ARACEOUS AND NONARACEOUS HOSTS OF TARO FEATHERY MOSAIC DISEASE

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ABSTRACT

Six plant species belonging to Araceae and one species of Solanaceae were infected with taro feathery mosaic disease. *Typhonium trilobatum* (Linn.) Schott, *Dieffenbachia maculata*, *Dieffenbachia* sp., and *Datura metel* Blanco were highly susceptible while *Xanthosoma* sp. was moderately susceptible. *Caladium bicolor* (Avit.) Vent showed stunting and leaf distortion while *Cyrtosperma merkussii* (Linn.) Schott was the only species which showed latent infection. *Dieffenbachia* spp. had an average incubation period of 4.5 days followed by *D. metel* with 7.8 days; *T. trilobatum*, 13.5 days; *Xanthosoma* sp., 14.4 days; *C. bicolor*, 17.6 days and *C. merkussii*, 14 days. Back-inoculation to taro showed the positive presence of taro feathery mosaic in these plants.

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KEY WORDS: Taro feathery mosaic disease. Alternate hosts. Symptoms. Manual inoculation. Back-inoculation. Latent infection. Araceae. *Colocasia esculenta*.

INTRODUCTION

Taro (*Colocasia esculenta* (L) Schott) is a relatively long-season crop such that it is very common to find other plants growing with it in the field. The close association of plants (i.e., weeds and intercrops) with diseased taro provides an opportunity for transmitting the causal agent and the disease to them.

Taro feathery mosaic disease (TFMD) has recently been described to be manually transmissible to *Colocasia* species. It is also biologically transmitted by planthoppers (Palomar et al., 1983).

Researchers believe that the symptoms found in taro from Papua New Guinea, New Britain, Bougainville, Solomon and in many other countries in the Pacific region are expressions of dasheen mosaic virus (Gollifer et al., 1976). However, transmission studies indicate that dasheen mosaic virus is biologically transmitted by aphids (Zettler et al., 1970). Edwardson (1974) reported 24 species of Araceae which are susceptible to the dasheen mosaic disease.

This study presents the araceous and nonaraceous hosts of taro feathery mosaic disease in the Philippines.

MATERIALS AND METHODS

Common weeds associated with upland crops, plants related to taro, standard local lesion hosts and other root crops were collected and planted in 19.2 cm dia. clay pots containing sterilized soil. Healthy species were manually inoculated with sap extract from leaves of Kalpao taro infected with feathery mosaic virus. A small amount of celite was used as an abrasive during inoculation. The plants were observed daily for the appearance of symptoms.

Local Lesion Assay. Plants which are commonly used as local lesion hosts for plant viruses were inoculated with taro feathery mosaic. They were observed daily for one month for the initial appearance and development of symptoms.

Latent-infection Test. Inoculated test plants that did not show symptoms of the disease within a month were tested for latent or masked infection. Back-inoculation was manually done to healthy taro plants. Appearance of symptoms was likewise noted.

Back-inoculation. Leaves of test plants showing symptoms of TFMD were used as source of inoculum for manual inoculation to Kalpao taro, the standard source of taro feathery mosaic disease. The plants were examined daily to observe the appearance of symptoms.

RESULTS AND DISCUSSION

Out of the 33 plant species inoculated with taro feathery mosaic (TFM), three species namely; *Typhonium trilobatum*, *Xanthosoma* sp. and *Caladium bicolor*, responded by showing symptoms resembling those caused by the disease in taro plants. All three belong to Araceae and showed interveinal symptoms with systemic invasion of TFM (Table 1). Local lesion symptoms were shown by three plant species namely, *Datura metel*, *Dieffenbachia maculata* and *Dieffenbachia* sp. which belong to Solanaceae and Araceae, respectively.

Systemic Infection

Typhonium trilobatum Schott (Typhonium) – Symptoms first appeared in the youngest leaf 11 days after inoculation. Whitish spots with short streaks were distributed throughout the partially opened leaf. These spots gradually increased and streaks formed into feathery patterns which followed the outlines of the vein. The feathery pattern gave the characteristic vein banding with mottling in between leaf veins (Fig. 1A). Mosaic pattern with colors ranging from whitish to yellowish green became apparent after

Table 1. Degree of susceptibility of 33 plant species after mechanical inoculation with taro feathery mosaic disease.

