Sin proceso

IICA

ZONA DE LAS ANTILLAS
Representacion en Jamaica
P.O. Box 349
Kingston 6, Jamaica

ABC OF VEGETABLE FARMING
A DRAFT HIGH SCHOOL TEXTBOOK

VOLUME III a

A.B.C. OF VEGETABLE FARMING.

(How to grow Different Vegetable Crops.)

By: Neville Farquharson
Ministry of Agriculture
Jamaica.

PART 3.

"AGRICULTURE IN JAMAICA"

Collection of papers of the Office of IICA in Jamaica.

1977 - 1978

No. I - 1. Fritz Andrew Sibbles, "Basic Agricultural Information on Jamaica", Internal Document of Work, January, 1977.

No. I - 2. Yvonne Lake, "Agricultural Planning in Jamaica", June, 1977.

No. I - 3. Aston S. Wood, M.D. "Agricultural Education in Jamaica", September - October, 1977.

No. I - 4. Uli Locher, "The Marketing of Agricultural Produce in Jamaica", November, 1977.

No. I - 5. G. Barker, A. Wahab, L.A. Bell, "Agricultural Research in Jamaica" November, 1977.

No. I - 6. Irving Johnson, Marie Strachan , Joseph Johnson, "Land Settlement in Jamaica", December, 1977.

No. I - 7. Government of Jamaica, "Agricultural Government Policy Papers", February, 1978.

No. I - 8. Jose Emilio Araujo, "The Communal Enterprise", February, 1978.

No. I - 9. IICA and MoAJ "Hillside Farming Technology - Intensive Short Course", Vols. I and II, March, 1978.

No. I - 10. Jose Emilio Araujo, "The Theory Behind the Community Enterprise-Seminar in Jamaica", March, 1978.

No. I - 11. Marie Strachan, "A National Programme for the Development of Hillside Farming in Jamaica", April, 1978.

No. I - 12. D.D. Henry, "Brief Overall Diagnosis of Hillside Farming in Jamaica", May, 1978.

No. I - 13. Neville Farquharson, "Production and Marketing of Yams in Allsides and Christiana", May, 1978.

No. I - 14. R.C. Harrison, E. McDonald, A.H. Wahab, "Fertility Assessment of Newly Terraced Hillside Soils using the Microplot Technique, the Allsides Case Study", May, 1978.

No. I - 15. IICA - IDB "Course in Preparation and Evaluation of Agricultural Projects", Vols. I and II, November, 1977.

No. I - 16 Neville Farquharson, "Production and Marketing of Dasheen in Allsides and Christiana", June, 1978.

1978 - 1979

II - 1 O. Arboldea-Sepulveda (IICA-CIDIA),"Agricultural Documentation and Information Network in Jamaica (Elements for a Proposal)

II - 2 Victor Quiroga,"National Agricultural Information System (NAIS - Jamaica) Project Profile, September, 1978.

II - 3. Joseph S. Johnson "A Review on Land Reform in Jamaica for the Period 1972-1978" September 1978.

II - 4. Neville Farquharson, "ABC of Vegetable Farming" A Draft High School Textbook. Volumes I, II, III and IV February 1979.

FOREWORD

IICA - Jamaica - who recognised the need - with financial assistance from the Canadian High Commission and the Royal Netherlands Embassy, spearheaded the preparation of "ABC of Vegetable Farming" - a high school textbook to teach Agriculture.

"ABC of Vegetable Farming" is a revolutionary step in Caribbean secondary education, in that it seeks to provide that much talked about agricultural textbook information which was hitherto conspicously absent.

This most important break-through and the information provided therein are in line with the philosophy of Caribbean Governments and the Jamaican Ministry of Agriculture which clearly indicates that children at primary and secondary stages of education should be exposed to agricultural education.

While no praise can be too high for IICA, the Canadian High Commission, the Royal Netherlands Embassy and Jamaica (Ministry of Agriculture) for their sterling contribution, special tribute should be paid to two members of the staff of the Ministry of Agriculture, Jamaica:- Mr. Neville Farquharson who prepared the original document in 4 volumes and Garnet Malcolm who read and assisted in editing the document.

