

The Radish

Radish (*Raphanus sativus*), is one of the major vegetable crops in the Philippines. It is highly appreciated by consumers for its pungent taste. It could be eaten raw in salads, prepared as pickles or cooked with fish, meat and shrimp and other meals.



Due to its popularity, radish is often planted in many home garden or raised commercially in the field. Out of 52,630 hectares devoted to vegetable growing in the country, 2,050 hectares were planted to radish with a normal average production of 11,269 metric tons (BAS,1979).

There is a vast area for the production of radish as vegetable, but ironically, there is no local seed production effort to satisfy radish seed requirement resulting to complete dependence on foreign seed source. One main reason for this is the lack of technical information on local seed production of the crop and its feasibility. It is in this line that this paper is written as a guide for potential seed growers, extension workers, researchers, students and others interested in local seed production of radish. This guide is based on seed production trials in farmers' fields and experiment station located in low, medium and high elevation.

Soil and Climatic Requirement

Radish produces good yield of seed under temperate climate with less humidity especially during the reproductive stage. High temperature during flowering causes drying of stigma and non-germination of pollen resulting in a poor seed yield.

In the Philippines, it is best grown for seed production at higher elevation of 2000 feet or above, to fulfill low temperature requirement. Data showed (Table 1) that the seed yield is better at higher elevation compared to lower elevation.

Table 1. Yield of radish seed production under different elevations a_/

SITE	ELEVATION	COMPUTED SEED YIELD (KG) per HECTARE
Talaga, Tanauan, Batangas(1980)	low	53
Montaa, TanauanBatangas(1980)	low	---b/
Mamala, Sariaya, Quezon(1979)	medium	216
Iruhin, Tagaytay, Cavite (1980)	medium	---b/
MSAC, La Trinidad, Benguet (1979)	high	649
MSAC, La Trinidad, Benguet (1980)	high	440

a/ Based from the study conducted by the Seed Technology Div., Agronomy Dept., UPCA, Seed Support Project, NFAC/UPLB Countryside Action Program, College Laguna.

b/Poor flowering due to ineffective vernalization.

The vast area of high elevation (e.g. Benguet, Mt. Province, mountainside of Mt. Banahaw, Mt. Makiling, Mt. Kanlaon, etc.) offers a great opportunity for radish seed production in the country.

For seed production, a fertile sand loam and silty loam soil with slightly acidic condition (pH 6-6.8) is recommended. The soil should be deep, friable, rich in organic matter and relatively free from disease-causing micro-organism.

Recommended Variety

The most popular radish variety grown in the country is the '60-days' variety. It possesses excellent eating quality, high potential yield, good handling and storage quality. Its root are long and large with white skin and attain maximum marketable size within 60 days from emergence. This variety is often pollinated and is very ideal for local seed production. With proper vernalization technique, it could be made to flower in about 75 days, mature in about 120 days and produce good seed yield.

OWNER	VARIETY	MATURITY (DAS)	FRUIT TYPE			SEASON	FEATURES
			COLOR	LENGHT	DIAMETER		
Harveson	Hybrid Mino Early (NONG WOO BIO)	70	Milky white	40-45	2	All year round	Vigorously growing variety
Harveson	Hybrid Success (NONG WOO BIO)	60-65	Green	18-22	8-Jul	All year round	Good quality and high yielding
Pine Valley Corp	Mino Early (ALLGROW)	60	Pure white	40-45	4.5-5.3	Uplands best during warm weather	Heavy yielder. With 550-650 grms in weight and grows vigorously
Allied Botanical	Red Round Cherriette (SAKATA)	25	Bright red			All year round	Very high uniformity of attractive bright red round radish

Allied Botanical	Sinandok	46	Pearly white	28.28	3.5	All year round	Highly uniform plants and roots high yielding
Harveson	Summer Best (NONG WOO BIO)	60-65	Green	18-22	8-Jul	All year round	It shows slow bolting and late pithiness development
Argoseed Traders Phils., Inc.	Alpine Hybrid	60-65				Summer	Tolerant to club root fusarium wilt and virus. Early growing, slow bolting, roots are white with green neck, firm texture, late pithiness and excellent storage quality
Argoseed Traders Phils., Inc.	Argo Radish	38-45				All year round	
Argoseed Traders Phils., Inc.	Asia Gaul Jeo Jang Hybrid	65				Year round	Good for denes planting. The roots have flesh, few branch roots and excellent keeping quality, the delicious taste is the key merit of this variety
Argoseed Traders Phils., Inc.	Mino Early Long White	55-60		35-40			Strong tolerance to virus. Dark green leaf, tender texture, smooth skin.
East-West SEED	Speedy						

