Influence of plant population and nitrogen on fruit yield quality and leaf nutrient content of Kew pineapple.

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INFLUENCE OF PLANT POPULATION AND NITROGEN ON FRUIT YIELD QUALITY AND LEAF NUTRIENT CONTENT OF KEW PINEAPPLE.

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SUMMARY - A plant population of 53,333 plants/ha in a two row system of planting with a spacing of 25x45x105 cm was found optimum for 'Kew' pineapple, yielding 106 tons/ha which was 30 per cent more than 37,037 plants/ha (control). Nitrogen level at 500 kg/ha was found best yielding 109 tons/ha with a reduction at higher levels. Low population plants produced bigger sized fruits with high T.S.S. while ascorbic acid was more in high plant population fruits. Nitrogen increased the ascorbic acid content and reduced the T.S.S. of the fruits. Low plant population increased the leaf P, K and Ca and reduced the leaf Mg content. Nitrogen application increased the leaf N, P, Ca and Mg contents and reduced the leaf K content at 12th month stage.

INFLUENCE DE LA DENSITE DE PLANTATION ET DE L'AZOTE SUR LA QUALITE DU FRUIT ET SUR LES TENEURS DES ELEMENTS DANS LES FEUILLES CHEZ L'ANANAS «KEW».

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RESUME - Une densité de 53.333 plants/ha en rangées doubles selon le dispositif 25x45x105 cm s'est révélée optimum pour l'ananas «Kew» assurant une récolte de 106 t/ha soit 30 p. 100 de plus que le témoin à 37.037 plants/ha.
La meilleure dose d'azote a été 500 kg/ha et a produit 109 t/ha ; des doses plus élevées entraîneraient des réductions de rendement. Des faibles densités ont donné des fruits plus gros à extrait sec élevé, alors que l'acide ascorbique était plus important aux fortes densités. L'azote a augmenté la teneur de ce dernier et réduit l'extrait sec.
Dans les feuilles, aux faibles densités, P, K et Ca croissaient alors que Mg diminuait. L'apport de N a augmenté les teneurs foliaires en N, P, Ca et Mg, et réduit celle en K.

INTRODUCTION

Plant population plays an important role in determining the yield of pineapple and higher plant population increased the hectare yield appreciably (Chadha *et al.*, 1973 ; Norman, 1978 ; Dass *et al.*, 1978). Plant population has no influence on the vegetative growth of pineapple (Mustaffa, 1980). Due to high cost of nitrogen fertilizers and also its adverse effects on fruit quality, standardizing optimum nitrogen for pineapple add special importance (Tay, 1972 ; Singh *et al.*, 1977). Accordingly, a study was conducted to find out the optimum plant population and nitrogen for maximum yield with good quality fruits in Kew pineapple.

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MATERIALS AND METHODS

The study was conducted at Central Horticultural Experiment Station, Chethalli, Coorg, which is situated at an altitude of 950 m and receives an annual rainfall of 1700 mm mostly during June to September. 'Kew' variety of pineapple was used in the study during 1980-81. The treatments were : Five plant populations viz., 37,037 (P_1), 40,404 (P_2), 44,444 (P_3), 48,484 (P_4) and 53,333 (P_5) plants/ha planted in a double row system of planting with four levels of nitrogen viz., 400 (N_1), 500 (N_2), 600 (N_3) and 700 (N_4) kgs N/ha in a factorial randomised block design with three replications. The soil nutrient content of the experiment field was medium in N and P, high in K and pH 6.7 with clay loam texture. Nitrogen as urea was applied in six split doses at six bi-monthly intervals upto 12 months. 100 kgs P_2O_5 and 500 kgs K_2O/hectare were applied in two and three splits respectively along with urea. Sprinkler irrigation was given at monthly intervals during the dry months (March to May).

The variates recorded were : fruit length, breadth and fruit weight (with crown) from twenty fruits/treatment. The hectare yield was estimated by multiplying fruit weight with crown with flowering percentage. The fruit quality characters viz., T.S.S., acidity, sugar/acid ratio, ascorbic acid, reducing and total sugars were estimated adopting standard procedures (Ranganna, 1977). The leaf samples were collected at 12th month stage from the 'D' leaf base and were analysed for leaf N, P, K, Ca and Mg contents (Subramanian *et al*., 1974).

RESULTS

Fruit Characters :

Significant differences were obtained among the plant populations for fruit characters (Table 1). Low plant population (P_1) produced fruits with highest length, breadth and weight of fruits. Highest hectare yield of 106.13 tons/ha was recorded by P_5 population which was 30% increase over P_1 population (81.48 tons/ha). The average fruit weight (2.20 kg), fruit length (18.5 cm) and fruit breadth (13.5 cm) were highest in the low plant population (P_1). The minimum was recorded by P_5 population for length, breadth and weight of the fruits.