It is my wish that "ABC of Vegetable Farming" will not only find pride of place in school and home libraries, but will be used to the extent it will assist in guiding teachers to impart, and students to become eminent fellows in their fields of endeavour. For the youth to whom this textbook is dedicated, I am sure it will become a guiding influence.

Derrick Stone
Permanent Secretary
Ministry of Agriculture of Jamaica.

PROLOGUE

The office of IICA/Jamaica is extremely pleased that the proposed book titled "ABC of Vegetable Farming" has reached this draft stage of preparation.

The fact that this activity became possible once IICA had thought of the idea was due in large measure to the financial assistance provided by the Canadian High Commission and the Royal Netherlands Embassy, to both of whom we are profoundly grateful.

There is little doubt that the proposed text-book will fill an important gap in the education of the youth of the English speaking Caribbean countries. The existing high dependence on agriculture; the low status of agriculture in most of these countries and the associated low incomes of rural dwellers, most of whom rely on agriculture for a living; the high degree of rural/urban migration and the social costs associated therewith, are factors which make it necessary to take early steps to inculcate into our youth knowledge concerning agriculture. This book is a contribution to that effort.

While expressing my pleasure with the outcome of this venture and the catalytic role which IICA/Jamaica has been able to play, I also record my fervent hope that this book will be only the first in a series of such publications.

In the above context I must also express our pride in having been able to work with Mr. Neville Farquharson of the Ministry of Agriculture, Jamaica on this activity.

This draft preparation is being presented to a number of key personnel in the English speaking member countries of the Caribbean for suggestions for modification where appropriate. These suggestions will then be made available to IICA's Central Office in San Jose for the attention of Carlos Molestina, Director of Public Information and Publication. The book in final form is expected to be the result of action to be taken by IICA's Headquarters at San Jose.

Percy Aitken-Soux PhD.
Director, IICA Office, Jamaica.

TABLE

O F

CONTENT

(PART 3.)

Chapter 18. GROWING THE DIFFERENT VEGETABLE CROPS.

In the earlier section, we looked at the practices that are common to all vegetable crops. In this section, more specific information will be given for individual crops. It is important however, for the grower to make adjustments where necessary to suit the particular needs of his farm. Crop behavour will also vary under different conditions.

The information given in the section should be looked at with this in mind. For instance, harvester beans are normally ready for first reaping in 8-9 weeks, but if the crop is growing on poor soil or if it has not got sufficient moisture, it may take 10-12 weeks to first reaping. Similarly, the growth habit of the tall and flowering, but if as before, the soil is poor or sufficient moisture is not available to the beans, it might well be 6-8 ins, (15-20cm) with no flowers.

Seasonal conditions will also be a key factor in determining the way each crop grows in an area. It will have similar effect as when the crop is grown on different soils. So that while in one place, Ox-heart tomato will take about 11-12 weeks to get the first reaping, in another place with less rainfall and generally warmer (hence more rapid evaporation), the crop might well take 14 weeks from planting.

The grower should use the information given in this section mainly as a guide to growing each crop. As a guide, the grower should be able to use it to find his way to grow his vegetable crops.

Also, to make this section simple and useful to even students about to grow their first crop, many recommdndations and much of the information will be made more specific, instead of using levels mentioned in the previous section, for the benefit of beginners, we will give a definite figure.

For example, instead of recommending a planting population level of 6,000-8,000 plants per square chain, with a distance of 15-30" x6-2", in this section we will suggest a population of 7,000 plants with a planting distance of 15"x 6" (or 38 x 15cm).

In most cases we will simply use the average figure for the different levels. As we have seen before, general recommendations are best given as ranges and the grower given a chance to make adjustments to suit the conditions of his farm. However, for the sake of being simple, we will depart from this principle here. As students become more advanced, they should try to understand and use the levels, given in the previous section and find their own specific recommendations to suit the conditions on their farm.

The crops dealt with in this section are under 4 main headings.

