PERFORMANCE OF PINEAPPLE *(ANANAS COMOSUS)* IN TWO AGRO-ECOLOGICAL ZONES IN THE DRY ZONE OF SRI LANKA

S.S. WEERASINGHE[1]
Research Officer
Field Crops research and Development Institute
Maha Iluppallama

Pineapple is presently confined to wet and intermediate zones of Sri Lanka, and the total extent under pineapple is still less than 5000 ha. It is mainly grown under coconut in the major growing areas (Ministry of Agriculture and Land, 1997) of Gampaha and Kurunegala districts. However, the extents of coconut lands in these areas are declining due to rapid urbanization. Therefore, exploring the possibility of growing pineapple in the dry zone, where lands are available is a prime need for the development of pineapple industry in Sri Lanka.

Pineapple is a true xerophytic crop with many specific adaptations to survive under limited water availability. Presence of less number of stomata in leaves (Collins, 1960; Purseglove, 1972), their behavior (Samson, 1980), presence of trichomes, water storing tissues and air canals inside the leaf (Samson, 1980) are some features which contribute to the drought withstanding ability of pineapple. In addition, the shallow trough shaped leaf blade with thick cuticle is capable of collecting drizzle or even dew and conducts the water to the leaf base where it is absorbed by trichomes (Samson, 1980). The shallow, fibrous root system can absorb the moisture present in the upper soil layers even after a mild shower. Further, pineapple uses the CAM (Crassulacean Acid Metabolism) system in photosynthesis and hence efficient in dry matter production (Purseglove, 1972). All these features suggest that pineapple would be better adapted to the conditions in dry zone of Sri Lanka. Therefore, the main objective of this study was to examine the feasibility of growing pineapple under DL_1 and DL_2 agro-climatic conditions.

1 Present address: Regional Agricultural Research and Development Center, Angunakolapelessa

MATERIALS AND METHODS

Investigations were initiated at the research fields of regional agricultural research centre, Aralaganwila (DL_2) in 1986 and further continued at field crops research and development institute, Maha Illuppallama (DL_1) in 1995.

The first experiment was established with tissue cultured planting materials of variety Mauritius and Kew. The second experiment was started with conventional suckers (shoots) of varieties Kew and Mauritius obtained from Makandura. Conventional suckers were treated with prothiophos solution against mealy bugs *(Dysmicocus brevipes)* before planting.

The experiment at Aralaganwila in DL_2 region was established as a sole crop in (plot size 1000 Sq.m) in Non-calcic Brown soils*(Haplustalf)* whereas the experiment in DL_1 was started as an intercrop under eight years old mango crop with the spacing of 10 X 10 m (plot size 1000 Sq.m) in Reddish Brown Earths *(Rhodustalf)*.

In both cases double row planting system was followed and suckers / plants were planted in furrows. The furrows were prepared in a special manner to retain moisture effectively under mulched condition. 90 cm wide and 10 cm deep furrows were prepared at 1 m space between adjacent two furrows. A shallow inner furrow of 5 cm deep and 60 cm wide were also prepared leaving 15 cm from the edge of the first furrow (figure 1).

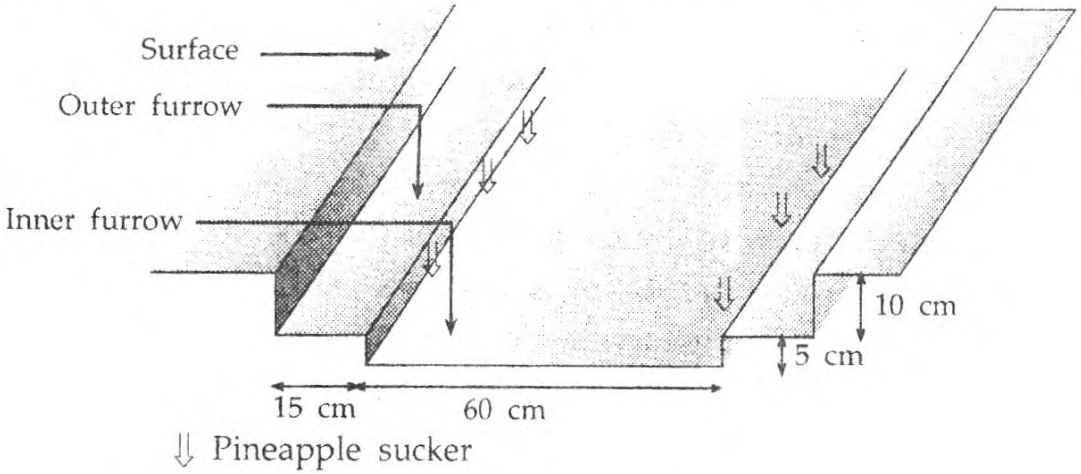

Figure 1: A schematic diagram of the planting system adapted during the establishment of pineapple.

