STEMS AND TUBERS FOR REARING SWEET POTATO WEEVIL

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Portion of BS thesis conducted by the senior author in ViSCA.

Accepted for publication 21 May 1980.

ABSTRACT

Sweet potato weevil, *Cylas formicarius elegantulus* Fabr. was successfully reared on mature stems using longitudinal halves and on tubers using thin chips held between plastic rearing blocks. There were no differences in size and behavior of larvae, pupae and adults but there was only slight difference in duration of life cycle and mortality of weevils reared on tubers and mature stems. Results show that mature stems were as suitable as tubers in rearing sweet potato weevil. However, the use of tuber chips was the most suitable and economical method of rearing sweet potato weevil in the laboratory.

Ann. Trop. Res. 2:80-88.

INTRODUCTION

Sweet potato, *Ipomoea batatas* Lam., is one of the most important root crops grown for food in the Philippines. The tuber is a substitute staple food for rice and corn in some parts of the country and provides high amount of calories. Although this crop has long been cultivated in the Philippines, its production per hectare has remained low. One reason for this predicament is the presence of insect pests, the most important of which is the sweet potato weevil, *Cylas formicarius elegantulus* Fabr. Torres (1976) cited that infestation by this insect may range from 20 to 50% on many farms at low elevation and may even result in total crop failure. It attacks tubers and stems in the field as well as tubers in storage. The larvae tunnel into the tubers tainting them with disagreeable odor and imparting bitter taste, which renders them unfit for human and animal consumption. The damage inflicted by

this pest may even provide entrance to pathogens such as bacteria and fungi which could lead to secondary infection.

Because of the economic importance of this insect pest, many studies have been conducted on its biology and control. However, in previous biological studies, weevils were reared only on tubers and not on vines and stems. If the reactions of the stems and tubers to weevil attack are similar, the former can be used in varietal screening of sweet potato without waiting for the tubers to develop to maturity, as is presently being practiced.

This study sought to compare the life cycle of sweet potato weevils reared on tubers and stems and to gather additional information on the life cycle and behavior of the insect which are important in formulating an effective pest management program for its control.

MATERIALS AND METHODS

Mass Rearing of Sweet Potato Weevil. — Weevil-infested tubers were collected from the field and placed in wire-screened cages to confine emerging adults which were later allowed to mate and oviposit in separate rearing jars provided with tuber pieces as oviposition substrate. Eggs were collected daily and placed in Petri dishes lined with moistened tissue paper. First instar larvae that emerged from these eggs were used for testing.

Comparison of Rearing Media and Techniques. — *Rearing Weevils on Tubers Using Three Techniques.*

1. *Whole Tubers*-Small tubers, about 8 cm long, were each provided with a small hole for the introduction of first instar larvae artificially. The holes were covered with cellotape to prevent the larvae from escaping. One tuber was used for each larva until it completed development.

2. *Tuber Chunks* — First instar larvae were introduced into tuber chunks measuring about 2 cm^3. These were also provided with initial holes for entry of larvae and then sealed with cellotape. The tuber chunks were placed in glass jars (10 cm H x 5 cm Dia) lined with moistened tissue paper (Fig. 1). The tuber chunks were changed every 3 to 4 days until the larvae pupated.

