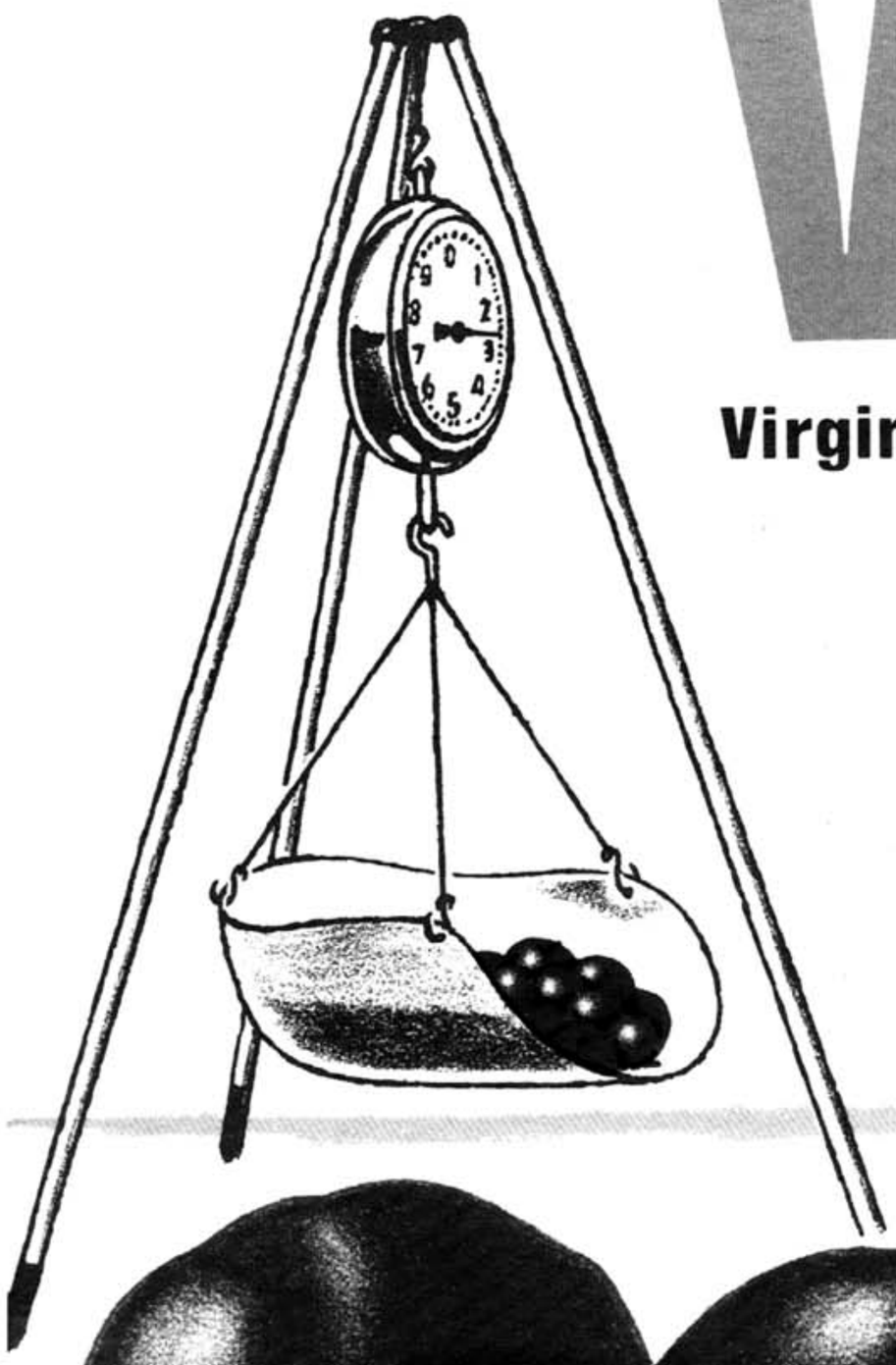
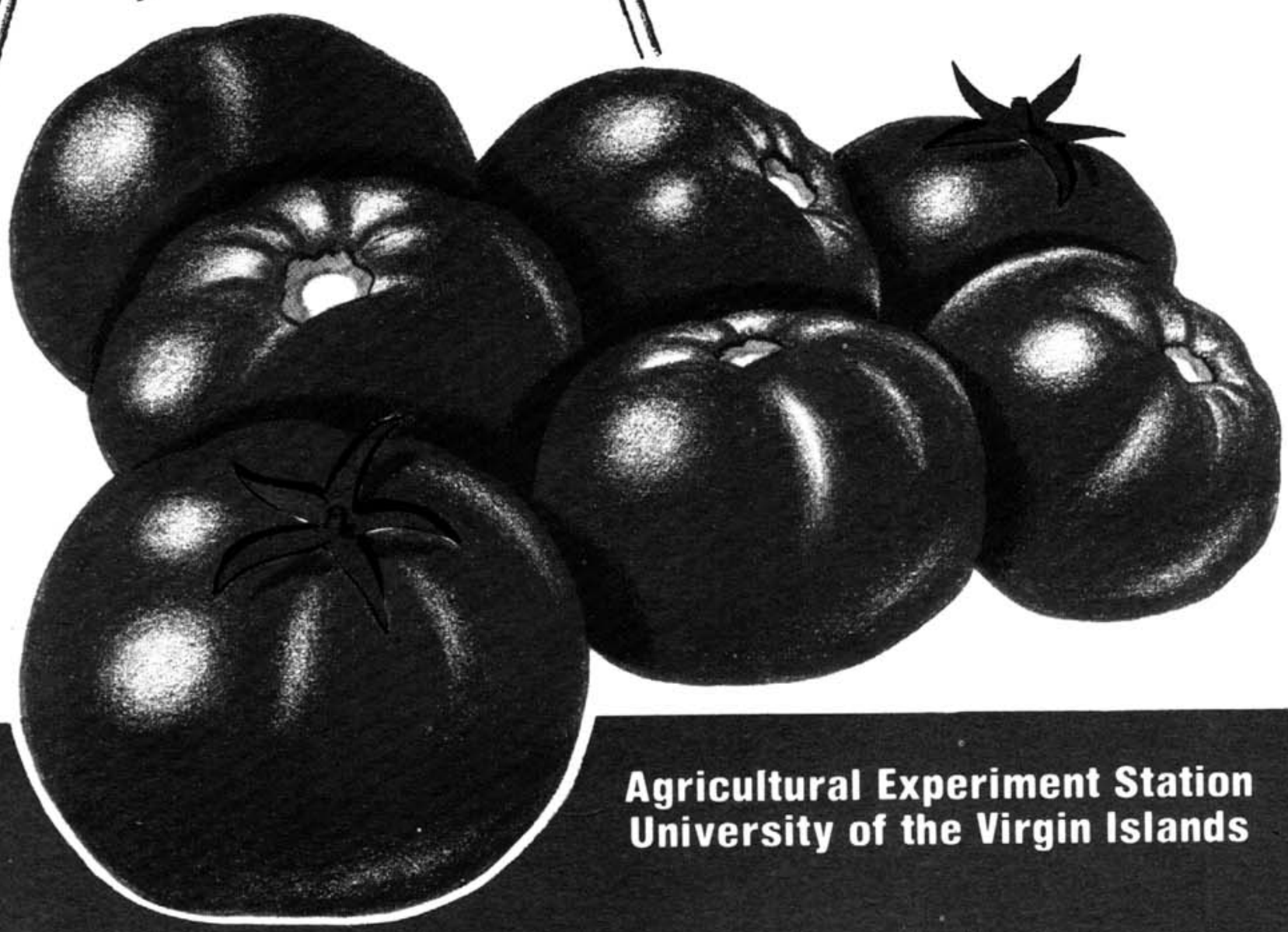


V.I.P.

Virgin Islands Perspective

Agricultural Research Notes

Summer - Fall 1987
Vol. 2, No. 2



Agricultural Experiment Station
University of the Virgin Islands

Arthur A. Richards - President

Darshan S. Padda - Vice President
Research and Land-Grant Programs

V.I.P.