Significant influence of nitrogen on fruit parameters were recorded (Table 1). Nitrogen application increased the fruit length and breadth however, the differences were not significant. Maximum fruit length (17.8 cm) and breadth (13.15 cm) were recorded at 500 kg and 700 kg N/ha respectively. Significant increase by nitrogen was observed for average fruit weight and the highest (2.44 kg) was recorded by 500 kg N/ha while the higher levels reduced it. Similarly, hectare yield was maximum at 500 kg N/ha (109.2 tons) recording an increase of 19 per cent over 400 kg.

Quality characters :

Plant population did not influence significantly on the quality characters (Table 2). High population (P_5) has no influence on T.S.S. (Brix) and sugar/acid ratio and this was important for processing industry. High acidity (1.204%) and ascorbic acid (16.9 mg) contents were recorded in high population (P_5) fruits and the minimum was recorded by P_1 population. Significant differences were observed for reducing, non-reducing and total sugars which was maximum at low plant population while high plant population reduced them.

Nitrogen application significantly reduced the T.S.S. (Brix) and acidity contents of the fruits and the maximum was recorded at 400 kg N/ha. Highest ascorbic acid (15.1 mg) was observed at 700 kg N while the reducing, non-reducing and total sugars were maximum at 400 kg N/ha.

Leaf nutrient composition :

The leaf nutrient analysis indicated significant differences among the population (Table 3). Plant populations had no influence on the leaf N. Leaf P (0.15%) was maximum at P_1 population and was significantly higher than P_5 population (0.09%). Leaf K was also high at P_1 population (3.49%) and was 71 per cent higher than P_5. Low plant population recorded the maximum leaf Ca content (2.74%) while leaf Mg (0.99%) content was maximum at high plant population and the differences were significant.

Nitrogen application increased the leaf N, P, Ca and Mg contents of pineapple significantly and decreased the leaf K content. Maximum leaf N, P, Ca and Mg contents were recorded at 700 kg N while the maximum leaf K was observed in 400 kg N level.

DISCUSSION

The increase in fruit parameters by low plant density was due to lesser competition from neighbouring plants and an adequate soil volume for their root growth (Collins, 1960 ; Chadha *et al*., 1973 ; Norman, 1977). Maximum hectare yield was obtained at high plant density owing to higher plant population per unit area (Gunjate and Limaye, 1977; Wee, 1969). High T.S.S., reducing, non-reducing and total sugars were recorded at low plant population may be due to larger leaf area available for photosynthesis. High plant population increased the acidity and ascorbic acid contents of the fruits. Chadha *et al.* (1973) found that high population increased the acidity while Norman (1978) reported that population has no effect on acidity content. Nitrogen application increased the fruit characters and yield to a level and then decreased at higher levels as reporter by Tay *et al.* (1968) and Singh *et al.* (1977). Nitrogen application decreased the T.S.S., acidity and sugars and increased the ascorbic acid content of the fruit (Tay, 1972).

The leaf N, P, K, Ca contents were high at low plant population due to more soil volume and more area for absorption (Collins, 1960). The nitrogen application increased the leaf N, P, Ca and Mg and similar results were reported by Subramanian *et al*. (1974). The leaf K content decreased with increased nitrogen application due to the antagonism between these elements (Tay *et al*., 1969).

CONCLUSION

Kew variety of pineapple was planted in five plant populations viz., 37,037, 40,404, 44,444, 48,484 and 53,333 plants/ha with four nitrogen levels viz., 400, 500, 600 and 700 kg N/ha. The results indicated that the average fruit length, breadth and weight were highest at 37,037 plants while the hectare yield was highest at 53,333 plants/ha which was 30 per cent more. High population had no effect on T.S.S. (Brix) and sugar/acid ratio and increased the ascorbic acid content which are of great practical importance for canning industry. At 500 kg N, the average fruit length, weight and hectare yield increased significantly and was found optimum recording a highest yield of 109 tons/ha. Further, higher nitrogen levels reduced the yield. Nitrogen application reduced the T.S.S. and acidity but increased the ascorbic acid content of the fruits. Higher plant population decreased the leaf N, P, K and Ca while leaf Mg increased with higher plant population. The nitrogen application increased the leaf N, P, Ca and Mg contents and decreased the leaf K content.

TABLE 1 - Effect of population and nitrogen on fruit and yield characters of Kew pineapple.