(18:1) **Fruit (and Seed) Vegetables***

(1 Beans	(5 Cucumber	(9 Muskmellon
(2. Peas	(6. Cho-cho	(10. Watermellon
(3. Corn	(7. Pumpkin	(11. Tomato
(4. Okra	(8. Squash	(13 Pepper

Root (and Tuber) Vegetables*

14. Beet	18. Rutabaga	22. Onion
15. Carrot	19. Radish	23. Escallion
16. Parsnip	20. Kohl-rabi	24. Leek
17. Turnip	21. Potato	25. Garlic
		26. Shallot

Leafy Vegetable*

27. Cabbage	33. Broccoli	38. Chard
28. Brussels sprout	34. Lettuce	39. Spinach
29. Collard	35. Endive	40. Calaloo
30. Kale	36. Celery	
31 Mustard	37. Parsley	
32. Cauliflower		

Some plants with parts used as vegetables

Arrow-root	Dandelion	Mango
Banana	Dasheen	Paw-paw
Bread-nut	Garden cress	Sorrel
Cashew	Jack-fruit	Tamerind
Cassava (sweet)	Jerusallem	Yam
Coconut	Artichoke	

---

*Note - The 3 groupings, fruit, root and leafy vegetables are more or less an "Agricultural" rather than a strictly botanical grouping. These are the grouping used by many agriculturalists and farmers over the years based on some simple standards such as appearance and how the crop grows, its use etc.

For example, in strict botanical terms, onion is a bulk produced by storage of food in swollen leaves. But it is usually grouped among the root crops, since the bulb is produced partly under-ground. Potato (non-sweet) is a stem tuber, the sweet potato is a root tuber, both bear underground like most roots. Khol-rabi has a swollen stem, but because it is grown and used like turnip, it is grouped as a root vegetable. Finally, although the crops grouped as roots and tubers are really swollen roots and stems, tubers and bulbs, they will mostly be referred to as root vegetables.

FRUIT AND SEED VEGETABLES

18. BEANS.

Family - (Legume)

KINDS* - Broad beans, kidney beans, lima beans, soya beans.

USES - Beans are grown mainly for their pods and seeds. The entire fruit of kidney beans can be eaten before it becomes mature. This is what is known as snap or string beans), and when grown to maturity the seeds are used. The other kinds are grown almost entirely for mature seeds. Young leaves can also be cooked and used as a vegetable.

(18:2) The table below gives values for 3.5 ozs (100 gms) of dry seeds

Food Value	Water ( )	Carboh. gros	Prot. (gms)	Ca (mgs)	Iron (mgs)	Vit A (I,U)	Vit B (mgs)	Vit C (mgs)	App.
Lima beans	12	58	20	90	6	negl.	0.5	negl.	135
Kidney Snap beans	10	57	24	110	8	negl.	0.5	negl	n.a
Soya beans	8	20	35	200	7	negl.	1.0	negl.	high-est

Legumes are the main vegetable group containing any significant amount of fats. Soya bean app. 35 gm fat in 100 gm is highest, peanut app. 25 gms, lima beans approx. 2 gm/100. The information on food value should be used for comparing the amount of nutrients that each crop supplies to the body. (negl. means negligible or very small)

SEASONAL REQUIREMENT - Bean is a warm season crop that will give best yield when grown at temperatures of 65° - 85°F. (18°-30 °C). The grower should try to avoid growing the crop at temperature greater than 5°F outside the range as this will have bad effects on quantity and quality of yields.

* Kinds here defer to the species of the crop. The family of the crop is useful to decide how to rotate crop.

Selecting varieties.

These are varieties of beans most commonly used for small and large-scale production.

(18:3)

VARIETY	Plant description	Approx. wks. to 1st reap	Approx. wks. to final	Pod description	Remarks
Aquadulce Green Windsor Longpod	Plant grow to ht. of 4-6 ft (1½-1 3/4 m) at maturity. Foliage dark green	12-16	3-6	Pods 6-8"x½-3/4* with 4-8 seeds per pod.	
Kidney beans -					
(Bush varieties)	Plant grows			Most varieties	
Black valentine	erect to height of	7-8	2-6 depend	hold 6-10 seeds.	
Bountiful	12-18 ins. (30-45 cm) at maturity		on whether crop reaped as snap beans green or dry peas	Pod: 6-7 x ½ (15-18 x 1 cm)	
Brown beauty					
Burpee string less improved	Plants grow to heights of 12-18 ins	7-8		Pod: 5-6x3/4 (12-15x1cm)	Highly susceptible to mosiac.
Bush Blue Lake	(30-45 cm) at maturity	8-9			
Bush wax	Foliage co-or range				
Bush Kentucky wonder Bonita	from light to dark green	8-9	4-6	Pod:7-8x3/4 (18-20x1cm)	
Canadian wonder Contender		7-8	2-3	Pod:6-7x½ (15-18x1cm)	Resistant to mosiac and powdery mildew

* Multiply ins. by 2.5 to convert to cm.
Multiply ft. by 0.3 to convert to metres.