Virgin Islands Perspective

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Published by the University of the Virgin Islands
Agricultural Experiment Station
RR2, Box 10,000 Kingshill
St. Croix, U.S. Virgin Islands 00850

From the Director

This is the third issue of the "Virgin Islands Perspective," the Agricultural Experiment Station's semiannual report of selected research results. The articles in this issue report results obtained in four out of the eighteen projects presently underway at the Station.

Alfalfa was examined as a possible forage under the environmental conditions of the Virgin Islands. To improve cattle management on St. Croix, bull fertility was characterized in relation to breed, age, and season. Pan evaporation rates were used to determine the optimum drip irrigation rates for maximum tomato production. Demand (self) feeders were developed and tested in comparison with manual feeding for the cage culture of tilapia.

These projects have been designed to generate new knowledge of advanced technologies in alternative agricultural enterprises, to develop better adapted and more productive strains of plants and animals, to improve farming practices and farm management methods. All of these resultant technologies should produce higher economic returns to farmers and improve the quality of food for Virgin Islands consumers.

I urge all Virgin Islands residents to review the research information reported in this publication, and contact us for more information. The Agricultural Experiment Station and the Cooperative Extension Service have generated many other publications which are available to the community at no cost. Call or write us for information and assistance.

Darshan S. Padda
Vice President
Research and Land-Grant Programs

International Honor Award

Dr. Darshan S. Padda was the recipient of the 1987 International Honor Award from USDA. UVI President Arthur A. Richards, who participated in the ceremonies, proudly joined the other USDA dignitaries in congratulating Dr. Padda. Shown in the picture, from left to right, are Daniel G. Amstutz, Undersecretary for International Affairs and Commodity Programs, Deputy Secretary Peter C. Myers, Dr. Padda, President Richards and OICD Administrator Joan S. Wallace.

Tomatoes have specific water requirements.

Determination of the Minimum Irrigation Requirements of Tomatoes

By Adriano A. Navarro
Olericulture Program Leader

Tomatoes are one of the world's most popular vegetables. Among the twenty-two important vegetables in the world, tomatoes are ranked second in value, next to Irish potatoes. They are a good source of vitamins A and C, and the number of ways they can be used to improve the flavor of other foods is seemingly endless. In the U.S. Virgin Islands, as in other parts of the world, tomatoes are one of, if not the most important, cash crops. They are well adapted to the VI climate and soil, and the local market for fresh tomatoes is excellent.

In a dry climate such as we have in the U.S. Virgin Islands, it is almost impossible to produce a good crop of tomatoes without irrigation. Because of low and often erratic rainfall, water is not an abundant resource in the U.S. Virgin Islands. The underground water that is suitable for irrigation is also very limited. For these reasons, the use of water for irrigation can be justified from an economic standpoint only if used efficiently on high value crops such as tomatoes.

Determination of the mininum water requirements of tomatoes would provide valuable information in applying irrigation water more efficiently and economically. At the University of the Virgin Islands Agricultural Experiment Station, one of the research areas being pursued is the determination of the least amount of water that can be applied to various crops without any significant reduction in yield or impairment of product quality.

Drip irrigation studies to determine minimum water requirements of tomatoes were started in 1980. In the first experiment, different rates of water were applied using automatic switching tensiometers and solenoid valves. The tensiometers were set at suction pressures of 20, 40 and 60 centibars. Treatments set at lower pressures received more water than those at higher pressures. With the switching tensiometers, moisture level in the different treatments was maintained automatically. Irrigation water was turned on or off with the change in the degree of wetness or dryness of the soil. Royal Chico, a determinate tomato variety, was used in this experiment.

Funding Source: CBAG Project 572

The data (Table 1) show that the highest yield was obtained from the treatment which received water at the rate of 6.6 mm per week or 4.5 liters of water per plant per week. The second highest yield was taken from the treatment with irrigation application at the rate of 6.4 mm or 4.4 liters of water per plant. Since the difference in yield between the two treatments is not statistically significant, the lower rate of irrigation of 4.4 liters per plant per week is the preferable rate of application.

Table 1

Effect of varying irrigation application rates on the yield of tomatoes cv. Royal Chico. (1980)

Treatment (centibar)	Plant Density (plants/ha)	Irrigation Per Week (mm)	Irrigation Per Week (l/plant)	Average Weekly Precipitation (mm)	Mean[1] Yield (t/ha)
60	14,375	6.4	4.4	16.8	25.6 [a]
40	14,375	6.6	4.5	16.8	28.7 [a]
20	14,375	17.3	11.7	16.8	20.7 [b]

[1]Differences between means subscripted with different letters are significant at the 5% level.

In the following year, a similar experiment was conducted, using Tropic, an indeterminate tomato variety. The highest yield occurred in the treatment which was irrigated at a rate of 14.7 mm of water per week or 5.4 liters of water per plant per week (Table 2). The yield in this treatment was significantly ($P \leq 0.05$) higher than the yields at the lower rates of irrigation. A comparison of the irrigation rates shows an increase of 93% in the weekly irrigation rate (2.8 to 5.4 liters/plant/week) resulted in an increase of approximately 26% in the yield (from 30.2 to 38.0 tons). These data demonstrate that water was used much more efficiently at the lower rate of irrigation.

In 1986, another experiment on the determination of minimum water requirements of tomatoes was conducted using the indeterminate variety N-69. The results show that yields increased by 9.2 tons/hectare as the irrigation rate increased from 3.1 to 5.9 liters/plant (Table 3).

Analysis of the water use efficiency (unit of production per unit of water used) showed that irrigation water was more efficiently

Table 2

Effect of varying water application rates on the yield of tomatoes cv. Tropic (1981)

Treatment	Plant Density	Irrigation Per Week		Average Weekly Precipitation	Mean[1] Yield
(centibar)	(plants/ha)	(mm)	(l/plant)	(mm)	(t/ha)
60	26,953	7.6	2.8	17.5	30.2 [a]
40	26,953	9.6	3.6	17.5	30.9 [a]
20	26,953	14.7	5.4	17.5	38.0 [b]

[1]Differences between means superscripted with different letters are significant at the 5% level.

used at the lower rate of irrigation. An increase of 74 percent in water application (from 3.1 to 5.9 liters/plant/week) increased the yield by only 20 percent (from 45.4 to 54.6 tons).

The three experiments have revealed some important information on the water requirements of tomatoes. The first experiment indicated that tomatoes are quite specific in their water requirements. Yields will increase up to a certain level of water application, but beyond that level a reduction in yields can be expected. The second and third experiments also revealed that although the yield can be increased with an increase in water application (up to a point) the utilization of water becomes less efficient beyond a certain level of application and may no longer be economical, particularly where water is a limited and expensive resource. The data further showed that water use efficiency was highest at irrigation rates of 4.4, 2.8 and 3.1 liters/plant/week in the first, second and third experiments, respectively, or an average for the three experiments of 3.4 liters/plant/week.

The experiments also provided some information concerning the extent to which plant density and variety affected yields. The higher yields in the 1986 experiment can be attributed partly to variety and planting density. Planting at higher densities and using proven varieties can increase total yields and possibly improve water use efficiency. Finally, the data showed, as generally expected, that the amount of precipitation during the cropping period affects the irrigation requirements of crops. The amount of supplemental irrigation was lowest in the 1981

