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SEED PRODUCTION IN GARDEN NASTURTIUM

(*Tropaeolum majus* Linn.)

A thesis presented in partial fulfilment

of the requirements for the

Degree of Master of Agriculture Science

in Seed Technology

at Massey University

Palmerston North

New Zealand

VILIAMI TISILELI FAKAVA

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ABSTRACT

This thesis reports the results of research on seed production of garden nasturtium (*Tropaeolum majus*). The research programme was begun in late 1991 with an investigation on the effects of plant density on *Tropaeolum majus* cv. Choice Mixed grown under field conditions. The plant responses to changing plant density in terms of the vegetative growth and morphology, flowering pattern, seed yield and yield component were investigated using four different densities ranging from 3 to 45 plants per m^2. The results of this research showed that increasing plant density decreased branch number, dry weight, leaf number and area, and flower number per plant. It was also shown that seed yield is primarily determined by the number of flowers produced per m^2 and this character was identified as an important aspect to be manipulated for improving seed yield. Although increasing plant density resulted in decreased seed yield per plant, seed yield per unit area was similar at all densities.

Nasturtium flower and seed development studies showed that irrespective of density it takes about 12 days for the green floral bud stage to complete flowering and each flower needed 40-50 days from pollination to reach physiological seed maturity. Seed started shedding at 40 DAP at a moisture content of 78-80% and a maximum seed weight of 0.18 grams. Seed ripening occurs after 50 days from pollination after seed shedding on the ground surface. Maximum seed yield was achieved at 40 days after peak flowering at all densities.

The second stage of the study involved an assessment of the tolerance of nasturtium to various selective herbicides. This experiment was conducted in January-June 1992

in the glasshouse and was designed to provide information on the phytotoxicity of herbicides to nasturtium seedlings and plants. A wide range of soil and foliar applied herbicides were evaluated for their phytotoxicity to nasturtium. Four pre-emergence chemicals, chlorpropham (3.2 kg ai/ha), alachlor (2 kg ai/ha), oryzalin (3 kg ai/ha) and trifluralin (0.8 kg ai/ha) were considered to be the most selective and are recommended for direct sown nasturtium crops. Post-emergence applications of asulam (1.6 kg ai/ha), haloxyfop (0.3 kg ai/ha), methabenzthiazuron (1.4 kg ai/ha) were also well tolerated by nasturtium seedlings.

Seed production possibilities for the production of garden nasturtium seed under New Zealand conditions are also discussed.

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CHAPTER 1

INTRODUCTION

Tropaeolum majus L. is commonly known as a Garden Nasturtium, but also as Great Indian Cress or Creeping Canary. The plant is native to Peru and was introduced to New Zealand in the mid eighteenth century. *Tropaeolum majus* belongs to the family Tropaeolaceae, a small family comprising only 3 genera; *Tropaeolum* which consists of 86 species distributed from Mexico to central Chile, and Argentina, *Magallana* which contains only two species from Patagonia and *Tropheastrum* which consists of only 1 species (Sparre and Andersson, 1991). In *Tropaeolum*, 9 species are important to horticulture. This small family of climbing succulent herbs includes the cultivated *Tropaeolum majus* (garden Nasturtium - not to be confused with the genus 'Nasturtium', family Cruciferae). It is a relatively diverse genus of soft-wooded annuals and herbaceous perennials from South and Central America valued for their showy foliage and flowers, and their ease of culture (Rowell, 1986).