Variety	Plant description	Approx. Wks to 1st reap to final		Fruit description	Remarks
(Contd)					
Corneli 14		7-8	3-6 depend	Pod: 6 x	Close sets allows easy
Earlgreen	Same	6-7	on	Pod 5-6 long	reaping
Earliwax		7-8	whether	Pod 5-6 long	Resistant to
Extender		7-8	crop	Pod 5-6 long	beans mosiac
Harter		7-8	reaped snap beans, green or dry	Pod 5-6 x 3/8	"
				"	some resistance to mosiac and powdery mildew
Harvester		8-9	peas	Pod 5-6 long	resistance to bean mosiac.
Kinghorn wax	Same			Pod 5-6 long	resistance to rust
Miss Kelly		8-10		Pods 4-6"x3/8	
Resistant Cherokee.		7-8		Pod 6-7 x ½	
Provider					
Tendercrop	Same	7-8		Pod 5-6 long	
Tendergreen					
Wade		7-8		Pod 5-6 long	
Wadex					
Pole varieties					
Abundance	The pole ro			Most varieties	
Blue wade	climbing var-			hold 8-12 seeds	
Dade	ieties cline	8-9		Pod: 7-8 x 3/4	Resistance to
Florigreen	to heights				mosiac rust.
Everbearing.	of 6-8 ft. app (2-2.5 m)				
Kentucky Wonder		9-10		Pod: 7-9x½	Pods long and twisted.

Variety	Plant description	Approx. wks to 1st reap	to final	Fruit description	Remarks
Pole contd.					
Polaris	Same	9-10	2-6		
Romano		9-10		Pod: 5-6x3/4	
Kentucky string less		8-9		Pod: 7-8x½	
Lima beans (bush varieties)					
Allgreen	Plant ht. 15-18"	9-10	3-6 depend on stage at which crop reaped	Pod 3-4x1"	The smaller the width of the pod. the smaller will be the size of the seeds. Most varieties produce 3-4 seeds.
Burpee Bush Lime	Plant ht 15-18"	10-12		Pod 4-5x1"	
Butter green		9-10		Pod: 3-4x3/4	
Ford hook	Plant ht. 15-20"	10-12		Pod: 3-4 ½	
Henderson Bush	Plant ht. 15-18"	9-10			
Nemagreen	Plant ht. 9-10"	9-10		Pod 3-4x1"	Resistant to nematodes.
Thaxter	"	"		"	
Speckled Lima					
(Pole varieties)					
Carolina Christmas lima	Plant ht. 7-9 ft.	12-14		Pods 5-6x1½"	Produce over long period.
Florida butter	Plant ht. 6-8'	12-14		Pods 3-4x1'	
Pole Lima	Plant ht. 9-10" (2 3/4-3m)	11-12		Pod 3x1" (8x3 cm)	

Variety Contd)	Plant description	Approx wks to ast final &to final		Fruit descrip-tion	Remarks
<u>Soyabeans</u> Hardee Heron Improved Pelican Lee Seminole Over 1000 other varieties	Most varieties grow to height of 12-18 ins. leaves and stem light green in colour and hairy.	12-14	1-2	Pod size vary from 1-3 long by approx. broad	can be eaten green or reaped dry. Some varieties produce yellow-brown some produce black seeds

Note- The information on each variety will help the grower to know what to expect in the growth habit of the different varieties of beans.

<u>Broad beans</u> <u>Kidney beans</u> <u>Lima beans</u> <u>Soya beans</u>

Growth habit

The vegetable grower should have some definite ideas as to what he should expect from the crop he is growing. With a knowledge of the growth habit of the crop, the grower would know for instance, how long he should wait for his crop to emerge after planting. If a grower plants a crop of beans and supply adequate moisture, and after if he sees no sign of the seedlings, then he knows something is wrong. On the other hand if he had planted Parsley, he could not expect emergence before two weeks the earliest.