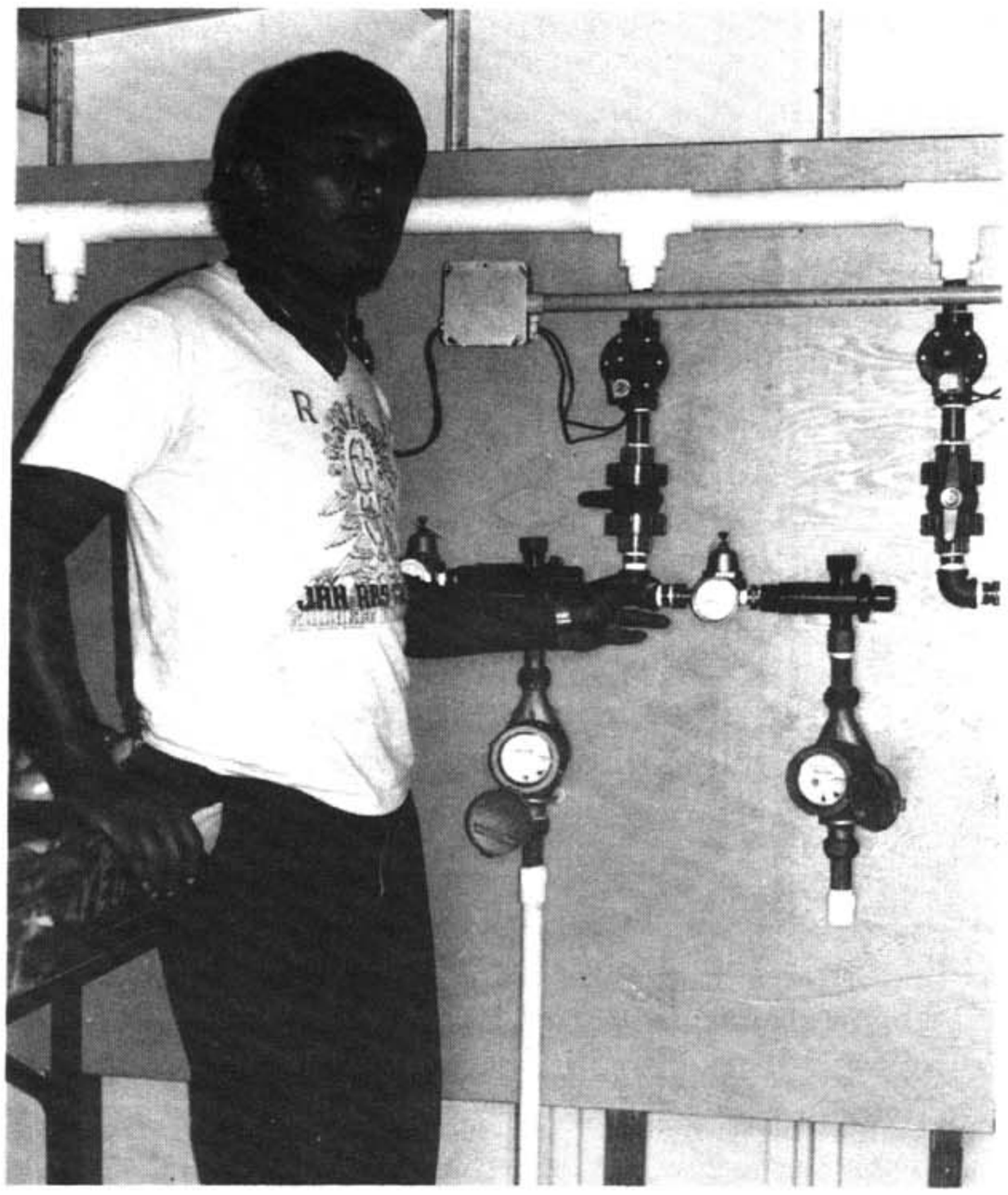
Table 3

Effect of two irrigation rates on the yield of tomatoes cv. N-69. (1986)

Treatment	Plant Density	Irrigation Per Week		Average Weekly Precipitation	Mean[1] Yield
(centibar)	(plants/ha)	(mm)	(l/plant)	(mm)	(t/ha)
40–50	17,968	5.5	3.1	9.3	45.4 [a]
20–30	17,968	10.4	5.9	9.3	54.6 [b]

[1]Differences between means is significant at 5% level.

experiment because of high precipitation during that cropping season.



Accurate water metering devices and soil moisture sensing devices such as tensiometers (not shown) can make irrigation more efficient.

Bull Fertility on St. Croix: Effects of Breed, Age and Season

By Stephan Wildeus
Research Animal Scientist

The reproductive performance of bulls contributes significantly to the overall fertility of a herd, particularly under conditions of natural mating. As part of natural mating under pasture conditions the bull is exposed to environmental stressors, is required to display a high level of physical fitness and may have to service large numbers of estrous cows over relatively short periods of time. These demands become more pronounced in a tropical setting, in which the animal is exposed to periodic nutritional stress and high environmental temperatures, both known to interfere with proper testicular function. Hence, bull fertility and management should play an important role in the overall management of a cattle operation.

On St. Croix the predominant breeds of cattle are the Senepol and the Holstein. Apart from the contrasting production stress encountered by the two breeds in a beef and dairy setting, respectively, these genotypes also differ in their degree of adaptation to the local environment. While the Senepol cattle were developed and selected to perform in a low input system under the local tropical conditions, the Holstein breed has a background as a high input dairy animal developed in a temperate climate. The following information was generated to provide an estimate of differences in bull performance of these two cattle breeds under St. Croix conditions.

In a first experiment two groups of mature, sexually-rested Senepol (10) and Holstein (9) bulls were examined for physical characteristics and semen quality during the summer months on St. Croix. The bulls of both breeds were located on adjacent farms on the southeastern shore of St. Croix, and exposed to grazing on native pasture without supplementation. Measurements on all bulls were made on the same day (82°F, 81.5% relative humidity) and by the same operator to reduce measurement error. Semen was collected by electroejaculation and analyzed for both quality and quantity.

The information obtained in this first study is presented in Table 1. Both groups were of similar age and body weight, but the Holsteins had a lower body condition score. Testis size, as

Funding Source: Regional Hatch Project #791

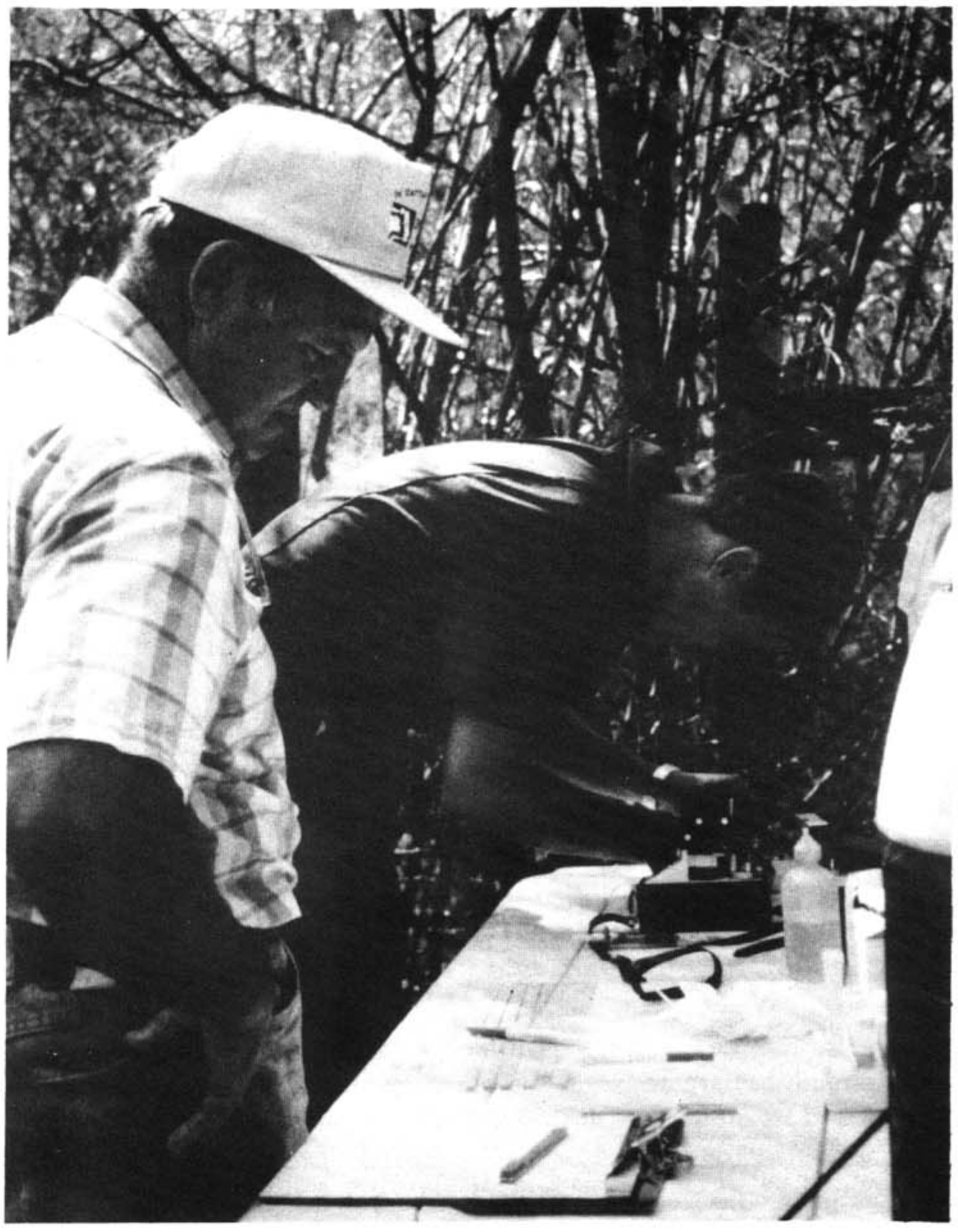
indicated by scrotal circumference, and testis tone, a measure of the firmness of the testicular tissue, were lower in the Holstein bulls. Under more ideal production conditions these values are reported to be generally higher for the Holstein breed and would suggest a somewhat reduced reproductive function under local conditions. Other indications of the physiological stress in the dairy bulls were elevated rectal temperatures and lower blood packed cell volume and hemoglobin values compared to the Senepol bulls.