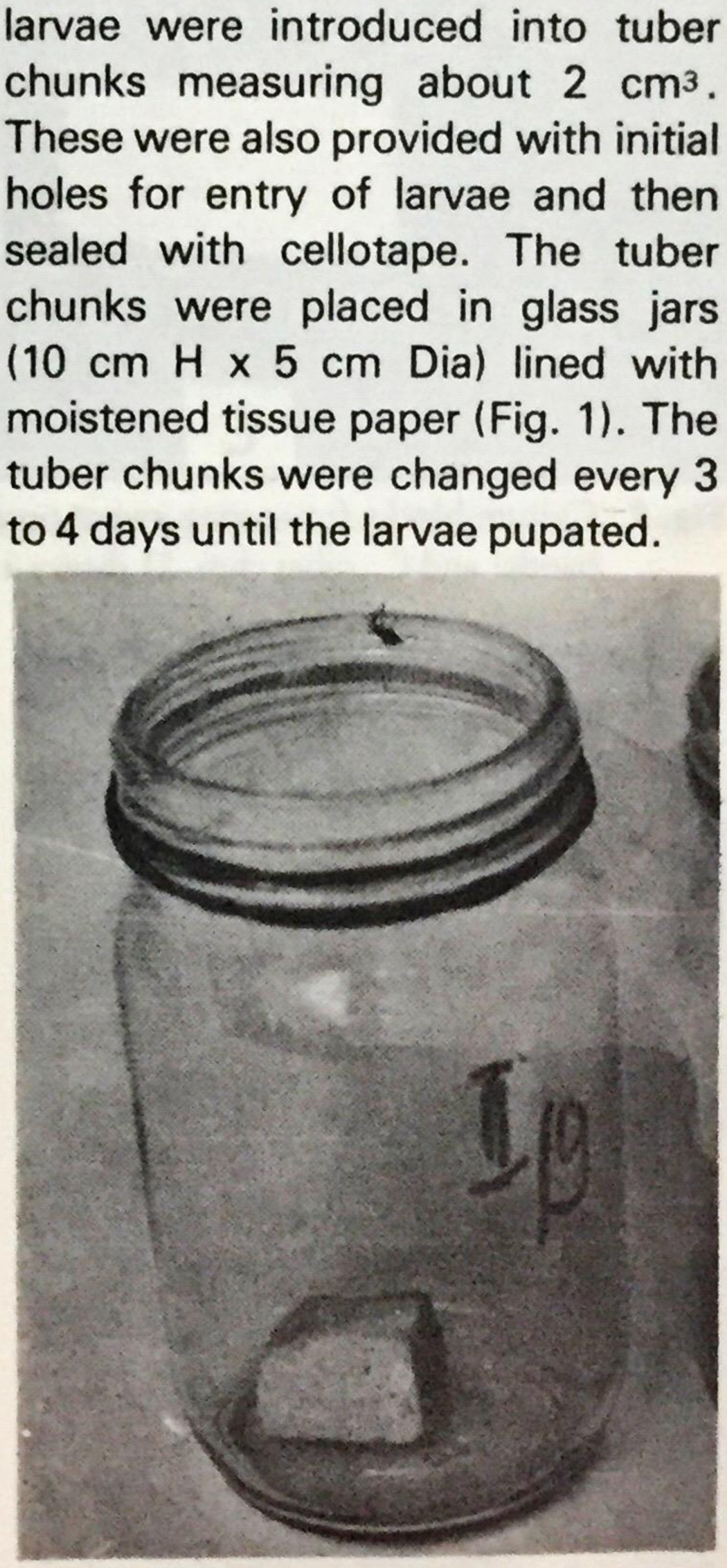

Fig. 1 . Glass jar containing individual culture of sweet potato weevil reared on tuber chunks.

