

muestras de la playa. Se notó la presencia de *Helicotylenchus*, *Hoplolaimus*, Tylenchids y *Dolichodorus* n.sp. en otras muestras, ya que al parecer estas especies son tolerantes al alto contenido de sal característico de este ambiente.

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MATING OF BRITISH AND PERUVIAN POPULATIONS OF POTATO CYST-NEMATODES *Globodera* spp. [CRUZAMIENTO DE POBLACIONES BRITANICAS Y PERUANAS DEL NEMATODO DE QUISTE DE LA PAPA]. J. Franco P.* and K. Evans, Rothamsted Experimental Station, Harpenden, Herts, England.

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ABSTRACT

The compatibility of populations of *G. rostochiensis* (Ro 1) and *G. pallida* (Pa 3) from the United Kingdom and Peru were studied by making single male-female crosses. Reciprocal crosses within and between populations showed that British and Peruvian populations of the same species interbreed and produce many eggs. Although interspecific matings occur, fewer eggs are produced and F1 progeny rarely survive. *G. pallida* males tended only to mate with their own females, whereas *G. rostochiensis* males mated with *G. pallida* females more frequently. *G. rostochiensis* females preferred their own males. This may operate to the disadvantage of *G. pallida* when both species occur together.

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INTRODUCTION

Species are usually identified on morphological characters but sometimes morphological and ecological data conflict and difficulty arises in deciding their

relative importance. Sexual compatibility also has to be considered. Ecological factors affect individuals both phenotypically and genotypically. Their indirect effects upon the genotype are longterm, being the results of interaction between the processes which cause and maintain genetic variation, and environmental factors moulding that variation.

Speciation is an adaptive process that involves establishment of barriers to gene flow between closely related populations by isolating them reproductively. Species may be defined as breeding communities able to produce viable and fertile off-spring (7) or as groups of actually or potentially interbreeding populations which are reproductively isolated from other such groups (9). Failure of individuals to interbreed indicates genetic incompatibility and leads to the establishment of new species.

Variation in nematodes is largely genetically controlled (14). Mayr (8) considered that races of parasitic nematodes might be regarded as sibling species, defined as sympatric forms, morphologically similar and closely related, but with specific biological features and reproductively isolated. Sturhan (13) applied Mayr's sibling species concept to plant-parasitic nematodes.

When the cyst-nematodes were thought to be one species, there was much talk of the danger of populations adapting to new hosts grown frequently. These fears proved groundless and speculations ceased when the species were adequately described and their host ranges determined (6). The potato cyst-nematodes have host ranges clearly separated from those of other cyst-nematodes, but differences between populations of potato cyst-nematodes were observed when some were found able to reproduce on potato plants containing genes for resistance (2, 5).

Parrott (in Jones, 1967) studying the inheritance of ability of potato cyst-nematodes to reproduce on the resistant potato cultivar Maris Piper, made single reciprocal crosses between populations. Mating within population groups were equally as successful as selfings, but populations from different groups mated much less successfully. Populations now known to be pathotypes of *G. pallida* (Pa¹ and Pa³) interbred freely, but fewer fertilizations occurred when they were crossed with males or females of *G. rostochiensis* (Ro1). The production of fertilized eggs averaged 63% for crosses between *G. rostochiensis* populations (Ro1 x Ro1) and 64% for crosses between *G. pallida* populations (Pa³ x Pa³; Pa¹ x Pa¹ and Pa³ x Pa¹), but only 20 and 27% between species (Ro1 x Pa¹ and Ro1 x Pa³). The new females produced by raising juveniles from successful crosses on a susceptible potato variety were counted. Not only did fewer females from interspecific crosses produce eggs, but fewer juveniles hatched from these eggs. Very few of these juveniles developed into F1 females (11, 12).

Bedi (1), without evidence of infertility between species of potato cyst-nematodes, made controlled matings between *G. rostochiensis* (Ro1) and *G. pallida* (Pa1) and obtained F1 eggs from only 14% of the females.

We used populations of *G. rostochiensis* (Ro1) and *G. pallida* (Pa3) from the United Kingdom and Peru and made single male-female crosses in all combinations.

MATERIALS AND METHODS

Potato plants (*Solanum tuberosum* cv. Arran Banner) were grown in 10 cm plastic pots and freshly hatched juveniles added to the soil. Sixteen days later the roots were washed of soil and suspended in aerated water, so that the males fell away from the roots on emergence and the females remained unmated.

Beginning four days later, males were collected daily and transferred to a 100 µm aperture nylon sieve submerged to a depth of 2 mm in water. Only active males passing through this sieve within 2 hours were used for mating. Females were collected forty-

two days after juveniles were added to the plants (14). Two sets of plants, inoculated at different times, were used to provide fresh males and females at the same time.

Females were placed in the center of agar plates (5 ml of 0.8% water agar in 5 cm plastic Petri dishes), one per plate. A single newly-emerged male was placed next to each female. There were twenty dishes for each cross and for unmated females which acted as controls. The dishes were kept in darkness at 20°C and the females were examined after 4 weeks. When a female contained embryonated eggs it was assumed to have been fertilized, as unfertilized females contain no eggs or only a few abnormal, non-embryonated eggs (3). None of the unmated females contained eggs.

The populations used in mating tests were Feltwell and Puno (British and Peruvian *G. rostochiensis* Ro1, respectively) and Cadishead and Otuzco (British and Peruvian *G. pallida* Pa3 respectively).

