

## RADISH SEED PRODUCTION

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M. FERNANDO, Ph.D. (Lond.),  
ACTING BOTANIST.

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### SUMMARY.

**M**ETHODS of radish seed production recommended for adoption by vegetable growers who desire securing their own planting material, and by nurserymen, are described.

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### 1.—INTRODUCTION

The growing of radishes which, in Ceylon, has always been a popular market-garden crop, has expanded considerably in war time. The industry has, in the past, depended almost completely on foreign supplies of seed, and is menaced by the high cost and limited availability of imported seed. At the present time, many growers at Kandapola and Palugama obtain their planting material by allowing a small proportion of their crop to run to seed. There has, however, been no attempt at supplying the seed requirements of growers in areas where climatic and disease factors discourage seed production but permit the raising of a satisfactory crop of roots. The acreage in this country under radishes warrants the establishment of a seed industry of modest proportions. It is hoped that both growers who aim at securing their own planting material and nurserymen will find the description, in this paper, of methods of radish seed production adopted at the Vegetable Seed Station, Matale, useful.

### 2.—VARIETIES.

The Indian radish attains considerable size, and differs markedly from the European. Watt (1908) suggests that their origins differ. Systematists, however, place both varieties in the species, *Raphanus sativus* L. The present paper refers, of course, to the Indian variety.

A diversity of types of good quality exists in Ceylon, including long and turnip-rooted, white and scarlet strains; white types are commoner than coloured ones. The Botanist's strain, Long White, is derived from a single-plant selection made in 1939, and has been grown successfully since that time every year at the Vegetable Seed Station, Matale. The methods described below have particular application to this strain.

### 3.—CULTURAL METHODS.

Apart from its insistence on a light, rich, friable soil, radishes are not fastidious in their requirements. The plant thrives in both the dry and wet zones, and at elevations ranging from sea-level to over 6,000 ft.

For seed production, holes spaced 3 ft. apart and measuring 9 in. (deep) by 12 in. by 12 in. are prepared, and manured with compost at the rate of about 15 tons per acre. It is unnecessary to dig deeper than 9 in. ; even in very deep holes penetration does not exceed 9 in.

Four seeds are dibbled per hill ; one seed is placed in the centre of the hill, and the other three are disposed in a triangle with a six-inch side round the central one. It is the plants derived from the peripheral seeds that are usually thinned. This method of crowding plants in widely separated hills is preferred on account of the greater room it allows for tillage operations, and of the more satisfactory spacing and stand it provides the plants left over after the final thinning. Radish seed has good keeping qualities, and the percentage germination normally obtained approximates to 100 per cent. Germination is evident about three days after sowing.

The area should receive at least three weedings. The weeding dates recommended are two, ten and seventeen weeks after sowing. As the tap root elongates, the plant protrudes out of the soil. Roots should be hilled up as they appear above soil level. At least two earthings should be done, the first six weeks and the other ten weeks after sowing.

Marketable roots can be lifted four-five weeks after sowing. The plants flower on about the 45th day after sowing, and all hills should be thinned to a single plant before that date. If the stand is good, and the thinning done in time, about 10,000 marketable roots per acre should be available.

In the eleventh week after sowing, staking of the plants becomes necessary. The stakes need not be longer than four feet. Leaf sheaths of plantain or arecanut provide admirable material for tying, and are cheaper than string.

The four-petalled, pale purple flowers set into conical siliquae ; convexities on the surface of the siliquae mark the position of the seeds. The first harvest of seed becomes available when the plants are fourteen weeks old. Seed that is ready for harvesting is chocolate-brown in colour, and is hard and cannot be crushed by pressure between the thumb and fore-finger. The racemes ripen in acropetal succession, and harvesting should be delayed till the seed at the tips of the racemes are fully mature. Whole plants are lifted. The roots are cut off and destroyed in an incinerator. The tops are stocked on a barbecue and sun dried for several days till the pod walls turn brittle. The seed can

then be threshed with ease under the feet of labourers. The threshed seed is hand winnowed, hand sorted and subjected to a final period of sun drying before storage.

The methods described above are satisfactory for the multiplication of seed for distribution to the public. The initial seed from which the seed grower derives his commercial crop should, however, be raised with greater care. Continuous seed production on the lines described above would result in strains that produce profuse seed and poor roots. To obtain seed for his own sowing, the seed grower should select, at the time the hills are thinned, a sufficient number of the best roots lifted. Selected roots should not be below average size and should conform to type. If casualties caused by soft-rot are not too numerous, 500 roots should provide sufficient seed for sowing one acre. The rosettes of leaves are cut off to reduce transpiration losses, and the mother roots are transplanted 3 ft. apart in prepared soil. The soil should be well compacted round the roots to prevent desiccation and to secure good anchorage during the flowering and seeding periods.

#### 4.—CONTAMINATION OF SEED STOCKS

Radishes belong to the Cruciferae, a family in which cross-pollination is notoriously easy; members of this family produce wind-borne pollen in profusion. Radishes cross readily with cauliflowers, cabbages, turnips, kale, kohlrabi and other members of the mustard family (Quinn, 1941). Self-pollination by bagging inflorescences with cloth or paper is possible, but is neither practicable on a large scale nor economic. Percentage fruit set in bagged plants is, moreover, very low. The only feasible method, in commercial seed growing, of ensuring freedom from crossing is isolation of the crop: there should be no cruciferous seed crop within one mile of the radishes. The area should also be kept free of cruciferous weeds.