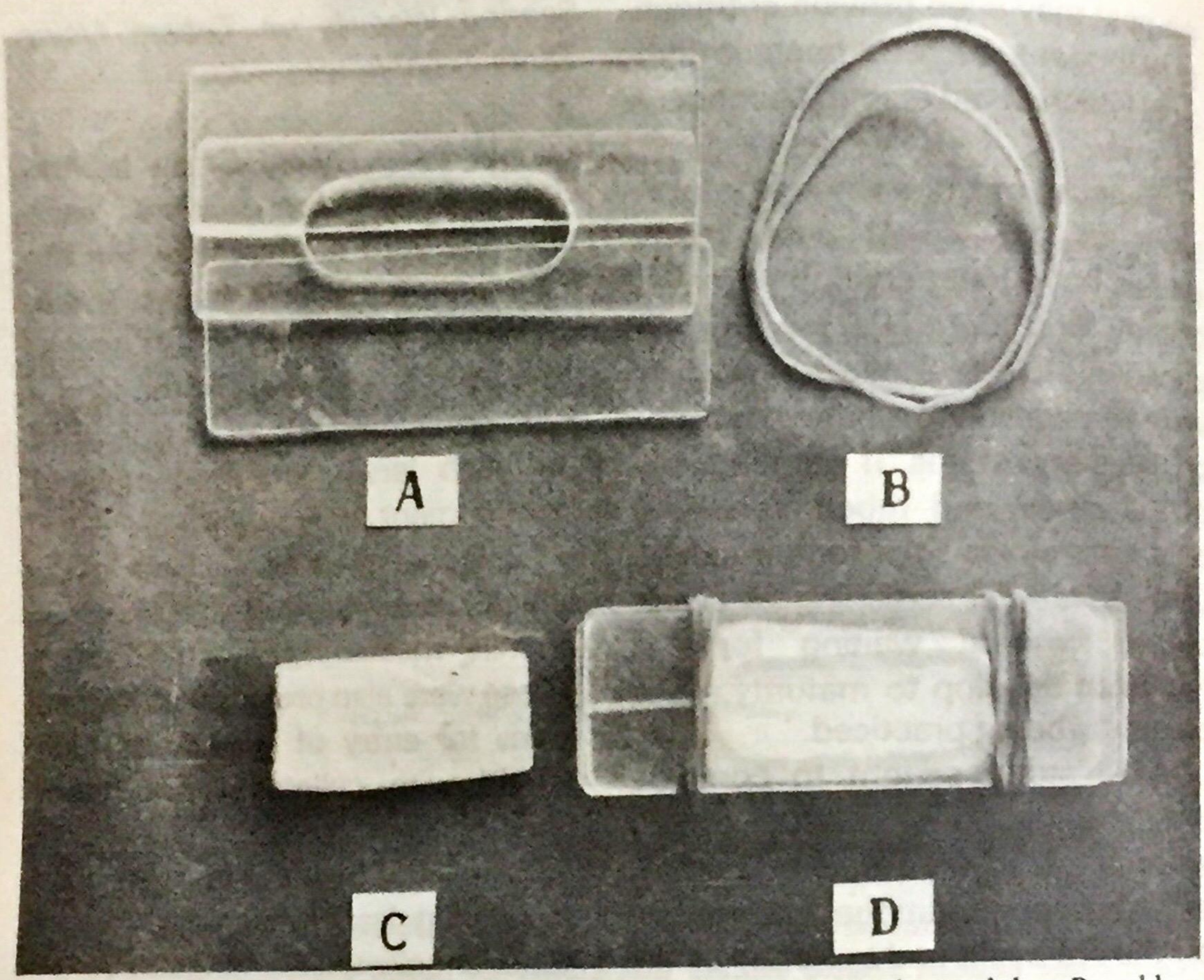

Fig. 2 Culture blocks for rearing sweet potato weevil using A, 3 plastic slides; B, rubber bands; and C, tuber chip. D shows a complete set up.

Fig. 3 Glass jar containing individual culture of sweet potato weevil reared on tuber chips.

3. *Tuber Chips* — Tubers were sliced into thin chips about 5 cm long, 2 cm wide and 0.3 cm thick. Each chip was provided with a small hole for introducing a newly emerged larva before it was placed in-between 3 plastic slides, the middle slide provided with an observation hole to facilitate examination (Fig. 2). Both ends of the rearing blocks were tied with rubber bands. The rearing blocks were then placed in covered bottles (Fig. 3). The same tuber chips were often used for the entire larval period of the weevil.