Culture and Management

- A. **Time of Planting.** Planting time must be initially planned for best result. Flowering of the crop should coincide with the coolest month of the region to fully fulfill the cool climate requirement. Likewise, pod maturity and harvesting must be on the dry season to minimize seed losses due to lodging brought about by heavy rains and obtain a favorable condition for harvesting and other post-harvest operation.
- B. **Vernalization Requirement.** To induce early, abundant and uniform flowering, radish requires vernalization. Vernalization of radish first requires incubation of the seeds to

allow the radical to come out of the seed coat. This is done by soaking the seeds in equal amount of water for 24 hours. After incubation, the seeds are laid in trays lined with moist paper or cheese cloth two centimeters thick and placed in cold room under 5°C temperature for eight days. The seeds should always be maintained in a moist condition during vernalization.

- C. **Land Preparation.** Preparing the land for planting varieties with the soil and field condition in the selected site. Shallow and depleted soils require pre-planting conditioning to obtain good texture and structure. This involves deep plowing and incorporation of adequate amount of inorganic matter such as well decomposed animal manure. Likewise, field with dense weeds must first be cleaned thoroughly before initial land preparation. Soils should be plowed and harrowed alternately at least twice to attain favorable texture and structure. Raised beds one meter wide and 30 centimeters high are prepared following the slope of the area to insure good drainage and ease of other field operations. A day before planting, shallow canal of five centimeters deep and 30 centimeters apart are made on top of the bed.
- D. **Planting.** Planting the vernalized seeds in the field can be done any time of the day as long as there is adequate moisture in the soil. In planting, three to four germinated seeds are carefully placed in the shallow furrow 20 centimeters apart. The seeds are immediately covered with thin layer of soil about one centimeter thick by gently passing a rake on top of the bed. The vernalized seeds should always be maintained in moist condition during planting to prevent drying. Irrigation should follow days after planting to insure good emergence and seedling stand.
- E. **Fertilization.** The amount of nutrient to be applied depends on the initial soil fertility level and soil organic matter content. Initial assessment of the nutrient level of the soil through soil analysis will be helpful in determining the amount of fertilizer to be applied. In general however, radish seeds production requires the rate of 120-90-90 kilograms per hectare of Nitrogen; Phosphorus and Potassium (N; P₂O₅ ; and K₂O). All of the P and K and half of N are best applied in the soil during land preparation. The fertilizer should be incorporated properly and thoroughly to prevent contact with the vernalized seed for it may cause injury to the seedlings. The remaining half of N is side-dressed three weeks after emergence. The field should be thoroughly weeded and crops properly thinned before side-dressing.
- F. **Irrigation.** Water should be applied more frequently during the early part of the growing period. Adequate irrigation should be done immediately after planting. Likewise, application of water once a week until the seedling had fully established should be continued. Other stages where water is initially needed are during vegetative, flower initiation and pod development stages. Irrigation water can be applied either by overhead sprinkler method or by furrow irrigation.

G. **Thinning** .The purpose of thinning in radish seed production is two- fold; to maintain the proper density of the crop and to rogue off-types and diseased plants. The crop is thinned to about one to two plants per hill at the early part of its seedling stage to minimize over-crowding. Likewise, off types and diseased plants are rouged to obtain seeds that are pure and disease free.

H. **Weeding and Cultivation**. The most applicable method of weeding in radish is by cultivating the space between the rows and hills. Cultivation must be thorough enough to control weeds but must also be shallow (eight to 10 centimeters deep) to avoid serious root injury. Weeding must start on the earliest date when weeds are observed. By this way weed control will be easier.

I. **Insect Management**. The annotated listing and suggested control for common radish seed production pestare given in this section. Suggested guide for chemical control of radish pest is prevented.