Some of these physical differences were also reflected in ejaculate characteristics. Ejaculate volume and total number of spermatozoa per ejaculate were considerably higher in the Senepol bulls. In contrast, sperm quality was not affected to a similar degree. Sperm motility and seminal fructose did not differ significantly, due to greater variation between individual bulls rather than the two breeds. However, abnormal sperm tails and

Table 1

Performance and semen characteristics (mean±SEM) in two groups of Senepol and Holstein bulls during the summer months on St. Croix.

Characteristics	Senepol	Holstein
Age (months)	36.2±2.9	38.3±2.7
Weight (lbs)	1545±64	1606±119
Condition score (1-10)	5.8±0.13	5.0±0.5
Scrotal circumference (cm)	37.7±1.0	34.7±1.5
Testis tone (1-9)	7.7±0.21	5.1±0.4
Body temperature (°F)	102.8±0.2	104.0±0.3
Packed cell volume (%)	53.0±0.8	45.6±1.8
Hemoglobin (g/dl)	13.0±0.3	12.3±0.7
Sperm motility (%)	71.7±3.1	63.6±5.9
Ejaculate volume (ml)	11.1±0.8	2.6±0.6
Concentration (mill/ml)	350±86	333±119
Sperm/ejaculate (bill)	4.14±1.11	0.92±0.5
Seminal fructose (mg/dl)	251±36	309±59
Sperm morphology (%)	87.3±1.9	72.3±8.1
abnormal heads	6.3±1.8	6.4±1.5
abnormal tails	5.2±0.9	17.9±5.7
cystoplasmic droplets	1.1±0.6	3.4±1.4
intact acrosomes	75.6±3.7	48.9±11.1



Portable lab for analyzing semen in the field.

missing acrosomes (the cap covering the sperm head) were present in larger numbers in the Holstein bulls.

In a second study these preliminary observations were re-evaluated in a larger number of Senepol and Holstein bulls. Bulls were examined on three beef and five dairy farms located throughout the island. Samples were collected in association with the end of the dry/warm (August, September) and cool/wet season (February, March) to determine possible seasonal differences. These dates were chosen in order for the animals to

display the long-term effects of the season on the animals' physiological characteristics. Apart from testicular and semen measurements, blood glucose and blood urea nitrogen levels were determined to estimate the nutritional status of the bulls in this study.

Scrotal circumference and testis tone were higher in the Senepol bulls in this study and are in agreement with the findings of the earlier experiment. Season only affected seminal fructose concentrations significantly, which were lower following the wet/cool season, but sperm motility showed a similar tendency to be lower following the wet/cool season (Table 2). In contrast, the percentage of morphologically normal spermatozoa was lower during the dry/warm season. However, measurements of sperm motility and morphology varied greatly between individual bulls. Sperm motility may have been influenced by the ambient temperature at the day of collection. Blood metabolite levels were not affected by either breed or season.

Bulls were further classified as young (less than 37 months), mature (37 to 72 months) and old (73 months and older) in order to examine the effects of age within the breed on reproductive performance. Scrotal circumference increased with age in both breeds but reached a greater mature dimension in the Senepol compared to the Holstein bulls (Figure 1). In contrast, testis tone significantly decreased with age in both breeds, but was con-

Table 2

Reproductive characteristics and blood metabolites (mean±SEM) in Senepol and Holstein bulls during the wet and dry season on St. Croix

Characteristics	wet/cool season		dry/warm season	
	Senepol	Holstein	Senepol	Holstein
Scrotal cir. (cm)	35.2±0.4	35.2±0.7	36.8±0.6	35.7±0.6
Testis tone (1-9)	7.69±0.12	6.95±0.23	7.88±0.08	7.00±0.22
Sperm motility (%)	59.3±3.6	48.8±8.6	65.0±2.7	55.2±5.2
Normal sperm (%)	82.7±2.6	88.3±3.5	80.1±2.3	83 1±3.3
Semen fructose (mg/dl)	101±20	54±18	186±25	94±27
BUN[1] (mg/dl)	13.7±0.9	15.0±3.7	14.1±3.1	10.6±0.9
Blood glucose (mg/dl)	68.3±1.2	67.9±1.5	67.7±1.8	65.5±1.9

[1]BUN = Blood urea nitrogen

sistently lower in the Holstein bulls within age groups. Neither the percentage of motile or morphologically normal spermatozoa nor seminal fructose levels changed with age, while blood glucose levels tended to decline in the older bulls (Table 3). The breakdown into age-categories resulted in relatively small numbers of animals in the 'old' classification and thus accounts for the considerable variation and missing measurements in some of the variables in this group. Age in the older bulls apparently had no effect on ejaculate characteristics and should impair bull reproduction function only indirectly through reduced physical fitness.