Remember that it is best to make the heaviest application of fertilizer when the rate of growth of a crop is highest i,e. at the time when the crop is growing the fastest. It is by knowing the growth habit of the crop that we can determine this time.

We should bear in mind the difference in varieties of a crop. So that strickly speaking, to talk about the growth habit of a crop is not totally correct. What would be more correct is the habit of each variety. However, because of the large number of varieties of most vegetable crops, and most varieties follow a definite pattern, it is more practical to look at one or more varieties which gives the general picture of the growth habit of the different varieties. In the case of Kidney beans, the growth habit of a bush variety and that of a pole variety, would give a fairly reasonable picture of the growth habit of a crop.

Note that factors like difference in seasonal conditions and management, will affect the way in which the plant grows. So that the information in this book on growth habit, will not be true for all areas. However, the crop will more or less follow the pattern given here.

The information given on each variety (under selecting varieties), should also help the grower to know what to expect in the growth habit of different varieties of the crop.

(18:4) Growth habit of bush kidney beans (Harvester).

Time from plant (wks)	Approx. ht. of Stem*	Approx. ht. added	Crop Description
2nd	3-4" (7-10 cm)	3" (8 cm)	Emergence 5-8 days. Seedling with 2-4 developed leaves
4th	6-8" (15-20 cm)	4" (NPK)* (10 cm)	Crop enter period of most rapid growth
6th	10-12" (25-30 cm)	4" (10 cm)	Flowering and early fruiting. Pods 1-2" long.
8th	14-15" (35-38 cm)	3" (8 cm)	Crop ready for first reap if used as string beans. Pods 5-6
10th	15-16 (38-40 cm)	1' (3 cm)	Crop ready for 1st reap as green beans. Reaping of string beans should be completed or nearly complete.
12th	15-16 (38-40 cm)		Reaping of green beans (seeds) should be nearly completed. Complete 1-2 weeks later.

Approx. height added is calculated from the median value of the approx. heights given. eg. median value for 2nd wk. = 3" (i.e. $\frac{2\ 4)}{2}$, and the median value for 4th wk. = 7" (i.e. $\frac{6\ 8)}{2}$. The height added = 7-3 = 4 ins.

The time at which the heaviest fertilizer application should be made is marked NPK_H.

* Note - Ht. of stem is taken from ground level to base of terminal bud.

Growth habit of Pole Kidney beans (Kentucky Stringless) (18:5)

Time from plant (wks)	Approx ht.* (ins)	Approx ht. added (ins)	Crop Description
2nd	2-4 (5-10cm)	3" (8cm)	Emergence 5-8 days. Seedling with 2-4 developed leaves.
4th	8-10" (20-25 cm)	6" (NPK_H) (15 cm)	Crop enter period of very rapid growth. Growing tips start to elongate hence need for staking.
6th	36-42 (app. 1m)	30" (app. 3/4m)	Flowering and early fruiting. Pod along almost entire length of plant from lowest point of branching. Pods 2-3" long. (5-8cm)
8th	48-60 (approx 1-2-1.5 m)	14" (35 cm)	Flowering continue with fruits <u>almost</u> ready for 1st reap as string beans Pods: 6-7x½" (approx. 18x1cm)
10th	60 -66 app. (1.5-1.7m)	9" (23 cm)	Reaping as string beans should have started around the 9th week.
12th	66-72" (1.7-1.8m)	6" (15 cm)	Crop ready for first reap as green beans (seeds) Reaping of string beans should be completed or nearly complete.
14th	66-72" (1.7-1.8m)		Reaping of green beans should be nearly completed in 1-2 week later.

* Approx ht. of stem taken from ground-level to base of terminal bud.

CROP pH REQUIREMENT - For best results beans should be grown under moderately acid to neutral soils. (pH 5.5-7.0) Lime should be added where necessary to make the soil less acid. Powdered sulphur or acidic fertilizers can be used to make soil acid. Alkaline sandy, loam and clayey soils would need about 50,80 and 100 lbs of sulphur. Very acid sandy soils would need about 200 lbs per sq. chn. and very acid clay and loam soils would require 300 and 400 lbs of burned lime (CaO) in 2 applications, 6 months apart.