Suggested Chemical Control for Radish Insect Pests

Pest	Common name	Typical Brand Names	Application Rate	Frequently and Method of Application	Remarks
Diamond back moth	Decamethrin	Desis 2.5 EC	2 tablespoon/5 gallon water	7 day interval	In case of severe infestation of pest use higher rate and shorten spraying interval
	Basillusthuringiensi s(Biological insecticide)	Difel	2-4 tablespoon/5gal lon water	7 day interval	Effective only on the larval stage of the pest
	Carbofuran	Furadan 3G	1 bag (16.7 kg)/ ha.	Apply in furrows at planting time	
		Kafil	3-5 tablespoon/5 gallon water	7 day interval	
Armyworm s	Methomyl	Lannate	3-6 tablespoon/5 gallon water	7 day interval	

	Methyl parathion	Parapest MEC	1-2 tablespoon/5 gallon 1water	7 day interval	In case of severe infestation of pest use higher rate and shorten spraying interval
	Malathion	Malathion E57	3 tablespoon/5 gallon water	7 day interval	
Black cutworm	Carbofuran	Carbofuran	1 bag (16.7 kg)/ha.	Apply in furrows at planting time or apply near the base of the plant after germination	
	Methomyl	Lannate 20 EC	3-6 tablespoon/5 gallon water	7 day interval	Late in the afternoon or early in the morning spraying
	Methyl parathion	Parapest M EC	1-2 tablespoon/5 gallon 1water	7 day interval	
Aphids	Malathion	Malathion E57	3 tablespoon/5 gallon water	7 day interval	Thoroughly spray the inner and back portion of the leaves
	Methyl parathion	Parapest M EC	1-2 tablespoon/5 gallon 1water	7 day interval	
	Methomyl	Lannate 20 EC	3-6 tablespoon/5 gallon water	7 day interval	
	Carbofuran	Carbofuran	1 bag (16.7 kg)/ha	Apply in furrows at planting time	

1. **Diamond Back Moth.** This insect pest is the most serious pest among crucifers. The larvae first feed on the leaves as a miner, then progressively feed by making small holes. It also feeds on the flower buds, the rind of the flower stalks and the immature pods. If left unchecked, they multiply rapidly and become only noticeable

due to the defoliated appearance of the crop, the debarking of the rinds of the flower stalks and the deformation of the immature pods. Preventive measure should be employed to discourage the establishment and prolific multiplication of the pest. Situating the area away from fields of other crucifers crop is likewise recommended. Application of granular systemic insecticide before planting and continuous spraying during the early onset could prevent further development of the pest. In cases where the pest had established, tiny larvae could be suppressed by spraying contact and biological insecticide (Table 2). During severe infestation, doubling the recommended rate and shortening the interval of spraying should be employed. Likewise, alternate use/or mixture of different insecticides is recommended.

2. **Aphids.** Aphids cluster on the young tender leaves of the host plant. During flowering, they could also be found on the soft parts of the flower stalks and immature pods. The insect damage the crop by sucking the sap of the soft tissue of the leaves, flower stalks and pods. Heavily infested leaves turn yellowish and speckled in appearance. Pods hardly develop when the flower stalk and immature pods are infested. The insect often easily establish in an overcrowded and weed infested field. So that, proper density and weed control are the best preventive measure for such pest. Moreso, the insect could be easily controlled by spraying recommended insecticides' table of insect control.
3. **Cutworms.** The larvae remain buried about two to five centimeters below the surface of the ground during the day and feed at night by biting through the stem of growing plant at ground level. Infested plant falls-off and eventually dies. The degree of damage of this pest is rather high with in the first two weeks after germination. Applying granular insecticide on furrows before planting minimizes the occurrence of the pest. Once the symptom of infestation appears, spraying of recommended insecticide late in the afternoon when the larvae appear could help control the pest.
4. **Armyworm.** The larvae are voracious feeders. They eat mostly the rind and other soft parts of the flower stalks, stalk branches and immature pods. They feed mainly at night and when left unchecked, they can even destroy large portion of the field in a single night. Regular field visitation to detect any sign of pest infestation should be done. Spraying of contact insecticide (Table 2) is recommended when the first sign of infestation appears.
5. **Disease Control.** Damping-off is the most common disease of radish during the seedling stage, while mosaic and bacterial soft rot often appear on the latter vegetative stage of the crop. As guide to their identification, their casual organism and characteristics symptom are provided in this section. Suggested guides for chemical control of this disease are as follows.