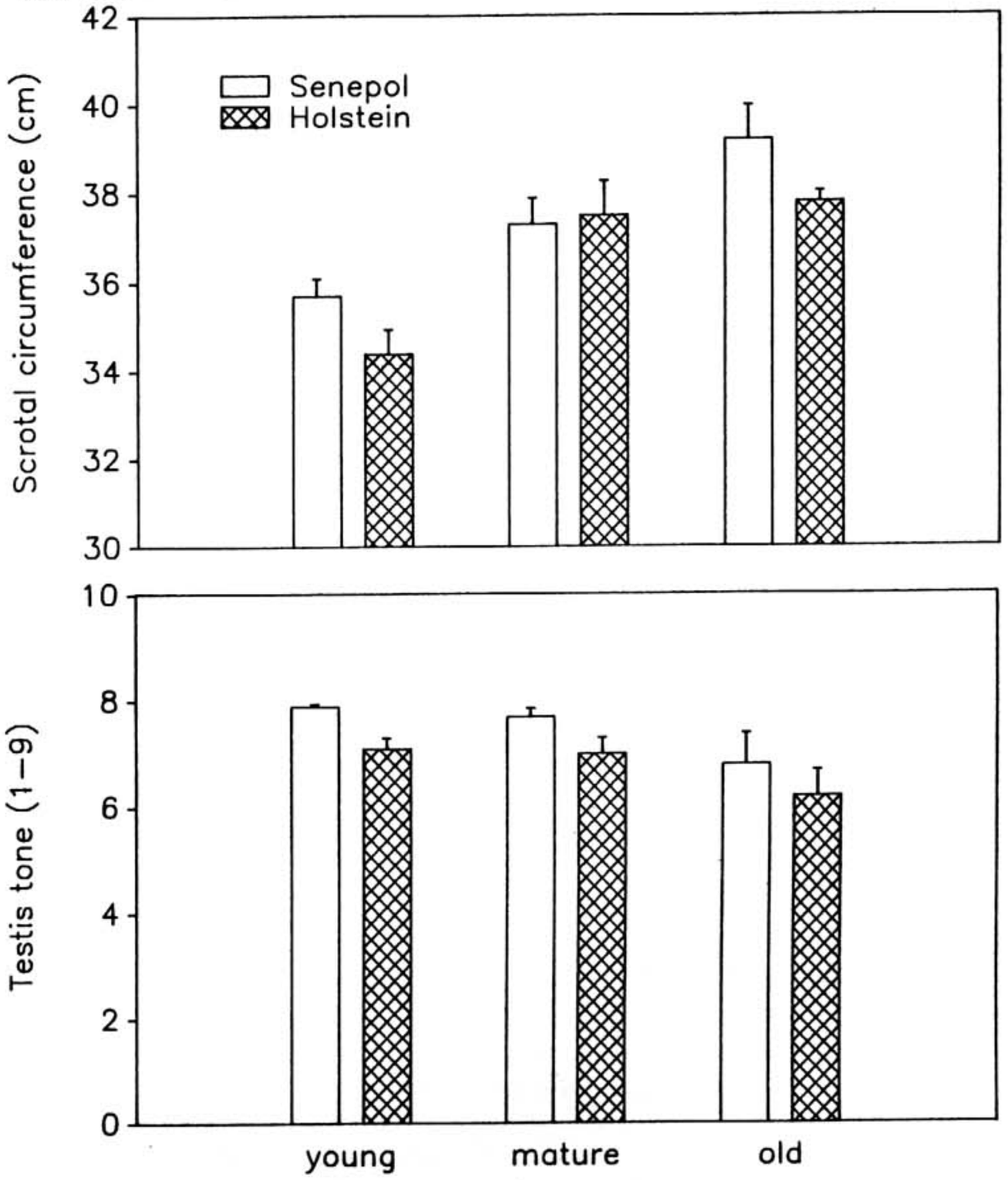


Figure 1. Distribution by age of scrotal circumference and testis tone (mean+SEM) in Senepol and Holstein bulls (young: < 37 mo, mature: 37 to 72 mo, old: > 72 mo).

Table 3

Semen characteristics and blood metabolites (mean±SEM) in Senepol and Holstein bulls in three age categories.

Characteristics	Young (<37mo)		Mature (37-72mo)		Old (>72mo)	
	Senepol	Holstein	Senepol	Holstein	Senepol	Holstein
% Motile	63.4+2.3	56.7±5.1	62.6±5.4	41.4±9.8	60.0±12.3	62.5±12.5
% Normal	80.7±2.4	82.5±3.4	81.8±2.7	91.0±1.7	84.3±5.2	86.0±0.0
Fructose (mg/dl)	152±22	70±18	156±30	49±28	---	---
BUN (mg/dl)	14.9±2.3	12.7±25	10.7±1.5	13.0±1.5	20.9±12.9	8.8±2.0
Glucose (mg/dl)	69.2±1.1	67.4±1.8	67.3±1.9	65.4±2.3	60.2±10.5	63.3±2.1

The results obtained in these studies point to a markedly lowered reproductive function in Holstein compared to Senepol bulls on St. Croix. This difference appears to be consistent throughout the year, with only minimal variations between seasons. The lack of seasonal differences would point to high environmental temperatures, present on St. Croix throughout the year, as the primary source of stress on the dairy bulls, though the (in)ability to cope with nutritional deficiences and high parasite burdens is likely to contribute to the variation in performance between the two breeds. Since sperm quantity rather than sperm quality tended to be affected more severely, some benefits in dairy bull management may be derived from reducing the numbers of cows exposed per bull and providing the bulls with adequate sexual rest.

The technical assistance of Ms. Joni Rae Fugle and Ms. Kim Traugott is gratefully acknowledged. This study was possible due to the cooperation of the following farms: Annaly, Castle Nugent, Corn Hill, Estate Granard, Estate Sight, Mon Bijou, Petronella and Windsor. The author would like to thank Dr. A. Hammond, USDA-ARS, for the analysis of the blood metabolites.

Feeding Practices for Caged Blue Tilapia

By John Hargreaves
Research Specialist - Aquaculture

The UVI-AES aquaculture program has been conducting research on the cage culture of the blue tilapia (*Tilapia aurea*) since 1977. Cage culture offers many advantages over the open pond culture of fish[1], as caged fish are more conveniently stocked, fed, sampled, and harvested. Perhaps most importantly, the culture of tilapia in cages will prevent successful spawning as eggs will fall through the cage mesh. The initial capital investment for cage materials and construction is low, resulting in a relatively quick payback period.

One of the main facets of this cage culture research has been the evaluation of various feeds and feeding practices. Since caged tilapia are usually confined at high densities (200 - 400 fish/m^3), the contribution of naturally-occurring food items to fish production is minimal. The use of a complete ration with a high level of crude protein (32 – 40%) and vitamin and mineral supplements is essential to achieve fish growth rates (2.5 – 3.5 g/day) and feed conversion ratios (<2:1) which will yield a favorable return on investment to the fish farmer. Feed costs constitute approximately 50 - 60% of the total costs of a cage culture operation.

Fish culturists typically feed fish their daily ration as a percentage of body weight, which is higher for smaller fish and decreases as the fish grow. Adjustments are made based on a sample of the fish population or an assumed feed conversion efficiency over the sample interval. However, feeding fish on a fixed schedule based on feeding rate tables does not take account of the interactive complex of water quality and other variables which affect fish feeding response, digestion, and assimilation.

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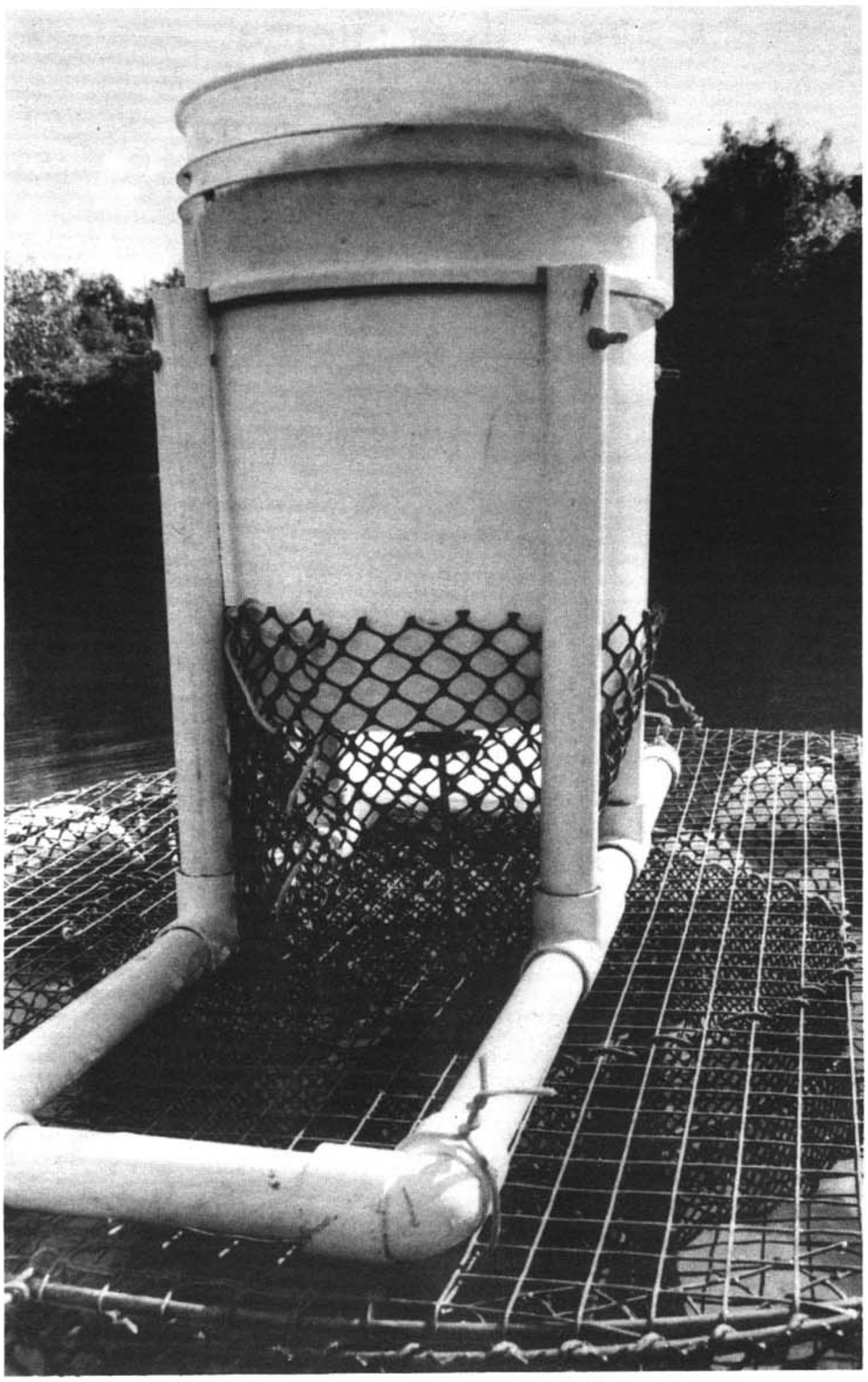
[1]Freshwater resources on St. Croix are limited and generally fully exploited. However, freshwater ponds are multi-use resources that have not been developed to their optimum potential. These ponds are used for livestock watering, crop irrigation, temporary water storage for recharge of aquifers, and as a soil conservation or flood prevention measure. Between 1920 and 1975, 225 ponds were constructed or renovated on St. Croix. Most of these ponds are 0.5 to 1 ha in surface area, irregular in shape and bottom profile, subject to wide fluctuations in water level, and difficult or impossible to drain completely. As such, they are not suitable for the open pond culture of fish.