RESULTS AND DISCUSSION

Crosses within species gave a greater percentage of successful matings (29%) and produced more eggs per cyst (180) than those between species (9% and 110, respectively). The percentage of fertilized females in the latter was greater when the males were *G. rostochiensis* (14%) rather than *G. pallida* (5%) (Table 1). The percentages of females fertilized in crosses between populations are in Table 2. Within species crosses were usually the most successful but Cadishead females were readily fertilized by males of all other populations. Overall, males of the four populations were about equally successful at fertilizing females (15-21%) but many more (38%) Cadishead females were fertilized overall than those of the other three populations. This difference seems partly to arise from the relative ease with which *G. rostochiensis* males fertilize *G. pallida* females, whereas *G. rostochiensis* females are much more successfully fertilized by their own males.

Since no interspecific crosses have yet been shown to develop beyond the F1 generation, interspecific mating in mixed field populations could influence competition between the species especially where *G. pallida* is in a minority. Then the ready fer-

Table 1. Number of fertilized females and eggs per female.

Crosses	Females			Eggs	
	No. Mated	No. with eggs	% with eggs	Mean % for group	Mean number per female
<i>Within Species</i>					
rostochiensis x rostochiensis	160	34	21.1	28.8	180
pallida x pallida	160	58	36.3		
<i>Between Species</i>					
rostochiensis x pallida	160	22	13.8	9.4	110
pallida x rostochiensis	160	8	5.0		

Table 2. Percentages of females fertilized in crosses between populations.

Male Parents	Female Parents			Cadishead Mean	
	Feltwell	Puno	Otuzco		
Feltwell	20	35	5	20	20
Puno	10	20	5	25	15
Otuzco	5	0	15	65	20
Cadishead	0	15	25	40	21
Mean	9	18	13	38	

Note: Feltwell and Puno populations are *G. rostochiensis* Ro1, and Otuzco and Cadishead populations *G. pallida* Pa3.

tilization of *G. pallida* females by *G. rostochiensis* males to form sterile hybrids might place *G. pallida* at a disadvantage. Conversely the fertilization of *G. pallida* females by *G. rostochiensis* males might result in some *G. rostochiensis* females remaining unfertilized, although nubile females attract many males and a single correct mating would probably be effective.

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RESUMEN

La compatibilidad reproductiva de poblaciones de *Globodera rostochiensis* y *G. pallida* procedentes del Perú y Gran Bretaña fueron estimadas por pruebas de apareamiento.

Resultados de cruzamientos recíprocos dentro y entre poblaciones mostraron que tanto las poblaciones Británicas o Peruanas pueden entrecruzarse. Sin embargo, cruces dentro de especies son siempre más frecuentes y las hembras producen mayor número de huevos embrionados, en forma independiente del lugar de origen.

También parece existir cierto apareamiento preferencial dentro de poblaciones de *G. pallida*, no así en *G. rostochiensis* donde los machos aparean y fertilizan hembras de la otra especie. Las hembras mostraron preferencia por sus propios machos. Este comportamiento sugiere que *G. pallida* competiría menos favorablemente que *G. rostochiensis* en situaciones donde ambas especies estuvieran presentes.

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EFFECTO DE DIFERENTES NEMATICIDAS SOBRE EL RENDIMIENTO DEL BANANO EN LAS ISLAS DE BARLOVENTO [EFFECT OF DIFFERENT NEMATICIDES ON BANANA YIELDS IN THE WINDWARD ISLANDS]. S. R. Gowen,* Winban Research and Development, P.O. Box 115, Castries, St. Lucía. Nueva dirección: INIAP, Aptdo. 7069, Guayaquil, Ecuador. *Funcionario de Asistencia Técnica Británica.

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RESUMEN

El efecto de dosis diferentes de varios tipos de nematicidas sobre el combate de nematodos de banano fue comparado en cuatro ensayos de campo. En un ensayo, 10 ml/planta de DBCP aplicado cada 6 meses, produjo más que con dosis de 3, 4 y 5.7 ml.; en otro ensayo no hubo diferencia de rendimientos entre dosis de 3.3 ó 15 ml. de DBCP. Con nematicidas granulados aplicados con frecuencia de 4 meses se obtuvieron buenos resultados con 2 a 3 g.i.a. de phenamiphos, 2.5 g.i.a. de carbofuran, 4 g i.a. y 6 i.a. de oxamyl que fue disminuído a 3 g i.a. En general, los nematicidas - granulados fueron tan efectivos o mejores que el DBCP, incrementando la producción de banano.

INTRODUCTION

El combate químico de los nematodos del banano con DBCP (1,2 dibromo -3-cloropropano) se ha venido recomendando a los agricultores de Sta. Lucía, San Vicente, Granada y Dominica desde hace 6 años (1). Más recientemente, se han demostrado los beneficios del uso de nematicidas granulados en banano, en la zona del Caribe (4) y en Africa Occidental (5). En este trabajo se presentan los resultados obtenidos en experimentos en que se usaron diferentes dosis de nematicidas granulados y DBCP en rendimientos de banano.

MATERIALES Y METODOS

Se establecieron ensayos en la granja de WINBAN, Roseau, Sta. Lucía, en agosto de 1972, noviembre de 1972 y enero de 1974, respectivamente, en suelo de tipo margoso y arcilloso, utilizando los clones Grand Naine (ensayos 1 y 2) y Robusta (ensayo 3) de *Musa* AAA. En el primer ensayo se compararon cuatro niveles de DBCP con una dosis de phenamiphos; en el segundo ensayo se evaluaron cuatro nematicidas granulados con un nivel de DBCP; y en el ensayo 3 se compararon dos dosis de tres nematicidas