Rearing Weevils on Mature Stems. —

Healthy mature stems were cut into 7 cm pieces and split length-

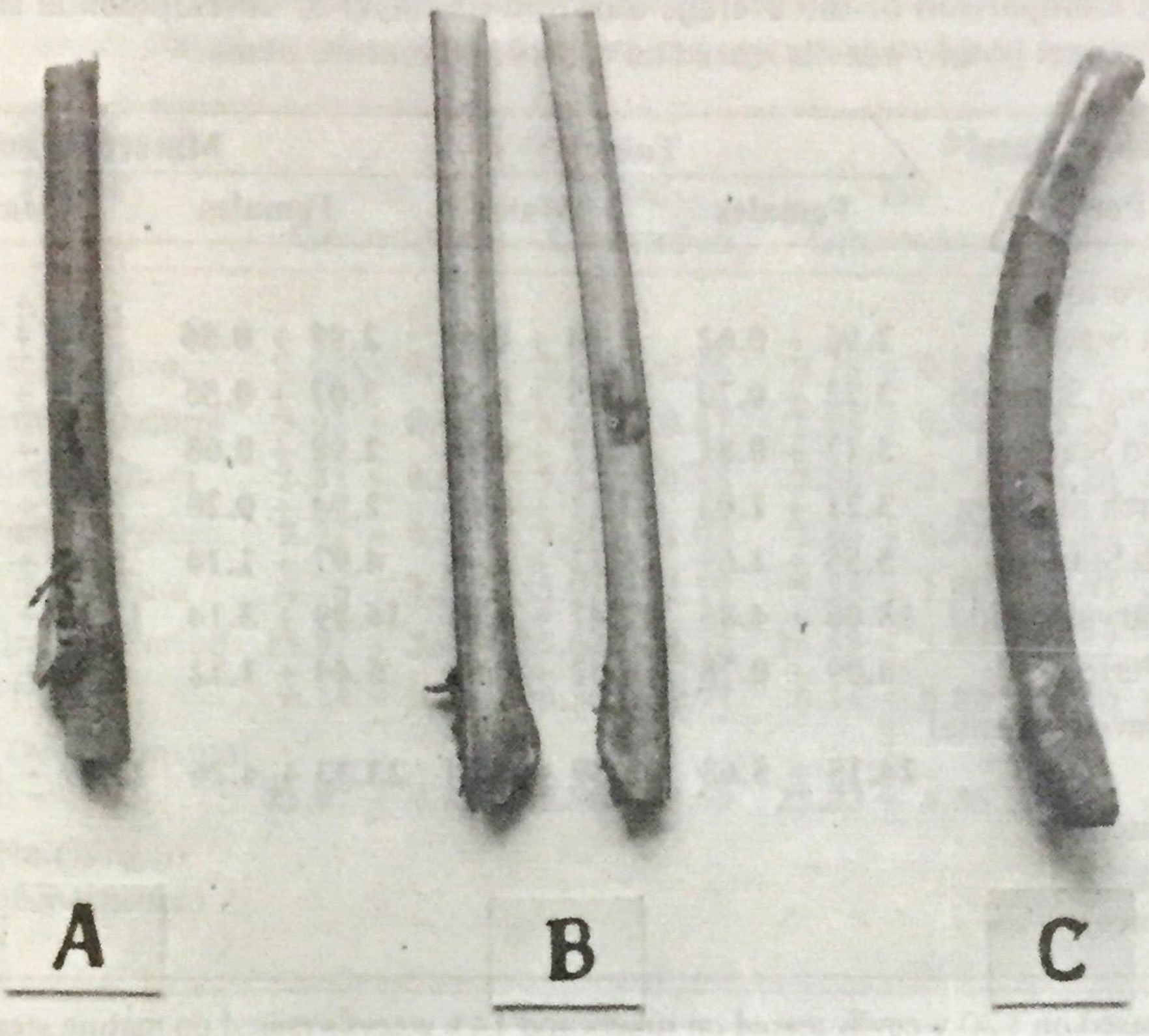

Fig. 4 Mature stems for rearing sweet potato weevil: A, stem cut about 7 cm long; B, halved stem, one side provided with initial hole for introducing larva; and C, stem halves taped together at ends.

wise. One of the halves was provided with a small hole for introducing a newly emerged larva. Stem halves were taped together on both ends to prevent the larvae from escaping. Stem pieces were placed individually in Gerber bottles covered with nylon cloth and then loosely covered again to prevent dehydration of stems. Stem pieces were replaced with fresh ones every 5 to 7 days (Fig. 4).

RESULTS AND DISCUSSION

Rearing Weevils Using Different Techniques.

The first two techniques tested using whole tubers and tuber chunks proved to be inapplicable. Whole tubers were bulky and large numbers were needed to maintain individual cultures. Tuber chunks were prone to the attack of fungi, especially *Rhizopus* and *Aspergillus,* and they dried up due to loss of moisture. Moreover, both required excavation into the tissues to observe change and behavior of developmental stages resulting in high mortality due to mechanical injury.