Family	Common Name	Scientific Name	Degree of Susceptibility
Araceae	Taro	*Colocasia esculenta* (Linn.) Schott	***
	Typhonium	*Typhonium trilobatum* Schott	***
	Yautia	*Xanthosoma* sp. (Linn.) Schott	**
	Gabi-gabi	*Caladium bicolor* (Avit.) Vent.	*
	Galiang	*Alocasia macrorrhiza* (L.) Schott	–
	Palawan	*Cyrtosperma merkussii* (Hassk.)	±
Convulvulaceae	Kangkong	*Ipomoea aquatica* Forsk.	–
	Sweet Potato	*Ipomoea batatas* (Linn.)	–
	Moti-moti	*Ipomoea triloba* (Linn.)	–
Graminae	Aguingay	*Rottboellia exaltata* (Linn.)	–
	Barnyard grass	*Echinochloa crusgalli* (Linn.) Beauv.	–
	Carabao grass	*Paspalum conjugatum* Berg.	–
	Crab grass	*Digitaria sanguinalis* (Linn.) Scop.	–
	Jungle rice	*Echinochloa colona* (Linn.) Link	–

Table 1. Continued . . . .

Family	Common Name	Scientific Name	Degree of Susceptibility
Cyperaceae	Nutsedge	*Cyperus rotundus* Linn.	–
	Pandan-pandan	*Cyperus difformis* Linn.	–
Commelinaceae	Alikbangon	*Commelina diffusa* Burm. J. (Linn.)	–
	Sabilay	*Commelina benghalensis* (Linn.)	–
Euphorbiaceae	Gatas-gatas	*Euphorbia hirta* Linn.	–
	Cassava	*Manihot esculenta* Crantz	–
Amaranthaceae	Amaranthus	*Amaranthus spinosus* Linn.	–
Piperaceae	Olasiman	*Peperomia pellucida* (Linn.) R. & P.	–
Portulacaceae	Pigweed	*Portulaca oleracea* Linn.	–
Malvaceae	Baseng-baseng	*Sida rhombifolia* Linn. ssp. *rhombifolia*	–
Oenotheraceae	Tayilaktan	*Ludwidgia octovalvis* ssp. *sessiflora* (Mich.) Raven	–
Local Lesion Hosts			
Araceae	Spotted dumb cane	*Dieffenbachia maculata*	+++
		Dieffenbachia sp.	+++
Solanaceae	Talumpunay	*Datura metel* Blanco	+++
		Nicotiana benthamiania Linn.	–
		Nicotiana rustica Linn.	–
Mimosoideae	Partridge pea	*Cassia occidentalis* Linn.	–

Table 1. Continued . . . .

Family	Common Name	Scientific Name	Degree of Susceptibility
Aizoaceae	New Zealand spinach	*Tetragonia expansa* Murr.	–
Chenopodiaceae	Goosefoot	*Chenopodium quinoa* Linn.	–

***Highly susceptible – feathery mosaic accompanied with mottling and vein clearing; distortion of infected leaves with general stunting of the plant; mosaic patterns occurred 9-15 days after inoculation.

**Moderately susceptible – short feathery mosaic without mottling; mosaic patterns occurred 12-16 days after inoculation; symptoms gradually faded out upon further incubation. Stunting occurred.

*Less susceptible – curling and leaf distortion with stunting of the whole plant.

±Masked or latent infection.

–No infection.

+++Highly susceptible (local lesion hosts) – brown spots with yellowish border distributed on the leaves; blighting occurred when spots coalesced.

further incubation. Slight distortion of the leaf and severe stunting of growth were also observed in infected plants. Inoculated plants showed 80% infection with incubation period ranging from 11 to 18 days after inoculation (Table 2).

Xanthosoma sp. (Linn.) Schott (Yautia) – The initial symptoms of yellowish to whitish spots appeared 12 days after inoculation in the youngest unopened leaf. These spots gradually spread forming a feathery pattern which ran toward the center of the leaf (Fig. 1B). Twenty-eight days after inoculation, the mosaic pattern faded out until it finally disappeared. The symptoms did not reappear in the old leaves but they did in the younger leaves 2 to 3 weeks later. The pattern of symptom disappearance was typical of feathery mosaic disease in taro. The color of the mosaic was generally yellowish as distinguished from the prominent white mosaic in taro and Typhonium. There