Treatments	Fruits length (cm)	Fruit breadth (cm)	Fruit weight (kg)	Hectare yield (tons)
P_1 (30x60x120 cms)	18.50	13.54	2.20	81.48
P_2 (30x60x105 cms)	17.53	13.07	2.11	85.25
P_3 (30x45x105 cms)	17.52	13.02	2.08	92.44
P_4 (25x60x105 cms)	17.04	12.86	2.02	97.94
P_5 (25x45x105 cms)	16.92	12.74	1.99	106.13
CD	0.690 *	0.233 **	0.182 *	7.985 *
N_1 (400 kg/ha)	17.48	12.97	2.05	91.72
N_2 (500 kg/ha)	17.83	13.04	2.44	109.16
N_3 (600 kg/ha)	17.65	13.08	2.27	101.56
N_4 (700 kg/ha)	17.55	13.15	2.23	99.77
CD	NS	NS	0.162 *	4.476 **
P x N interaction	NS	NS	NS	NS

NS : non-significant * : 5% level ** : 1% level

TABLE 2 - Effect of population and nitrogen on quality of pineapple fruits.

Treatments	T.S.S. (Brix)	Acidity (%)	Sugar/Acid ratio	Ascorbic acid mg/100 g)	Reducing sugars (%)	Non-reducting sugars (%)	Total sugars (%)
P_1 (30x60x120 cms)	16.40	1.081	15.17	11.71	7.75	4.79	12.54
P_2 (30x60x105 cms)	16.30	1.138	14.32	12.63	7.23	4.24	11.47
P_3 (30x45x105 cms)	15.70	1.168	13.04	13.33	6.91	4.15	11.06
P_4 (25x60x105 cms)	15.40	1.198	12.85	14.10	6.65	4.13	10.78
P_5 (25x45x105 cms)	15.30	1.204	13.10	16.94	6.45	3.30	9.75
CD	NS	0.056 **	NS	0.495 **	0.371 **	0.622 **	0.393 **
N_1 (400 kg/ha)	16.60	1.311	12.66	12.29	7.85	4.26	12.11
N_2 (500 kg/ha)	16.20	1.226	13.21	13.31	7.26	4.28	11.54
N_3 (600 kg/ha)	15.70	1.105	14.21	14.27	6.69	4.08	10.77
N_4 (700 kg/ha)	14.70	0.987	14.89	15.10	6.19	3.85	10.44
CD	0.926 **	0.050 **	NS	0.443 **	0.332 **	NS	0.351 *
P x N interaction	NS	NS	NS	NS	NS	NS	NS

NS : non-significant * : 5% level * : 1% level

TABLE 3 - Effect of population and nitrogen on leaf nutrient content of Kew pineapple.

Treatments	Leaf N (%)	Leaf P (%)	Leaf K (%)	Leaf Ca (%)	Leaf Mg (%)
P_1 (30x60x120 cms)	1.95	0.15	3.49	2.74	0.64
P_2 (30x60x105 cms)	1.85	0.13	2.95	2.56	0.78
P_3 (30x45x105 cms)	1.79	0.11	2.65	2.48	0.86
P_4 (25x60x105 cms)	1.66	0.10	2.39	2.32	0.94
P_5 (25x45x105 cms)	1.60	0.09	2.04	2.15	0.99
CD	NS	0.015 **	1.024 **	0.426 **	0.0284 **
N_1 (400 kg/ha)	1.42	0.10	2.98	2.14	0.60
N_2 (500 kg/ha)	1.65	0.17	2.58	2.74	0.88
N_3 (600 kg/ha)	1.97	0.17	2.58	2.74	0.88
N_4 (700 kg/ha)	2.24	0.21	2.46	2.69	1.04
CD	0.205 *	0.017 **	NS	0.310 **	0.320 *
P x N interaction	NS	NS	NS	NS	NS

NS : non-significant * : 5% level ** : 1% level

Thus, a plant population of 53,333 plants/ha with 500 kg nitrogen/ha was found optimum for Kew pineapple for higher yield with good quality fruits.

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REFERENCES

CHADHA (K L.), MELANTA (K.R.) and SHIKHAMANY (S.D.). 1973.
Effect of planting density on growth yield and fruit quality in Kew pineapple (*Ananas comosus* MERR.).
Ind. J. Hort., 30, 461-466.

COLLINS (J.L.). 1960.
The pineapple.
Interscience Publishers Inc. New York.

DASS (H.C.), REDDY (B.M.C.) and PRAKASH (G.S.). 1978.
Plant spacing studies with Kew pineapple.
Scientia Hort., 8 (3), 273-277.

GUNJATE (R.T.) and LIMAYE (V.P.). 1977.
Effect of planting densities on growth and fruiting of Kew pineapple.
J. Maharashtra Agri. Univ., 2, 119-121.

MUSTAFFA (M.M.). 1980.
Annual report. Indian Institute of Horticultural Research Bangalore.