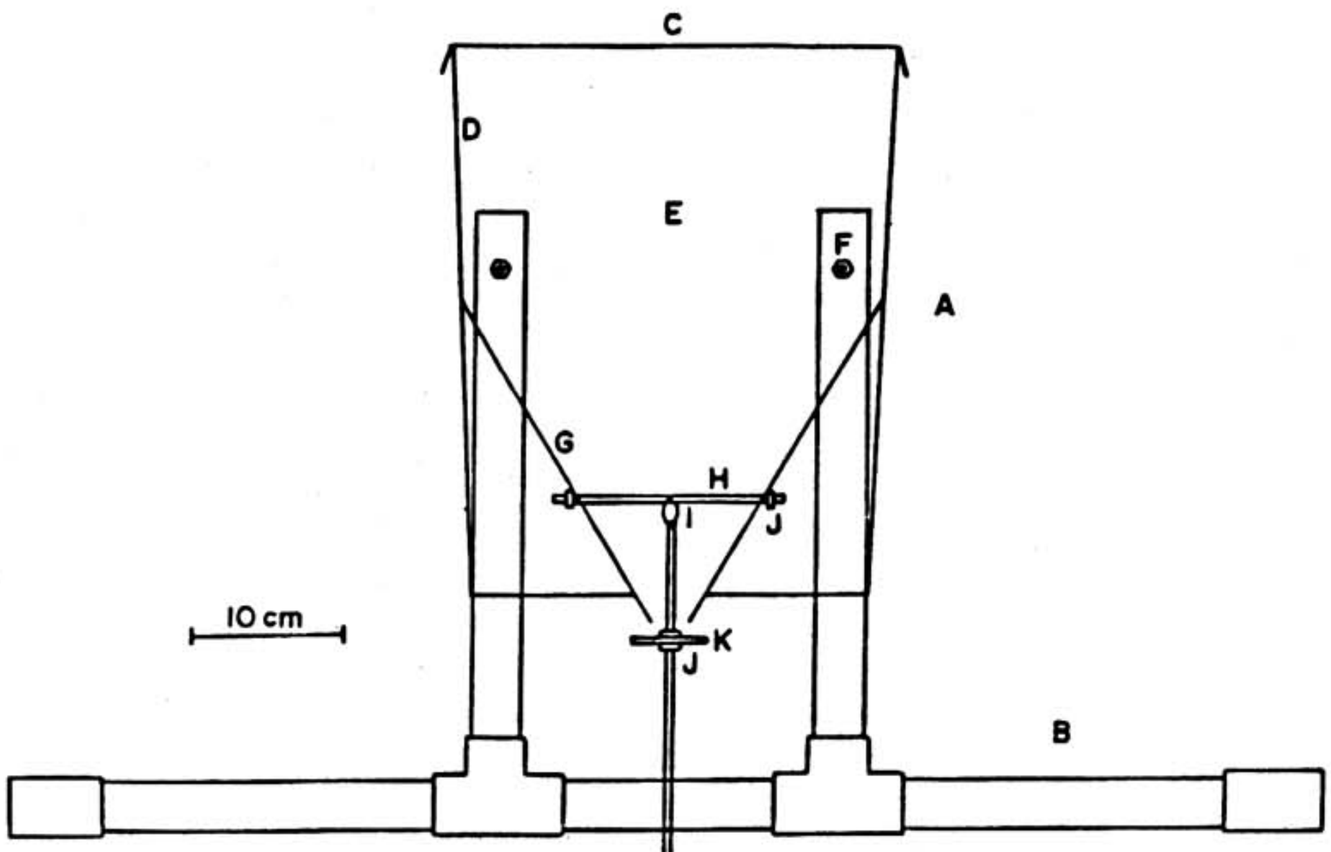
Funding Source: Hatch Project #011



Demand (self) feeder for cage culture of tilapia.

Tilapia have a digestive system adapted to their generally herbivorous feeding habit: the intestine is long relative to body length and the food passage rate is rapid (2.5 - 3.0 hrs at 30°C). Consumption of natural food items is continuous throughout the daylight hours. Increasing the feeding frequency of cultured tilapia may allow digestion to proceed more continuously than less frequent feedings and thereby improve the efficiency of digestion and assimilation. Demand (self) feeders allow fish to regulate feed consumption and thereby eliminate the need for a feeding rate table, feeding rate adjustments, and the labor required for regular fish sampling.

Studies were conducted during 1983 - 85 in St. Croix farm ponds to evaluate the growth, feed conversion ratios, and marketable production of blue tilapia fed according to a feeding



Key:

A – demand feeder
B – PVC support structure
C – cover
D – plastic bucket
E – feed chamber
F – brass nut and bolt
G – plastic funnel
H – horizontal brass rod
I – key ring swivel
J – brass nuts
K – plexiglass plate
L – vertical brass rod

Figure 1. Cross-sectional view of demand feeder with side view of support structure superimposed.

rate table or from demand feeders. The 1-m^3 cylindrical cages utilized in the studies were constructed of semi-rigid, 19-mm plastic mesh tied onto steel hoops.

Demand feeders were constructed with an 18.9-L plastic bucket into which a polyethylene funnel was inserted (Fig. 1). The feeder was mounted on the cage top and would release feed when the fish hit a rod that was suspended vertically from the funnel into the water. The feeders, which had a capacity of 5.5 kg of pelleted feed, were checked twice daily during fixed schedule feedings. Demand feeders were filled only when completely empty to determine the minimum labor required for feeding. Fish were cultured for 20 – 28 weeks depending upon seasonal water temperatures and other water quality factors.

Fish growth in all ponds and experiments was nearly linear and was not different between the two feeding regimes. Feed conversion ratios of fish obtaining feed from demand feeders (1.55) were lower than those of fish fed according to a fixed schedule (2.30) for all ponds and experiments, although these differences were not statistically significant (Table 1).

Marketable fish production in cages was affected by feeding regime, stocking rate, number of fish from the original cage stock which grew to market size, cage recruitment from tilapia populations in ponds, differential mortality and possible fish escape

Table 1

Production parameters from one experiment in which caged *Tilapia aurea* were fed according to fixed-schedule or demand feeding regimes.