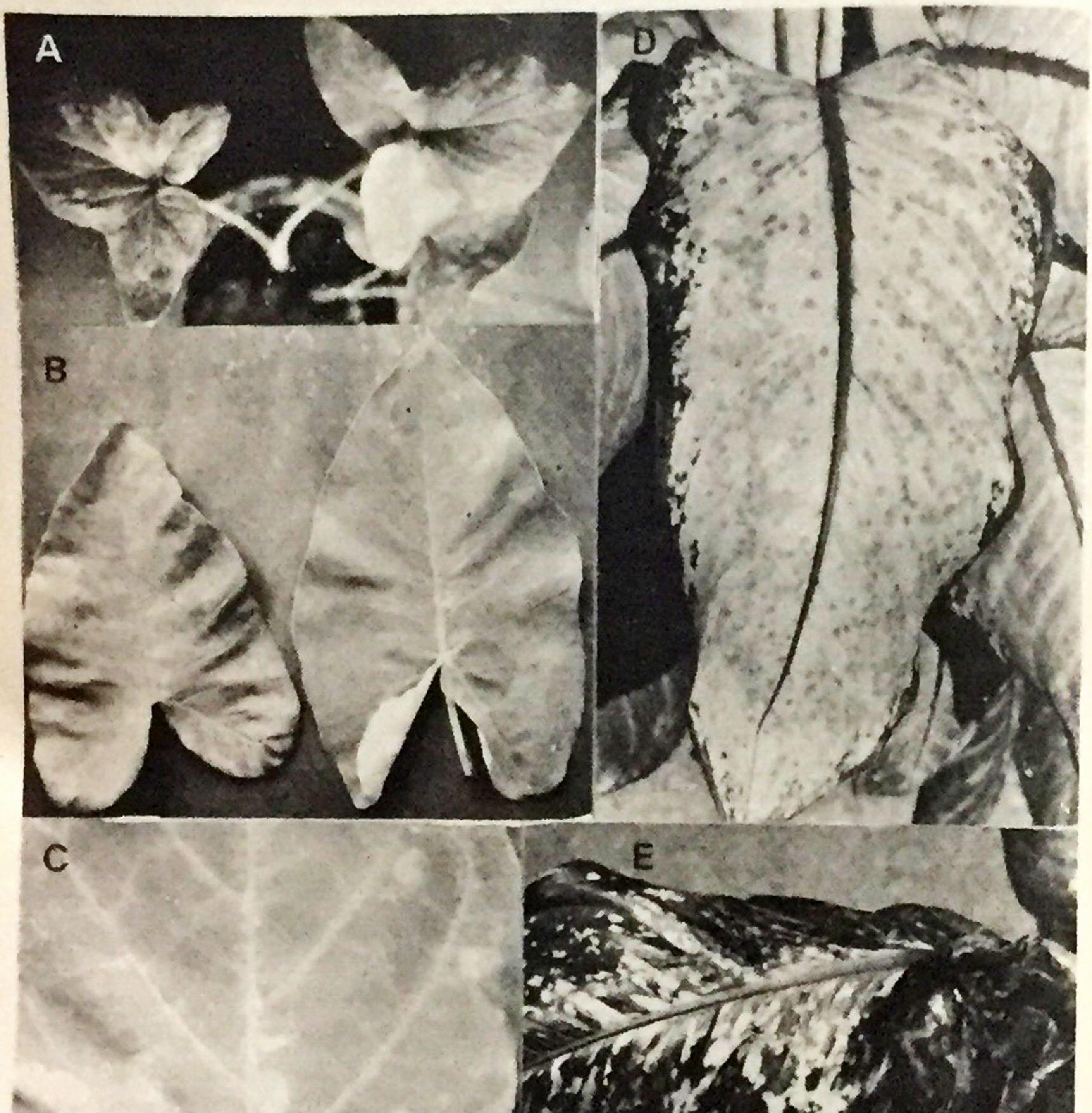

Figure 1. Taro feathery mosaic disease in various hosts: A. *Typhonium trilobatum*, B. *Xanthosoma* sp., C. *Datura metel*, D. Ring spots in *Dieffenbachia maculata* 8 days after inoculation, E. Necrotic spots and blighted appearance in *Dieffenbachia* sp. 20 days after inoculation.