Most important of this genus is *Tropaeolum majus* which is effective as an ornamental flower crop or vegetable plant. The colourful nasturtium flowers make splendid cut flowers or with bouquets and can be combined with young leaves to make an attractive garnish in salads (Macoboy, 1986). Pickled seeds are used as a substitute for capers (Heywood, 1978). It also has potential as a bedding plant or for trailing walls, edging, screens, hanging baskets or a floor covering in orchards. It can also be used effectively as a soil stabilising plant on steep slopes (Rowell, 1986). The fruit when green contains oil which can be used for cooking. As a herbal plant, nasturtium leaves are found to contain a natural antibiotic which is an useful remedy for

brochitis, catarrah and emphysema (Culpeper, 1983) and has been used in the past in folk medicine especially for treatment of scabies. Such potential uses have been more widely recognised recently and considered to be of commercial importance. According to a 1975 National Garden Bureau survey in the USA, *Tropaeolum majus* was fourth behind zinnia, marigold and petunia in top seed packet sales and popularity (Whiting, 1983). The value of commercial seed is surprisingly high with an average price of 10 cents per seed, about 7 seeds per gram, and with an average yield of 470 kilograms per hectare (Boulton, 1986).

In the literature there are many publications on the production of agricultural and horticultural seeds. However there is comparatively little published information on flower seed production (Vis, 1980). In the case of *Tropaeolum majus*, virtually no research has been carried out on the crop but some general cultural information is available. Garden nasturtium blooms best in sunny situations and is well suited to porous or well drained soils and to rather poor or low fertility soils. Rich soils result in much more attractive foliage or vegetative growth even though fewer flowers are produced (Hartmann *et al.*, 1981 ; Rowell, 1981). It performs excellently on sandy soils since it sheds its seeds early and these can be readily recovered at harvest by allowing this shedding to occur and by separating the seed and sand subsequently (Vis, 1980). It is suggested that Tonga, because of its generally favourable warm climate, and suitable soil conditions, coupled with an ability to grow the crop on a small land area and produce seed based on cheap hand labour might well be a suitable situation for *Tropaeolum majus* seed production and that this crop could be grown for seed for export. The present study, however, was carried out to provide information on the potential of this crop in New Zealand as a summer crop.

A major obstacle which severely limits seed production in *Tropaeolum majus* is its

indeterminate growth habit and flowering behaviour which results in plants flowering over an extended period of time (Boulton, 1986). This is an advantage for a garden blooming plant but creates problems in seed production. During flowering, young flower buds, blooming flowers, wilted flowers, young seeds and mature and shedding seeds may all be found on an individual plant at any one time. This makes it extremely difficult to determine the correct time to harvest the crop for the recovery of maximum seed yield. Nasturtium seeds shed at a high moisture content of about 78% and, as a result, commercial seed yield in *Tropaeolum majus* is often low and unreliable. Boulton (1986) has stated that actual yield of the plant in some cases proved to be 40%-70% of the plant's potential yield and this yield gap is highly contributed from shed seeds. She stated a peak viable seed yield of 471 kg/ha as an average yield.

The current research programme began as a result of the need for a better understanding of plant development and the need for information on appropriate management strategies for better seed production. The emphasis was also on identifying factors affecting garden nasturtium seed yield and quality. This work was carried out to identify those aspects of vegetative and reproductive growth which contribute most significantly to seed yield and quality in plants grown at different plant densities and also to provide information on the tolerance of nasturtium to various herbicides appropriate for weed control.

The present study comprises three main experiments which are presented separately in the three following chapters. The first experiment (Chapter 2) reports on a plant density trial designed to provide basic field information on the effects of plant competition as determined by variation in plant population density, on vegetative and reproductive development and on seed yield and quality in *Tropaeolum majus*.

Particular attention has been directed to the effects of plant competition on vegetative and reproductive development which contribute most significantly to seed production.

The second experiment considers the sequence of seed development in *Tropaeolum majus* (Chapter 3) with particular reference to seed yield. An important factor in this study was an attempt to determine the optimum or 'most appropriate' time to harvest seeds. The final experiment (Chapter 4) examines the tolerance of nasturtium seeds or seedlings to various herbicides used for weed control, and explores their effects on vegetative growth and reproductive capacity of nasturtium.

The overall research aim of this study was to determine the potential of nasturtium seed production in New Zealand and to examine ways of improving or maximising seed yield and quality by proper management, including optimum planting density and the most appropriate herbicides for weed control.

Plate 1.1 A view of the *Tropaeolum majus* crop at peak flowering (5th February 1992).