of the fruits was significantly increased by the applied nitrogen levels and was as high as 17.55 at 16 g nitrogen per plant. The sugar contents of the fruits were also found to be increased by applied nitrogen. The decreased acidity and increased sugars in the fruits when supplied with higher nitrogen level might be due to the accelerated conversion of organic acids to sugars.

The influence of methods of nitrogen application tried, on the quality aspects of fruits were apparent from the results. When 25 per cent

Table 2. Quality attributes in Kew pineapple in relation to levels of spacing, doses of nitrogen and methods of nitrogen application

Treatments	TSS, %	Citric acid %	TSS / acid	Ascorbic acid mg 100g^{-1}	Sugars, %		
					Reducing	Non-reducing	Total
Spacing IS)							
SI	14.82	0.857	17.34	13.80	4.05	6.96	11.00
S2	14.83	0.856	17.35	13.80	4.05	6.96	11.01
S3	14.83	0.856	17.32	13.80	4.05	6.96	11.01
CD(0.05)	NS	NS	NS	NS	NS	NS	NS
Nitrogen (N)							
N1	16.33	0.962	16.98	13.85	3.80	6.42	10.22
N2	14.67	0.839	17.48	13.85	4.10	6.99	11.08
N3	13.49	0.767	17.55	13.89	4.25	7.47	11.71
CD(0.05)	NS	0.002	0.03	NS	0.005	0.01	0.01
Methods of N appln (M)							
M1	15.37	0.896	17.19	13.87	4.10	7.09	11.19
M2	14.93	0.867	17.19	13.87	4.11	7.17	11.28
M3	14.19	0.805	17.64	13.84	3.93	6.62	10.55
CD<0.05)	0.02	0.002	0.03	NS	0.01	0.01	0.01

nitrogen was applied as foliarsprays after flowering, it helped to increase the total sugar content of the fruits while the TSS and acid contents were the medium. This situation also could be better explained as due to the increased conversion of acids to sugars in the fruits when supplied with nutrient sprays.

ACKNOWLEDGEMENT

The senior author is grateful to the 1CAR for the financial help in the form of Senior Fellowship.

REFERENCES

Chadha, K. L., Melanta, K. R. and Subramanian, T. R. 1975. Studies on nutrition of pineapple: IV. Effect of sources of nitrogen and potassium on yield and quality of pineapple. *Indian J. Hon.* 32 : 142-145

Dass, H. C., Redd>, B. M. C. and Prakash, G. S. 1978. Plant spacing studies with Kew pineapple. *Scientia Horticulturae* 8 : 273-277

IIHR, 1984. *Annual Report.* Indian Institute of Horticultural Research, Bangalore

Kore, V. N., Gunjate, R. T. and Limaye, V. P. 1982. Effect of spacing on growth and fruiting of Kew pineapple. *Indian J. Hort.* 39 : 183-185

Mwaule, Y. W. 1985. The influence of planting material, spacing and ethrel on pineapple development, production and quality. *Ada Horticulturae*, 153 : 63-68

Rao, G. G., Sharma, C. B., Chadha, K. L. and Shikamany, S. D. 1974. Effect of varying soil moisture regimes and nitrogen levels on plant growth, yield and quality of Kew pineapple. *Indian J. Hort.* 31 : 306-312

Singh, U. R., Pandey, 1. C. and Singh, D. V. 1974. Effect of different spacings on plant growth, fruit size and yield of pineapple var. Giant Kew. *Prog. Hort.* 5 : 69-76

Singh, H. P., Dass, H. C., Ganapathy, K. M. and Subramanian, T. R. 1977. Nitrogen requirement of pineapple under irrigated and rainfed conditions. *Indian J. Hort.* 34 : 377-384