#### 5.—DISEASES AND PESTS

Soft-rot caused by the bacterium, *Bacillus carotovorus* L. R. Jones often kills a large percentage of the plants soon after they have flowered, and constitutes the most serious limiting factor to successful radish seed production. The pathogen inhabits the soil and enters the root through wounds, *e.g.*, those caused by the extrusion of lateral roots or in transplanting; bacteria, unlike fungi, are incapable of puncturing the plant epidermis. Penetration of the host is followed by the secretion of quantities of the enzyme protopectinase, the active agent in this type of parasitism; this enzyme dissolves the middle lamellae and causes the subsequent death of the plant cells. Like most bacterial diseases, soft-rot is particularly troublesome in alkaline soils. Depressing

the pH value of the soil does not, however, provide a practicable method of soft-rot control.

Soft-rot is, in certain areas, so damaging that the choice of any particular planting method may be determined largely by its effect on the incidence of the disease. Indian seed growers transplant six-weeks-old mother roots after the excision of the leaf rosette and of the lower half of the tap root. It has been shown in an experiment carried out at the Vegetable Seed Station, Matale, that the mutilation of the root incident to this method results in severe damage by the soft-rot bacterium. Details of this experiment are given in Appendix I. The treatment did not even provide the traumatic stimulus that was expected of it; transplants flowered later and the yield of seed per plant was less.

The common cruciferous pest, *Crocidolomia binotalis*, is often troublesome. The moth deposits masses of eggs on the lower surface of the leaves. The caterpillars, apart from feeding on the leaves, may cause severe damage to pods. Bored pods produce no seed, and are filled instead with the faecal pellets of the insect. The insect pupates in the soil. Spraying with lead arsenate is recommended. If, however, spraying is done a short time before plants are lifted for consumption, derris may be used.

#### 6.—REFERENCES.

- Quinn, N. R. 1941 .. Production of Vegetable Seeds  
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 Watt, G. 1908 .. Commercial Products of India

#### APPENDIX I.

##### THE EFFECT OF THE METHOD OF PLANTING ON THE INCIDENCE OF SOFT-ROT (*Bacillus carotovorus* L. R. JONES).

The following treatments were included in a  $2 \times 2$  factorial experiment set down at the Vegetable Seed Station, Matale, in the *yala* season, 1941 :—

(T) Two methods of planting :

T<sub>0</sub> .. Seeds dibbled in the field

T<sub>1</sub> .. Planted according to the Indian method, *i.e.*, six-weeks-old plants uprooted and transplanted after excision of the leaf rosette and of the lower half of the swollen tap root.

(S) Two spacings

S<sub>0</sub> .. 3 ft.  $\times$  3 ft.

S<sub>1</sub> .. 1½ ft.  $\times$  1½ ft.

There were four replications of 1/97 acre plots. In harvesting, a single border row was discarded round each plot.

The soil of the experimental area was a relatively infertile loam of which the main component was an ironstone gravel, and had carried crops of capsicums, dwarf French beans and cambu (*Pennisetum typhoides* Stapf.) in previous seasons. The area received a dressing of eight tons of compost per acre on May 27, 1941. Individual holes received a further application of seven tons per acre.

On May 30, three seeds were dibbled per hill in  $T_0$  plots, and seeds were sown in nurseries for  $T_1$  plots. Plants in  $T_0$  plots were thinned to two per hill on June 25, and finally to one per hill on July 4. Six-weeks-old plants treated in the way described above were transplanted to  $T_1$  plots on July 15. Plants in  $T_0$  and  $T_1$  plots flowered on July 18 and July 25 respectively. Vegetative growth of plants in  $T_1$  plots was poor. Mature pods were harvested in both  $T_0$  and  $T_1$  plots on October 1, and dried before extraction of the seed.

Soft-rot caused by the bacterium, *Bacillus carotovorus* L.R. Jones, appeared in epiphytotic form during the experimental season. Total number of casualties in  $T_0$  and  $T_1$  plots were 716 and 941 respectively. The analysis of variance of percentage damage transformed to the appropriate inverse sine scale ( $\theta = \sin^{-1}\sqrt{P}$ ) is given in Table I. The variance ratio for planting methods is significant at the one per cent. point and indicates that transplanting mutilated roots aggravates the disease. The relevance of this result to other soil-borne bacterial diseases is evident. Dibbling seed in the field, instead of transplanting seedlings from nurseries, may, for instance reduce the damage caused by that scourge of solanaceous crops—the wilt organism, *Bacillus solanacearum* E. F. Sm.

Neither the effect of spacing nor the interaction between spacings and planting methods is significant. The highly significant block variance argues the existence of differences in various parts of the field (*a*) in the survival level of the pathogen, or (*b*) in the virulence of the pathogen, or (*c*) in the susceptibility of the host plant, and suggests the possibility of disease control by cultural methods. These differences in disease incidence between blocks were not correlated with differences in the pH value of soil.

TABLE I.

PERCENTAGES OF PLANTS KILLED BY *B. carotovorus* : ANALYSIS OF VARIANCE OF TRANSFORMED DATA.

		<i>DF</i>		<i>SS</i>		<i>MS</i>		<i>VR</i>	<i>One Per Cent Point.</i>
Treatments	..	3	..	1050·8	..				
(Planting Methods)	..	(1)	..	(995·4)	..	995·4	..	16·18	.. 10·56
(Spacings)	)..	(1)	..	( 14·4)	..	14·4	..		
(Interaction)	)..	(1)	..	( 41·0)	..	41·0	..		
Blocks	..	3	..	3816·9	..	1272·3	..		
Error	..	9	..	553·2	..	61·5	..		
Total	..	<u>15</u>	..	<u>5420·9</u>	..				