The use of tuber chips and mature stems cut into longitudinal halves were more suitable under laboratory condition. Tuber chips held between plastic blocks was the most suitable and economical method among the rearing techniques tested. The data presented in

Table 1. Comparison of the average duration (in days) of developmental stages of sweet potato weevils reared on tubers and mature stems. [1]

Developmental Period	Tubers		Mature Stems	
	Females	Males	Females	Males
Larval Period				
First Stadium	2.96 ± 0.62	2.88 ± 0.64	2.98 ± 0.56	2.90 ± 0.54
Second Stadium	3.22 ± 0.70	3.25 ± 0.50	3.02 ± 0.56	3.16 ± 0.66
Third Stadium	3.12 ± 0.81	3.11 ± 0.84	2.98 ± 0.68	3.10 ± 0.88
Fourth Stadium	3.21 ± 1.03	3.11 ± 0.85	2.94 ± 0.20	2.94 ± 0.91
Fifth Stadium	5.55 ± 1.69	5.12 ± 1.48	4.97 ± 1.14	5.23 ± 1.16
Total Larval Period	18.06 ± 4.85	17.47 ± 4.31	16.89 ± 3.14	17.33 ± 4.15
Pupal Period	6.09 ± 0.78	6.42 ± 0.93	6.44 ± 1.12	6.56 ± 1.01
Total Developmental Period (Egg Hatching to Adult Emergence)	24.15 ± 5.63	23.89 ± 5.24	23.33 ± 4.26	23.89 ± 5.16

[1]Data based on 170 weevils reared on tubers and 141 weevils reared on mature stems.

this paper were taken from weevils reared on tuber chips and mature stems only.

Comparison of Weevils Reared on Tubers and Stems.

Table 1 compares the duration of the different developmental stages of sweet potato weevil reared on tubers and mature stems. For weevils reared on tubers, the average developmental period (from egg hatching to adult emergence) was 24.15 days for females and 23.89 days for males with no notable difference between sexes. Except for the last stadium, which was longer with a mean of about 5 days, the duration of all the preceding instars was about the same with a mean of 3 days.

Weevils reared on mature stems had an average developmental period of 23.33 and 23.89 days for the female and male, respectively. The slightly shorter life cycle in stems may be due to the more limited food supply in the stems which might have hastened larval development. The trend in larval development was similar to that observed in tubers. Based on the results, stems are as suitable as tubers for rearing sweet potato weevil.

A comparison of the results obtained from 2 generations of weevils (Table 2) showed that the total developmental period of weevils reared on both tubers and mature stems was shorter during the first compared to the second generation. Weevils reared on

Table 2. Comparison of the average duration (in days) of developmental stages of sweet potato weevil reared on tubers and mature stem for two generations.[1]

Developmental Period	Tubers		Mature Stems	
	1st Generation	2nd Generation	1st Generation	2nd Generation
Larval Period				
First Stadium	2.62 ± 0.55	3.23 ± 0.56	2.78 ± 0.54	3.10 ± 0.52
Second Stadium	3.02 ± 0.40	3.46 ± 0.67	2.94 ± 0.54	3.23 ± 0.60
Third Stadium	2.81 ± 0.59	3.42 ± 0.88	2.88 ± 0.71	3.20 ± 0.84
Fourth Stadium	2.72 ± 0.58	3.60 ± 1.02	2.86 ± 0.82	3.02 ± 1.02
Fifth Stadium	4.76 ± 1.33	5.91 ± 1.59	5.23 ± 1.06	4.97 ± 1.21
Total Larval Period	15.93 ± 3.45	19.62 ± 4.72	16.69 ± 3.67	17.52 ± 4.19
Pupal Period	6.14 ± 0.72	6.36 ± 0.97	6.14 ± 0.88	6.90 ± 1.12
Total Developmental Period (Egg Hatching to Adult Emergence)	22.07 ± 4.17	25.98 ± 5.69	23.83 ± 4.55	24.42 ± 5.31

[1]Data based on 166 weevils reared on September to November, 1979 and 145 weevils reared on December, 1979 to February, 1980.

tubers have an average developmental period of 22.12 and 25.87 days for the first and second generations, respectively. Similar trend was observed for weevils reared on mature stems. The difference in life cycle may be due to the difference in temperature during the conduct of the experiment. The first generation was reared during September to November when days were warmer (average of 27.32°C) and the second generation was reared during the cooler months of December to February (average of 26.23°C). Although only 1°C difference was recorded outside the laboratory, actual temperature inside the rearing jars may have been higher during warmer days because the cultures were enclosed in covered containers.

There was no significant difference in the size (Table 3) and behavior of larvae, pupae and adults reared on tubers and mature stems. However, there was a slight difference in the female to male ratio of adults (Table 4) suggesting that if ever there was an effect of the media it may not be of much significance.