Pineapple suckers were planted in the triangular system along the either sides of the inner furrow leaving 30 cm between two suckers. Mulching material was distributed evenly up to the brim level of the inner furrow. Salvenia at Aralaganwila and paddy husk at Maha Iluppallama were used instead of coir dust, as they were the freely available mulching materials in those regions. Suckers were fertilized with a mixture of 11 - 7 - 31 of N, P_2O_5 and K_2O as 7 g urea, 5 g triple super phosphate and 16 g muriate of potash per plant at one month after planting and thereafter at every fourth month. Plants were supplementary irrigated at both locations.

RESULTS AND DISCUSSION

At both locations variety Kew was sporadically affected by the heart rot infection caused by the fungus *Phytophthora paracitica*. It was controlled by applying suitable fungicides (Mancozeb + Metalaxyl) at regular intervals. Sun scald resulted due to excessive heating of fruit surfaces was observed in the fruits, that had lean over due to the higher weight. Supporting fruits with coir ropes held along the rows easily prevented sun scald. Variety Kew was more prone to this condition than variety Mauritius, possibly due to its higher fruit weight.

SUCKER INITIATION

Sucker initiations under two different agro-climatic conditions are shown in table 1.

Table 1: Sucker production at vegetative phase of the two pineapple varieties grown at the two different agro-climatic regions in the dry zone of Sri Lanka.

Location	Variety	Shoots/plants	Suckers/plants
Maha Illuppallama (DL_1)	Kew	1 - 2	-
	Mauritius	3 - 4	0 - 1
Aralaganwila (DL_2)	Kew	2 - 3	0 - 1
	Mauritius	5 - 6	1 - 2

According to table 1, variety Mauritius produced 5 - 6 suckers before flowering in DL_2 region and 3 - 4 in DL_1 region. Variety Kew produced less suckers compared to Mauritius at both locations. It can also be observed that sucker production was less at Maha Iluppallama in both varieties. The comparatively higher sucker initiation of both varieties at Aralaganwila could possibly be due to the tissue-cultured nature of the planting material used in the experiment. Higher frequency of sucker production has also been reported in tissue-cultured banana (Smith *et al.*, 1992). However, the numbers of suckers produced by both varieties at both locations were lower than that in the wet and intermediate zones (Fernando, 1997).

FLOWERING AND FRUIT FORMATION

In both investigations variety Mauritius reached flowering stage at 10 - 11 months after planting whereas variety Kew flowered at 13 months after planting. Yield performances of pineapple at both locations are shown in table 2.

Table 2: Yield performances and fruit characteristics of the two pineapple varieties grown at the two different agro-climatic regions in the dry zone of Sri Lanka.

Region	Characteristic	Mauritius	Kew
Maha Iluppallama (DL1)	Age at flowering (months)	10 - 13	13-15
	Time taken to fruit maturity (months)	4 - 4.5	4.5-5.0
	Fruit weight (kg)	1.5 - 2.0	2.5-3.5
	Yield (mt/ha)	9.9 - 13.3	16.6- 23.3
	Brix value %	17	16
	Pulp colour	13 - A	12 - A
	pH value	3.4	3.2
	Acidity mg/100g	0.71	0.77
	Vitamin C content, mg/ 100g	35.0	38.0
Aralaganwila (DL2)	Age at flowering (months)	10 - 11	11 - 13
	Time taken to fruit maturity (months)	4 - 4.5	4.5 - 5.0
	Fruit weight (kg)	1.2 - 1.5	2.0 - 2.5
	Brix value %	16	15

According to table 2, age at flowering has been slightly extended in the DL_1 region in both varieties, but especially for variety Kew. This could be due to the initial variation of the sucker types used at both locations. Generally tissue - cultured planting materials spend comparatively longer period under controlled environmental conditions before field establishment. During this period they reach a certain level of physiological maturity, which determine the age of flower initiation. In addition, tissue cultured materials possess a well-grown root system, which helps quicker establishment in the field, compared to conventional suckers with no roots.

FRUIT CHARACTERISTICS

Fruit weights of both varieties were higher in DL_1 region (1.7 kg. in Mauritius and 3.0 kg in Kew) compared to DL_2 region (1.4 kg in Mauritius and 2.3 kg in Kew) (table 2). This variation could probably be due to the differences in agro-climatic conditions, soil types, micro climatic conditions prevailed under sole cropped and inter cropped conditions and / or due to the differences between conventional and tissue cultured planting materials used in the two experiments. However, no documented information in this regard is available.

According to table 2, fruit maturity and brix value have not been affected by differences in location. Values obtained from the fruit quality analysis showed a fairly high brix value (17%) (table 2), especially in variety Mauritius under dry zone conditions than the reported figures of 14% (Purseglove, 1978). It was further observed that the fruit colour and flavor also markedly higher in the fruits grown under dry zone conditions. Samson (1980) also reported that the fruit colour and the content of malic acid were increased with the solar radiation. Pursglove (1972) has documented that at high temperature and humidity, fruits are larger with low citric acid content resulting less sour fruits. The rest of the fruit quality parameters are comparable with the fruits obtained in other pineapple growing areas.