Suggested Chemical Control for Common Radish Disease

Disease	Chemical name	Application Rate	Frequency and Method of Application	Remarks
Rotting of Vernalized Seed	Arasan 75	1 tablespoon/ gallon water	During vernalization water the seeds daily with the preparation	
Damping-off	Arasan 75	1 tablespoon/ gallon water (need treatment)	During vernalization water the uprooted seeds with the preparation	
	Captan	3 tablespoon/ 5gallon water (spray)	For spray preparation apply after seed germination of the crop in the field	Repeat spraying as needed
Bacterial soft rot	Captan	3 tablespoon/ 5gallon water	Start applying wither by spray or drench when symptoms of infection appear	Repeat spraying as needed
Mosaic	Malathion E 57	3 tablespoon/ 5gallon water	7 days interval	For the control of insect vector
	Parapest MEC	1-2 tablespoon/ 5 gallon water	7 days interval	
	Lannate 20 EC	3-6 tablespoon/ 5 gallon water	7 days interval	
	Furadan 3G	1 bag (16.7 kg)/ha	Apply in furrows at planting time	

6. **Damping-off Seedlings.** All are fungi which are either soil-borne or seed borne. The following are the symptoms of the disease: seed may decay before it germinates, sprouts are withered before they reach the soil surface, or seedling may develop lesions near the soil level and fall over. To control the disease, seeds should be properly treated with Previcure or any fungicide before and after sowing or occurrence of symptom in the fields. Watering should be made early in the morning to minimize the onset of the disease.
7. **Mosaic.** This disease is characterized by yellowish mottling on the leaves. If the infection takes place early in the growth of the plant, it becomes stunted, deformed and it is total loss. Late infection, on the other hand, results in a reduced plant size. The casual organism is transmitted by insect, particularly aphids, and is carried in the seeds. Aphids should be properly controlled and use of disease-free seeds for seed production is recommended. Likewise, isolation and repeated rouging of infested plant should be employed.

8. **Bacterial Soft Rot.** A watery and slimy softening of the tissue develops on the base of the stem of the plant. As it progresses, the water exudes giving off an offensive odor. The avenue or point of entry is through the wounds being advanced by favorable condition for bacterial growth. Diseased plant should be pulled and burned. Spraying and drenching of fungicide on infected plant should be employed at the early onset to minimize the spread.
9. **Birds (MAYA) and (MARTINEZ).** Birds, particularly the locally called species “Maya” and “Martinez”, peck the maturing pods and eat the seeds. These particular birds visit the area early in the morning and late in the afternoon. To minimize their damage, scarecrows should be established in the field and the crop should immediately be harvested once the pods mature.

J. **Harvesting and Other Post Harvest Operations**

- a. **Harvesting.** Radish pods do not shatter even if allowed to fully ripen in the fields. However, when the pods are mature enough, the crop should be harvested as soon as possible to minimize risk of seed loss due to birds or unexpected heavy rains. The crop is ready for harvest once the pods turn matured and brownish in color and is brittle enough for cracking. The seeds must be brownish in color, firm and hard. In harvesting, the flower stalks where the pods cling are cut and gathered. Then they allowed to dry in an open area.
- b. **Threshing.** To have an easy threshing, the pods are first separated from the stalk by hand or by passing and pulling the stalks in a comb-like stripper. The separated pods are collected and sun-dried to become more brittle and pounded using wooden mortar and pestle to break the shell of the pods. The seeds are then separated from the shell of the pod by passing them in a sieve or by winnowing.
- c. **Drying.** Seeds should be dried properly to about 7% content before packaging to prolong its storage life. To attain such moisture content two days of continuous sun-drying will be enough. When the climatic condition does not permit sun drying, an overnight drying in a conventional type grain (palay and corn) drier will be sufficient to attain the target moisture content.
- d. **Seed Testing.** The seed must be tested for its germinability and purity. Seed samples must be analyzed to determine whether they are of good quality. Seed quality can be determined by National Seed Quality Control Services (NSQCS) seed laboratories located in the different regions of the country, where the seed sample of crop produced could be given for analysis.
- e. **Packaging.** Packaging seed materials must be air-tight and moisture proof. For commercial qualities, seeds could be packed in plastic bags and must be sealed using the plastic sealer. Certain information such as: name of crop, place of harvest, date of harvest, percent germination, etc should be labeled on the package.