NORMAN (J.C.). 1977.
The effect of plant density on the growth development and yield of pineapple (*Ananas comosus* MERR.) Cv. Smooth Cayenne in Ghana.
Acta Horticulturae, 53, 349-354.

NORMAN (J.C.). 1978.
Response of Sugarleaf pineapple (*Ananas comosus* MERR.) to plant population densities.
Gartenbauwissenschaft, 43 (5), 237-240.

RANGANNA (S.). 1977.
Manual of analysis of fruit and vegetable products.
Tata Mc Graw Hill Publishing Company Limited, New Delhi.

SINGH (H.P.), DASS (H.C.), GANAPATHY (K.M.) and SUBRAMANIAN (T.R.). 1977.
Nitrogen requirement of pineapple under irrigated and rainfed conditions.
Ind. J. Hort., 34, 377-384.

SUBRAMANIAN (T.R.), CHADHA (K.L.), MELANTA (K.R.) and SRINIVASA MURTHY (H.K.). 1974.
Studies on nutrition of pineapple.
II.- Effect of varying levels of N P K on leaf nutrient status in var. Kew. in high fertility soil.
Ind. J. Hort., 31, 219-222.

TAY (T.H.), WEE (Y.C.) and CHONG (W.S.). 1968.
The nutritional requirement of pineapple on peat soil in Malaya.
I.- Effect of nitrogen phosphorus and potassium on yield sugar and acid content of the fruit.
Malays. agric. J., 46, 458-468.

TAY (T.H.), KEE (P.C.) and WEE (Y.C.). 1969.
The nutritional requirements of pineapple *Ananas comosus* MERR. var. Singapore Spanish on peat soil in Malaya.
II.- Leaf analysis in relation to yield sugar and acid contents of the fruits.
Malays. agric. J., 47, 175-186.

TAY (T.H.). 1972.
Comparative study of different types of fertilizer as source of nitrogen, phosphorus and potassium in pineapple cultivation.
Trop. Agric., 49, 51-59.

WEE (Y.C.). 1969.
Planting density trials with *Ananas comosus* MERR. var. Singapore Spanish.
Malays. agric. J., 47, 164-174.

EINFLUSS VON BESTANDSDICHTE UND STICKSTOFFGEHALT AUF DIE FRUCHTQUALITÄT UND DEN ANTEIL DER ELEMENTE IN DEN BLATTERN BEI DER 'KEW'-ANANAS.

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KURZFASSUNG - Eine Bestandsdichte von 53.333 Pflanzen pro ha bei doppelten Pflanzenreihen und gemäss der Anordnung 25x45x 105 cm hat sich für die 'Kew -Ananas als optimal erwiesen und erbringt eine Ernte von 106 t/ha, d.h. 30 % mehr als die Kontrollplantage mit 37.037 Pflanzen/ha.
Die günstigste Stickstoffgabe betrug 500 kg/ha und erbrachte 109 t/ha ; höhere Gaben würden zu Ertragsminderungen führen. Schwächere Bestandsdichten erbrachten grössere Früchte mit hohem Trockensubstanzgehalt, während das Ascorbinsäure-Aufkommen bei starken Bestandsdichten höher ausfiel. Der Stickstoff hatte zur Folge, dass der Ascorbinsäuregehalt anstieg und der TS-Gehalt fiel.
Bei schwachen Bestandsdichten stiegen die Anteile an P, K und Ca und sank der Mg Gehalt im Blattwerk. Die Zufuhr von N führte zu einem höheren Aufkommen an N, P, Ca und Mg und zu weniger K im Blattwerk.

INFLUENCIA DE LA DENSIDAD DE PLANTACO

INFLUENCIA DE LA DENSIDAD DE PLANTACION Y DEL NITROGENO SOBRE LA CALIDAD DE LA FRUTA Y SOBRE LOS CONTENIDOS DE LOS ELEMENTOS DE LAS HOJAS EN LA PINA «KEW».

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RESUMEN - Una densidad de 55.333 plantas/ha en filas dobles según el dispositivo 25x45x105 cm ha resultado ser óptima para la piña «Kew» asegurando una cosecha de 106 t/ha es decir 30% más que el testigo con 37.037 plantas/ha.
La mejor dosis de nitrógeno ha sido 500 kg/ha y ha producido 109 t/ha ; dosis más elevadas acarrearían reducciones de rendimiento. Densidades escasas han dado frutas más gruesas con extracto seco elevado, mientras que el ácido ascórbico era más importante en las fuertes densidades. El nitrógeno aumentó el contenido de este último y redujo el extracto seco.
En las hojas, con escasas densidades, P, K y Ca aumentaban mientras que Mg disminuía. El aporte de N aumentó los contenidos foliares en N, P Ca y Mg y redujo el de K.