Parameter	Feeding Regimes	
	Fixed Schedule	Demand Feeding
Growth rate (g/day)	1.8	2.1
Specific growth rate (%/mo)	38	41
Feed conversion ratio (wet wt)	2.30	1.55
Marketable production (kg)		
Small	45.7	51.6
Large	77.9	94.0
Total	123.6	145.6
Feedings (no)	285	34

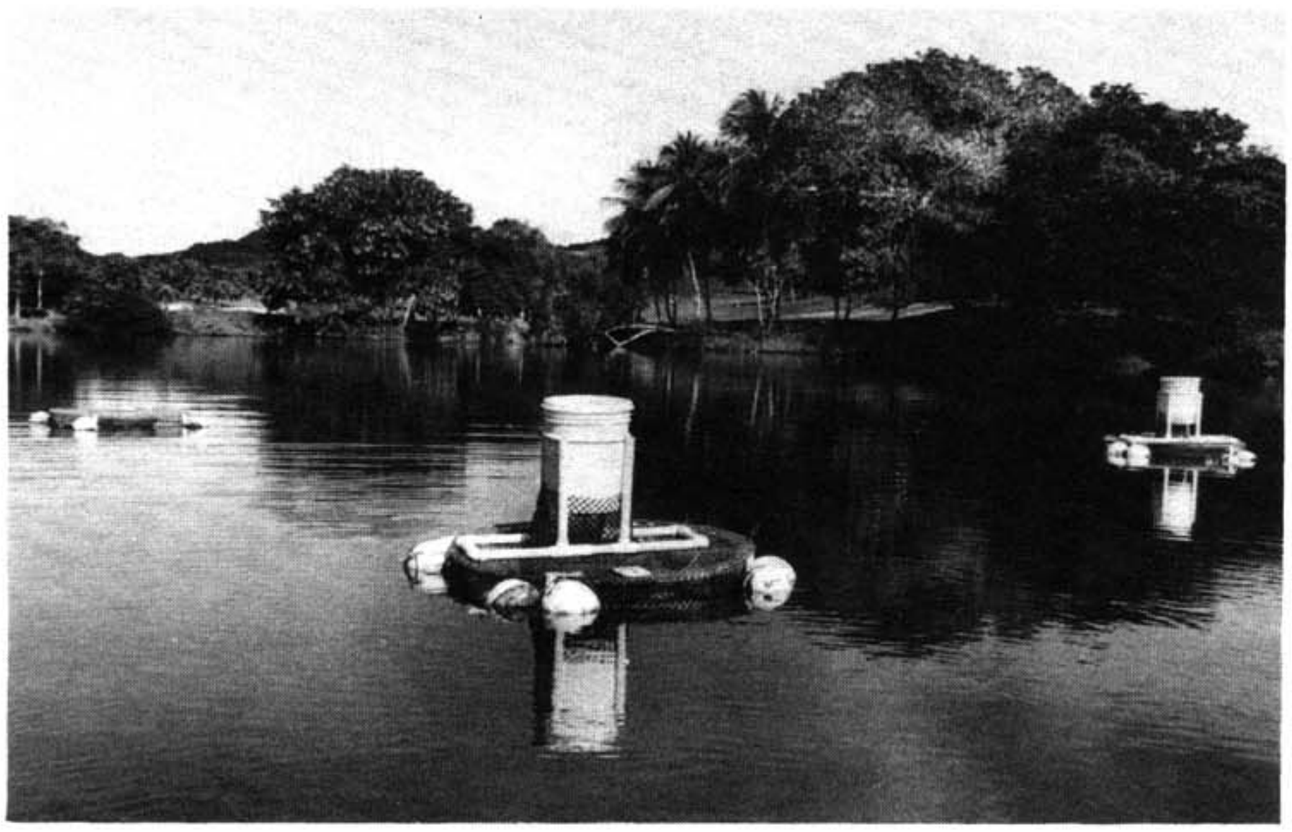
following runoff events. Fish ≥ 19 cm were considered marketable. Marketable production was 91 – 95% (by weight) of total production.

Interference from open pond fish populations can be a serious limitation of cage culture. Tilapia <9 g were able to pass through 19-mm mesh. These cage recruits competed for feed and space with the stocked population and were unable to escape after a period of growth. Most of these fish did not reach marketable size during the culture period and therefore represented a reduction in feed utilization efficiency. Cage recruitment accounted for a relatively small proportion (3.8 - 11.0%) of caged fish production by weight, but could account for more than one third of the mean number of fish harvested.

Control of cage recruitment of tilapia by stocking a piscivorous fish species into the open pond or by chemical eradication may be necessary. Use of a smaller mesh size (13 mm) would restrict fish entry into cages, but would also limit water circulation which could affect production.

Rapid changes in water quality following storm runoff generally have a deleterious effect on caged fish production. Small ponds (0.1 - 0.5 ha) are particularly sensitive to runoff-induced water quality changes. Storm runoff can lead to a depletion of dissolved oxygen in several ways. First, the flush of fresh water will mix anaerobic bottom layers of water with surface layers of water, causing a rapid decline in dissolved oxygen levels as the organic material breaks down in the presence of oxygen. The decomposition and mineralization of re-suspended organic sediments will release nutrients to the water which may result in the development of a dense phytoplankton bloom. Should this algae bloom "crash", oxygen production by algal photosynthesis will cease and severe caged fish mortality may occur. Second, increases in pond water level will submerge and thereby suffocate shoreline vegetation. The decay of this plant material will further depress oxygen levels. Vigilant observations of water quality, particularly dissolved oxygen concentrations, following a runoff event are necessary to inform the culturist of the potential requirement for emergency aeration.

Cage culture is likely to be a part-time activity, secondary to the main enterprise of the farm or ranch. The quantity of labor allocated to feeding fish in cages must be minimized if successful integration with the other farming activities is to be realized. Demand feeders can reduce the labor required for feeding by 88



Cage culture of tilapia in a golf course pond on St. Croix.

– 94%. Despite significant savings in labor for feeding, regular observations of feeding response and fish health should be maintained.

In summary, the results of the feeding studies indicated that differences in growth, feed conversion, and marketable production of fish fed according to a feeding rate table or by demand feeders were slight. The use of demand feeders significantly reduced the quantity of labor required for feeding fish. The importance of this factor should be evaluated in terms of the opportunity costs for labor in a commercial culture operation, with due consideration of the local employment situation.

The UVI–AES Aquaculture Program extends its appreciation to Annaly Farm, Mon Bijou Farm, Windsor Farm, Bethlehem Farm, Fountain Valley Golf Course, and the V.I. Department of Agriculture for use of their farm ponds.

Alfalfa Production in the U.S. Virgin Islands

By Cyndi L. Wildeus
Agronomy Research Technician II

Alfalfa (*Medicago sativa*) is a highly nutritious, palatable perennial forage crop that is widely adapted to areas that have well drained soils but no highly developed hardpans. In such soils it develops a deep root system which makes it drought tolerant, an important consideration when selecting a forage crop for the semi-arid tropics. Alfalfa is a good forage for all types of livestock and may be grazed, ensiled, used as green chopped feed or made into hay. It is chosen by dairymen particularly for its favorable effect on milk production. For these reasons the following experiment was designed to examine the feasibility of growing alfalfa under St. Croix conditions.

The experiment was conducted on a Fredensborg clay soil with a 2 to 5% slope. The soil pH ranged from 7.4 to 8.4. Average annual rainfall for the area is 35 to 40 inches (875 to 1000 mm), and the average temperature is 78 to 80°F (25.5 to 26.6°C). A randomized block design with three replications was used for the study. On December 6, 1985, twelve varieties of alfalfa were innoculated and broadcast by hand at a rate of 20 lb/a (22 kg/ha) onto individual plots 5 feet wide and 12 feet long (1.5 m by 3.6 m). The plots were rolled with a manual roller. Triple superphosphate fertilizer (0-46-0) was broadcast at the time of planting at the rate of 150 lb/a (168 kg/ha). Plots were harvested in strips 3 feet wide and 8 feet in length (0.9 m by 2.4 m) with a pick-up flail mower. A total of five harvests were made at the physiological stage of 10% bloom and a height of 2 to 4 inches (5.0 to 10 cm).

The fall armyworm (*Spodoptera frugiperda*) is a major pest affecting alfalfa production on St. Croix. A regular spraying schedule was followed to insure the insect population did not increase rapidly and cause extensive damage. It was found that insect damage may occur over a relatively short period of time (2 to 3 days). Therefore, the stand was checked frequently to determine when spraying was necessary. Previous research indicated that fall armyworm populations increased rapidly following rainfall when lush new growth occurred. Therefore, frequent field checks were made during the rainy season.