COST AND RETURN ANALYSIS PER HECTARE RADISH SEED PRODUCTION

A. LABOR		
	Man/Man-Animal	Value
	Hours <u>1</u> /	(P)
1. Land Preparation		
a. 1st plowing (5 laborers x 8 hours)	40	2,500.00
b. 1st harrowing (4 laborers x 8 hours)	32	2,000.00
c. 2nd plowing (4 laborers x 8 hours))	32	2,000.00
d. 2nd harrowing (3 laborers x 8 hours)	24	1,500.00
e. Preparation of beds (4 laborers x 8 hours)	32	2,000.00
2. Pre-planting Operation		
a. Vernalization (2 laborers x 8 hours)	16	500.00
3. Planting		
a. 1st fertilizer application (2 laborers x 8 hours)	16	500.00
b. laying out of furrows in bed (2 laborers x 8 hours)		1,000.00
c. planting (20 laborers x 8 hours)	160	5,000.00
d. 1st application of irrigation water (4 laborers x 4 hours)	16	500.00
4. Cultural Management		
a. Application of irrigation 10 application during the growing period (4 laborers x 4 hr.)	160	5,000.00
b. Thinning (5 laborers x 8 hours)	40	1,250.00
c. Weeding/Cultivation		
a) 1st weeding-two weeks after planting (10 laborers x 8 hours)	80	2,500.00
b) 2nd weeding—six weeks after planting (10 laborers x 8 hours)	80	2,500.00
d. 2nd application of fertilizer-side-dressing		

(2 laborers x 8 hours)	16.00	500.00
e. Roguing – before flowering (3 laborers x 8 hours)	24.00	750.00
f. Controlling of insect pests and disease 20 times sprayng (2 laborers x 4 hours)	160.00	5,000.00
5. Harvesting and Post-harvest Operation		
a. Harvesting (10 laborers x 4 hours)	40.00	1,250.00
b. Threshing (4 laborers x 32 hours)	128.00	4,000.00
c. Cleaning (4 laborers x 32 hours)	128.00	4,000.00
d. Drying (1 laborer x 16 hours)	16.00	500.00
e. Packaging (1 laborer x 8 hours)	8.00	250.00
B. Cost of Materials		
a. Seeds 8 kg @ 240.00_/kg		1,920.00
b. Fertilizers(13 bags T14, 1 bag Urea)		16,850.00
c. Insecticides(12 lts @ 1,300/liter)		15,600.00
d. Fungicides (4 kg.@ 750/kg)		3,000.00
e. Fuel (100 lts @ 45/liter)		4,500.00
Sub-total		86,870.00
C. Contingencies 10%		8,687.00
D. Tools and Equipment 2/	Value	Depreciation Cost
a) 2 units knapsack sprayer @ 1,500.00 / sprayer	3,000.00	990.00
b) 5 pcs. Of rake @ 200.00/ rake	1,000.00	330.00
c) 6 sprinklers at @ 150.00/sprinkler	900.00	300.00
Sub-total		1,620.00
E. TOTAL ESTIMATED PRODUCTION COST		97,177.00
<u>1/ PhP 250.00 per man-day or 8 man-hours</u>		

500.00 per man-animal day		
<u>2/ Depreciation occurs within 3 years.</u>		

F. Estimated Gross Income per Hectare of Radish Seed Production at Different Elevations and Seed Prices.

Seed	Production per Hectare (kg) <u>a/</u>		
Price (P/ kg)	Low Elev	Med Elev	High Elev
	(53 kg)	(216 kg)	(544 kg) <u>b/</u>
240	12,720.00	51,840.00	130,560.00
275	4,575.00	59,400.00	149,600.00
300	15,900.00	64,800.00	153,200.00
325	17,225.00	70,200.00	176,800.00
350	18,550.00	75,600.00	190,400.00

a/ Based on the per hectare yield trial data obtained by Seed Support Project CAP UPLB/NFAC (1979-1981).

b/ The average of: 649 kg/ha yield in MSAC, La Trinidad , Benguet (1979 planting) and 440 kg/ha yield also in MSAC, La Trinidad (1980 planting)

G. Estimated Net Return/Loss per Hectare of Radish Seed Production at Different Seed Prices and Production.

Seed	Return/Loss per Hectare in		
Price (P / kg)	Low Elev	Med Elev	High Elev.
	(53 kg)	(216 kg)	(544 kg)
240	84,457.00	45,337.00	
	(loss)	(loss)	23,383.00
275	82,602.00	37,777.00	
	(loss)	(loss)	52,423.00
300	81,227.00	32,377.00	
	(loss)	(loss)	66,023.00
325	79,952.00	26,977.00	
	(loss)	(loss)	79,623.00
350	78,627.00	21,577.00	
	(loss)	(loss)	93,223.00

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