High mortality rates of 53.75% and 64.75% (Table 5) were recorded for weevils reared on tubers and mature stems, respectively. These were mainly due to mechanical injury inflicted on the larvae during examination when the larvae have to be excavated from the tunnels and during transfer to fresh substrate. Infection by pathogens was

also observed. The higher mortality rate of stem-reared weevils as compared to tuber chip-reared weevils could be attributed to the faster drying up of stem pieces which necessitated more frequent transfer to fresh substrate. On both media, more weevils died during the first 3 larval instars. The highest mortality of 12.75 and 20.25% on tubers and mature stems, respectively, were recorded during the first instar. Mortality decreased as the larvae matured. Larval mortality during the fifth instar was mainly due to fungal and bacterial infection and attack of predatory ants.

Other Biological Data Obtained Which Were not Related to Rearing Techniques Used.

Egg laying started 7 to 13 days after emergence. Eggs were laid singly in holes made by the female on the oviposition substrate. Sometimes 2 eggs were observed in one hole. After oviposition, the female sealed the hole with brownish gelatinous substance. In some instances, the eggs were laid directly on the surface of the oviposition substrate.

Table 3. Comparison of length (in mm) of sweet potato weevils reared on tubers and mature stems of BNAS-51 variety.[1]

Developmental Period	Tubers	Mature Stems
Larval Instars		
First	1.4	1.4
Second	2.7	2.6
Third	4.3	4.1
Fourth	5.8	5.8
Fifth	7.1	7.1
(prepupa)	5.9	5.4
Pupa	5.3	5.2
Adult	5.7	5.8

[1]Data based on 170 weevils reared on tubers and 141 weevils reared on mature stems.

It was observed that the female also laid eggs on mature stems. However, female weevils showed higher preference for tubers for oviposition. When both substrates were present, most eggs were laid on tuber pieces. In stems, eggs were laid on succulent areas near

Table 4. Sex ratio of adult sweet potato weevils reared on tubers and mature stems of BNAS-51 variety.

Generation	Tubers		Mature Stems	
	Female	Male	Female	Male
First	49	34	45	38
Second	45	42	25	33
Total	94	76	70	71
Female to Male Ratio	1.24:1.00		1.00:1.01	

Table 5. Comparison of percent mortality of sweet potato weevils reared on tubers and mature stems of BNAS-51 variety.[1]

Developmental Stages	Tubers	Mature Stems
Larval Instars		
First	12.75	20.25
Second	12.50	11.75
Third	12.50	13.50
Fourth	5.25	6.50
Fifth	8.50	7.50
Pupa	2.25	5.25
Total	53.75	64.75
Average	8.96	10.79

[1]Data based on 170 weevils successfully reared on tubers and 141 weevils on mature stems.

the node. The manner of oviposition on stems was similar to that on tubers.

Incubation period lasted 6 to 12 days for both sexes. Out of 1,538 eggs incubated, only 972 (63.2%) hatched. Low percent hatchability was due to fungal attack during incubation and mechanical damage when the eggs were transferred from the oviposition substrate to Petri plates.

Contrary to the report of AVRDC (1977), sweet potato weevil underwent 5 larval instars which was similar to the results mentioned by Rejesus and Aguda (1975) and Jayaramiah (1975), instead of only 3 larval instars which was reported.

The larva is legless while the pupa is exarate and sub-ellipsoidal. The adult is ant-like in appearance. Newly emerged adult was creamy white at first. After few hours, the forewing gradually changed to brown and then greenish brown while the legs turned from light to reddish brown. Sclerotization took 2 to 4 days. During this period, the body gradually hardened and darkened. The head, forewing and abdomen turned metallic blue, while the legs and thorax remained reddish brown.

Adults were observed to be gregarious. They seldom moved about especially if the substrate was fresh. Males were more active than females. Mating took place either during the day or night. When mating was about to occur, the male used its antennae to locate the female. During mating, the male climbed on top of the female, its legs grasping the sides of its mate. When disturbed, the adults in copula disengaged immediately. Mating occurred repeatedly.

A female was capable of laying both fertile and non-fertile eggs. A female can lay from 24 to 149 eggs during a period of 54 to 119 days. At the start of egg laying, fewer eggs were deposited but gradually increased towards the 15th to 20th day of egg laying and then again decreased towards the end of egg laying.

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