Funding Source: Hatch Project #014

Without the use of a pre- or post-emergence herbicide, several hand weedings were necessary to remove broadleaf weeds. Hand weeding post-emergence was necessary due to the unavailability of herbicide and plots were periodically sprayed with Lannate (brand, active ingredient methomyl) insecticide at a rate of 10 ml Lannate/3.8 liters of water until the entire plot area was treated. Post-emergence, approximately 60% of the stand was infested with broadleaf weeds. Weeding was a necessary step to keep the weeds from competing with the newly emerged seedlings. In the established stand, broadleaf weeds were no longer a factor. However, there was a slow invasion of grasses, especially when the stand was stressed due to lack of moisture or insect damage.

The varieties tested were selected from previous trials conducted in South Texas. In St. Croix the top three producing varieties, on a dry matter basis, were Arc, WL 318, and WL Southern Special, respectively (Table 1), but were not significantly different from the other varieties ($P > 0.05$). However, the lowest yielding variety, Team, was significantly different from all

Table 1

Alfalfa harvest data taken on St. Croix.

Variety	Total yield (kg/ha)	Height (cm)	Dry matter (%)	Rank by maturity (% bloom)
Arc	9124	34	33	7
WL 318	8806	31	34	8
WL South. Sp.	8661	35	34	3
Cimmaron	8562	38	33	4
Baron	8120	37	35	2
Classic	7648	37	34	6
Florida 77	7302	41	35	1
Raidor	6712	33	34	5
Pioneer 555	6215	31	35	12
HiPhy	5967	31	35	10
Weevlcheck	5876	28	35	11
Team	5559	30	34	9

Harvesting with flail mower.

other varieties. The earliest varieties to reach the physiological stage for harvesting (10% bloom) were Florida 77, Baron, and WL Southern Special. These data suggest that variety WL Southern Special is the optimum choice under these growing conditions if a high yield and early maturity is desired. Early maturity is desirable for the following reason: Ten percent bloom is the optimum stage to harvest alfalfa. If harvested prior to 10% bloom, root reserves will become depleted resulting in poor recovery, and eventually the loss of the stand. Therefore, the earlier the stand matures, the sooner the grower can utilize the forage. Height measurements were taken, but did not appear to correlate well with the amount of dry matter produced. Dry matter ranged from 33% to 35%.

In the U.S. Virgin Islands, water is the most limiting factor in agricultural production. The data indicate that the amount of dry matter produced correlates with the rainfall. Rainfall received during the course of this study is shown in Figure 1. Due to its poor distribution, rainfall appears to be a limiting factor in alfalfa production. To compound the problem, the water retention capacity of Fredensborg clay is relatively low, evaporation is high and exceeds rainfall during some months of the year. Therefore, droughty periods of 3 or more weeks appear to exert a marked effect on the amount of dry matter produced.

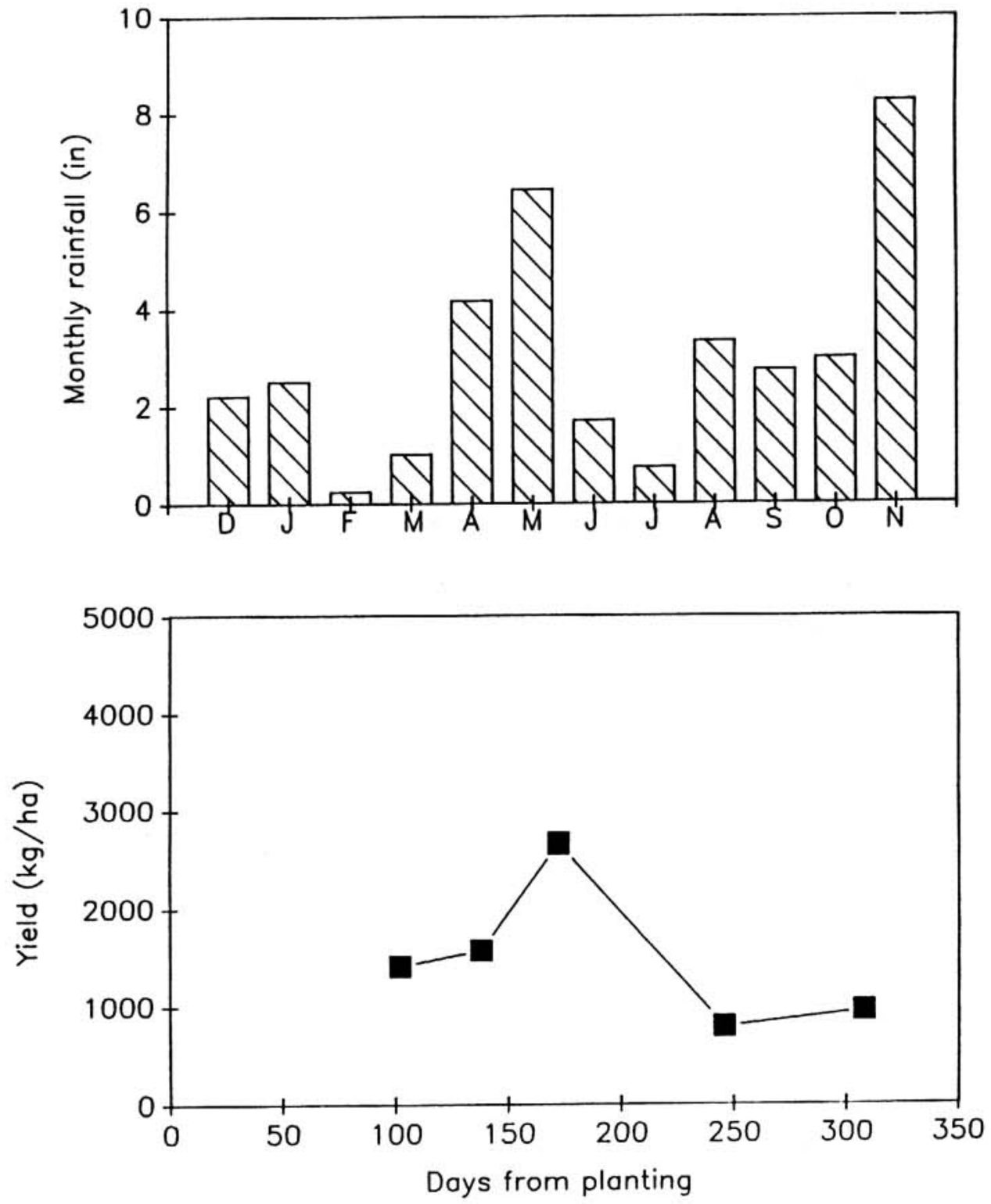


Figure 1. Yield of alfalfa in relation to rainfall.

Alfalfa is a labor intensive crop.

Another long-term problem that must be addressed is the apparent ability of alfalfa to deplete soil moisture reserves that may not be replenished under natural rainfall conditions. Reduction of soil moisture under dryland conditions could affect subsequent crops and a period of fallow may be necessary before planting a subsequent crop.

This study, due to the intensive manual weeding, frequent invasions of the armyworm and moisture stress was terminated after one year of data collection. While specific herbicides were economically feasible—in most cases, the price of shipping to this location doubled their cost—their use was necessary to prevent encroachment of broadleaf weeds and grasses. Without herbicide usage to insure a good weed free stand, weeds became damaging competitors during the dry season when alfalfa growth is slow. This resulted in significantly reduced yields due to the shading out of new growth. If manual weeding was not done under these circumstances, the extended life of the stand could not be maintained and costly reseeding would be necessary. For these reasons, alfalfa is not recommended to the grower on St. Croix who is unable to fertilize, plant, and maintain it properly. It was found to be a labor intensive crop and is not feasible for those who do not have the necesssary equipment to maintain a healthy stand. Therefore, it is recommended that those with limited experience in alfalfa production and limited mechanical resources should plant only a small acreage to determine how it will grow on their farm.

The author wishes to acknowledge Stanley Simicek (Texas A&M University) for his help in obtaining seed, Dr. W.R. Ocumpaugh (Texas Agricultural Experiment Station) for his invaluable assistance in planning the experiment, and Dr. M.W. Michaud (University of the Virgin Islands) for the use of his field personnel.

Recent AES Publications

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