WATER USE EFFICIENCY

Water use efficiency of pineapple at Maha Iluppallama (table 3) was calculated assuming the sole crop situation of pineapple in double row system. Since two pineapple rows were established in the middle of two mango rows with the spacing of 10 x 10 m leaving about 5.0 m from either side of mango trees, it was assumed that there were no interferences of mango trees on pineapple either due to shade or competition for water.

Table 3: Irrigation water use efficiencies (kg/M³/ha) of the two pineapple varieties at Maha Illuppallama in 1995 - 1996.

Variety	Plants/ha*	Total water applied M^3/ha		Yield kg/ha	Water use efficiency kg/M^3/ha	
		Irrigation	Rain fall		Supplementary Irrigation	Total
Mauritius	41,250	6,600	18,700	70,150	10.60	2.77
Kew	41,250	6,600	18,700	123,750	18.75	4.89

* Plants per hectare was calculated considering the sole crop situation of pineapple in double row system leaving 01 m in between a couple of double rows.

Both varieties of pineapples showed higher total water use efficiency. For variety Mauritius it was 2.77 kg/m^3 /ha and for variety Kew it was 4.89 kg /m^3 /ha. These values are much higher compare to those of commonly grown crops in the dry zone. Water use efficiency of rice is 0.83 kg/m^3 /ha (Nayakkorala, 1983) and banana is 1.0 kg/m^3 /ha. Irrigation water use efficiency is 10.6 kg/m^3 /ha for Mauritius and 18.75 kg/m^3/ha for variety Kew.

Although it is necessary to conduct more detailed studies on this aspect, these preliminary data suggest that pineapple shows an impressively high irrigation water use efficiency under fully and supplementary irrigated conditions. Samson (1980) also reported that the evapo-transpiration rate of pineapple is could vary from 4.5 mm/day (Ivory-coast) to 1.6 mm/day (South Africa) explaining the adjustability of the crop for the availability of water.

Results further show that pineapple can survive with limited supplementary irrigation even during extended dry periods with minimum rain. The average frequency of irrigation was about 45 days at Maha Illuppallama during the total growing period of 18 months. Chadha (1984) also reported that irrigation once in 20-25 days is needed to ensure a good crop in an exclusively dry period at Bangalore in India. Chadha (1984) further stated that pineapple can be grown even at 20% level of available moisture capacity without affecting the fruit size, quality and yield. The surviving ability of this crop under water scare conditions is most probably is due to its morphological and physiological adaptation to withstand drought.

CONCLUSIONS

This study has clearly demonstrated that pineapple could be successfully grown in the dry zone of Sri Lanka. It was further shown that the fruits produced in the dry zone possess better quality characteristics than that produced in the wet and intermediate zones. Average fruit weights of 1.5 kg in variety Mauritius and 2.6 kg in variety Kew can be obtained. The impressively high water use efficiency further increases the merits of pineapple as a crop for the dry zone where water is a scare resource. The shallow root system of the crop does not demand the presence of a deep soil for successful cultivation and it has been estimated that more than 50% of the cultivable extent in the dry zone comprise of shallow soils having a depth of around 50 cm (Dharmesena, 1997). Therefore pineapple can be considered as a crop having a great cultivation potential in the dry zone of Sri Lanka. It could be grown either as a sole crop or even as an intercrop.

ACKNOWLEDGEMENTS

The author extends her sincere thanks to Mr. H.D. Sumanaratne, RO in soil science and water management for calculating the water use efficiencies in this study. The field assistance provided by Mr. A.G. Pemachandra, research sub assistance is also greatly appreciated.

REFERENCES:

Chadha K.L. (1984). Pineapple cultivation, Indian Institute of Horticultural research, Hessaraghatta, Bangalore. p.16.

Collins J.L. (1960). The Pineapple, Leonard Hill, London. p.34.

Dharmasena, P.B. (1997). Personal communication.

Fernando, S. (1997). Personal communication.

Ministry of Agriculture and Land. (1997). Production programme for fruit crops (1998 – 2000).

Nayakkorala, H.B. (1983). Supplementary irrigation requirement for early grown low land rice during the rainy seasons in the dry zone. Tropical Agriculturist, 139: 51 - 56.

Purseglove, J.W. (1978). Tropical crops monocotyledons, Longman Group Ltd, London. p 607

Samson, J.A. (1980). Tropical fruits. Longman group limited, London. p 162 – 185.

Smith, M.K., Hamill, S.D. and Drew, R.A. (1992). The use of tissue culture for banana propagation and improvement, Maroochy Horticulture Research Station Report No 06. p. 22-26.