POLLEN FERTILITY IN RELATION TO OPEN POLLINATED TRUE SEED PRODUCTION IN POTATOES

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Abstract

The cost and difficulty of producing hybrid true potato seed (TPS) currently limits their use for commercial production. Twelve clones, selected in preliminary trials for low pollen stainability but high fruit and seed set, initially seemed promising for inexpensive production of mostly hybrid open-pollinated (OP) TPS. However, in subsequent tests, pollen stainability of these clones appeared to be highly variable and fruit and seed set were not as high. Bumblebees favored the most fertile clones, especially during periods when pollen stainability was the highest. Amounts of OP fruit and seed set correlated with maximum observed pollen stainability levels of the clones. Most of the OP seeds produced by these clones were probably the result of self-pollination; therefore, other methods must be used to obtain hybrid TPS.

Compendio

El costo y la dificultad para producir semilla (sexual) híbrida de papa limitan actualmente sus usos para la producción comercial. Doce clones, seleccionados en ensayos iniciales para una tinción baja del polen, pero un alto establecimiento de frutos y semillas, parecieron prometedores para la producción a bajo costo de semilla (sexual) mayormente híbrida de polinización libre (PL). Sin embargo, en pruebas posteriores, la tinción del polen de estos clones pareció ser altamente variable y la formación de frutos y semillas no fue tan grande. Los abejorros favorecieron a los clones más fértiles, especialmente durante los periodos cuando la tinción fue la más alta. Las cantidades obtenidas de frutos y semillas de PL logrados estuvieron correlacionadas con los niveles más altos de tinción de polen observados en los clones. La mayor parte de las semillas de PL producidas por estos clones fueron probablemente el resultado de autopolinización; por lo tanto, se deben utilizar otros métodos para obtener semilla (sexual) híbrida.
Introduction

Production of potato crops from true potato seed (TPS) offers several advantages to farmers in developing countries. Use of TPS greatly reduces the cost of planting materials (1). Two types of TPS are available. Hybrid seeds, which result in higher yielding and more uniform plants (13), are relatively expensive, because hand pollinations are required for their production. Open-pollinated (OP) seeds, often resulting from bumblebee pollinations, are less expensive to produce. However, resulting potato tuber yields are only 45-70% of those from 4x × 2x hybrid seeds and only 24-45% as much as those from virus-free seed tubers (11, 12). Selfing rates in Neo-Tuberosum materials have been estimated at 70-86% with a mean of 80% (7). Estimates obtained with the use of a seed spot marker in tetraploid Andigena ranged from 55-87% for different clones, with a mean selfing rate of 69% (5). Information from studies using marker genes in Group Tuberosum material is lacking, but about 80-85% of the seeds from open-pollinated clones under field conditions are assumed to be from selfing (9). The lower yields of OP progenies in Group Tuberosum are probably the result of inbreeding due to self-pollination.

The development of a low cost method of producing hybrid seeds would allow for expanded potato production via TPS in developing countries. Results of various trials indicate that 4x × 2x hybrid seedling transplants yield 50-70% as much as plants from virus-free seed tubers (11, 12), but at a fraction of the cost for planting materials. The use of bumblebees to facilitate controlled, large-scale inter-mating of potatoes has been suggested (14); however, bumblebees usually will not visit male-sterile flowers.

In this study, we investigated the potential of producing OP TPS on twelve clones, identified in a preliminary trial as having pollen stainability (fertility) less than 10% but high OP fruit and seed set. It was hoped that bumblebees might be attracted to certain, almost male-sterile clones, to produce largely hybrid OP seed. A more detailed study was subsequently conducted to determine the feasibility of using these twelve clones for hybrid OP seed production when interplanted with male-fertile clones, using bumblebees as pollinators.

Materials and Methods

Plant Materials and Field Design

In 1982, 160 cultivars and advanced selections from the Wisconsin breeding program were evaluated for pollen fertility and OP fruit and seed set at Rhinelander, WI. Twelve of these clones were selected for their low pollen stainability and high OP fruit and seed set. In 1983, these twelve clones, W729R (Rhinered), W738, W795, W815, W824, W847, W870, W909, W921, W925, W926, and W953, were evaluated further. Tubers