Table 2. Pathogenicity and incubation period of taro feathery mosaic disease in different host species showing systemic or local infection after mechanical transmission.[1/]

Plant Species	% Infection	Incubation Range (days)	Mean
Local infection			
Datura metel	100	6 – 8	7.8
Dieffenbachia maculata	100	4 – 5	4.5
Dieffenbachia sp.	100	4 – 5	4.5
Systemic infection			
Colocasia esculenta[2/]	100	11 – 19	12.1
Typhonium trilobatum	80	11 – 18	13.5
Xanthosoma sp.	60	12 – 19	14.4
Caladium bicolor	33	15 – 23	17.6

[1/] Average of 3 trials (10 plants/host/trial).

[2/] Control plants (Kalpao variety).

was 60% infection in inoculated yautia plants (Table 2).

Caladium bicolor (Avit.) Vent (Gabi-gabi) – The disease symptoms were different from those observed in the two hosts mentioned earlier. There was no distinct mosaic pattern nor mottling observed because of the normal white and green coloration of the leaves. However, pronounced stunting and distortion or curling of leaves were observed 15 days after inoculation. Other symptoms included the presence of an unfurled leaf which when forcibly opened appeared malformed, curled and cupped. These symptoms may be due to the unsynchronous growth of cells within the leaf caused by the invasion of the pathogen.

Local infection

Datura metel Blanco (Talumpunay) – The initial symptoms appeared as white spots with yellowish border 6 days after inoculation. The spots grew in diameter after 5 days, eventually turning brown with yellow border (Fig. 1C). Some of the spots coalesced after 5 days of incubation producing blights in the later stages of growth.

Dieffenbachia spp. (Dumbcane) – The two species of dumbcane had initial symptoms which appeared as water-soaked, light to dark brown minute spots 4 days after inoculation. The spots enlarged to typical ring spots with yellowish borders which distinguished the diseased portion from the normal color of the leaf tissue (Fig. 1D). Some of the spots coalesced after 7 days of incubation which resulted in a blighted appearance during the later stages of infection. Necrotic spots appeared on new leaves followed by rotting of the unfurled leaf (Fig. 1E).

The non-transmissibility of the TFM agent to other local lesion hosts could be due to host specificity or to the presence of some reducing agents such as ascorbic acid, glutathione and cysteine in the plant system (Solymosy et al., 1959).

Latent Infection

Of the 33 plants tested, only *Cyrtosperma merkussii* showed latent infection. Back-inoculation gave 33% infection of taro thereby indicating that this plant species harbored the pathogen but did not externally show the disease. The low percentage of infection of back-inoculated plants may be due to the low concentration of inoculum in the plants. However, the absence of symptoms could be attributed to the short length of time during which the plants were observed (28 days only). If the incubation period of TFMD in *C. merkussii* is longer than in taro, prolonging the observation period may enable the plant to express the symptoms of the disease.

The presence of the pathogen without external symptoms of infection could present a problem in disease detection. The pathogen may not have a direct effect on the plant that is latently infected but the possible transmission of the disease to other economic crops could lead to yield loss.

Back-inoculation

All inoculated test plants, whether showing symptoms or not, were back-inoculated to healthy taro to check the presence of TFMD. All taro plants manually inoculated with crude sap from the test plants suspected to harbor the agent did not markedly differ in incubation period of TFMD (Table 3). This showed that pathogenicity of TFMV is generally not affected when it is passed from one host to another. *D. metel* which exhibited 100% local infection produced only 42% infection on taro plants upon back-inoculation (Table 3). This could be explained by the localization of the pathogen which accounts for the lesser amount of inoculum in each plant compared to a systemically infected plant.

Indicator Host

Philodendron selloum was also inoculated to determine if TFMD is similar to "Alomae" disease found in the Solomon Islands. After several months of observation, no symptom was observed in the plants. This indicates that TFMD is not transmissible to *P. selloum* and it is different from "Alomae" disease.

Table 3. Pathogenicity and incubation period of taro feathery mosaic disease in healthy taro (Kalpao variety) plants back-inoculated with inoculum from alternate hosts.[1]

Source of Inoculum[2]	% Infection	Incubation Range (days)	Mean
Typhonium trilobatum	100	11 – 16	14.0
Xanthosoma sp.	100	12 – 16	14.3
Caladium bicolor	67	14 – 16	15.2
Cyrtosperma merkussii	33	13 – 18	14.0
Datura metel	42	11 – 17	14.8
Dieffenbachai maculata	73	11 – 16	14.6

[1] Average of 3 trials (10 plants/host/trial).

[2] Alternate host plants suspected to harbon TFM.

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