Applying organic manure

For growing beans as all vegetable crops, adding organic manure to the soil usually improves yields. The vegetable grower particularly on clay and sandy soils, should apply organic manure to his soil from time to time. On these soils, manure should be added at least once each year. This is very important where crops are not ploughed - in after reaping. This would be in cases where most of the plant is removed in reaping, (eg leafy vegetables), or where the remains are difficult to plough in (eg corn). Using the remains as animal feed would be another case.

The quantity of manure that the grower would apply will depend on many factors. eg amount available and soil type. Usually 5-10 tons per acre (11-22 tonne/ha) each year will usually benefit production on all soils.

Fertilizer and planting populations.
Suggested fertilizer grades for beans.

Here are some generall recommendations for beans. The grower should have some idea of what the nutrient level in his soil is like. This can be got from a soil test or soil survey of the area. The grower should start growing his beans with the recommendation suited for his soil condition. He should keep constant watch for signs of nutrient excess and deficiency. On observing this, increase or decrease the application of an element, by changing fertilizer grades in later crops. He may also adjust plant population and rate of application, one or both together to try and increase his returns.

The general recommendations are:-

1. Fertilizer grade approx. NPK/12-12-12*
2. at a rate of approx. 40 lbs per sq. chn. (20kg/400 sq. m.)
3. plant population approx. 6,000 per square chain or per 400 sq. m.
4. planting distance approx. 18" x 6" (45 x 15 cm)

These recommendations are based on a medium supply of N,P and K in the soil. If the nutrient status of the soil is known, adjustments can be made to suit such conditions.

(18:6) To find fertilizer grades for your soil type:-

- when the level of an element in the soil is very low, add 10% of that element to the general recommendation;
- when the level of an element is low, add 5%;
- when the level of an element is very high, subtract 10% of that element from the general recommendation.

To find fertilizer rates and populations per sq. chn. or per 400 sq. m.

(18:7)

Population dist. Planting dist.	Low pop^{n} app. 4,500 pl. dist. app. 24"x6"	Med. pop^{n} app. 6,000 pl. dist. app. 18"x6"	High pop^{n} app.9000 pl. dist. app. 18x 4"
Rates for (Low soil NPK	50 lbs (25kg)	60 lbs (30kg)	70 lbs (35kg)
(Med. soil NPK	30 lbs (15kg)	40 lbs (20kg)	50 lbs (25kg)
(High soil NPK	20 lbs (10kg)	30 lbs (15kg)	40 lbs (20kg)

* The approx. sign used to indicate this grade or the nearest grade to it should be used.

For pole beans, the fertilizer grade and rates are the same as bush beans but low population approx. 2500, medium approx 3500 and high approx 4500. On very rich soils fertilizers should be used to supply the element which is in relatively short supply for growing that crop.

Remember that where the fertilizer grade which is recommended cannot be got, use the closest grade to this which is available. But this grade should not differ by more than say 3% at the very most for each element. If neither the recommended grade or a close substitute can be got, use the balanced NPK fertilizer with its total % NPK closest to the total % NPK of the recommended fertilizer. Use the same rates of application for any of these grades

Example.

NPK/12-12-12
OR 14-12-10
OR 10-12-12
OR 10-11-15
OR 11-11-14

These grades can be used at 40 lbs per sq. chain to grow beans at 7000 plants per square chain or 20 kg to grow 7000 plants on 400 sq. metre .

Number of Applications

Short duration varieties -

These recommendations are for varieties which will be completely reaped within 12 weeks from planting.

On clay and loam soils: (1/3R+2/3R = 2 applications) Apply 1/3 of the recommended fertilizer rate at planting and the other 2/3 later, in both bush and pole varieties. The second application can be made around the 4th week after planting. This is the time that the crop is about to start a period of rapid growth (see table 18:4 and 18:5 on growth habit.

On sandy soils: (¼ R + ¼ R + ¼ R = 3 applications) ¼ of the required rate should be applied at planting, ¼ around the 4th week and the other quarter applied about 3 weeks later. If the variety is very short and reaping would complete in around 8 weeks, the fertilizer should be applied as on clay and loam soils.

Medium duration varieties -

For varieties that will take more than 12 weeks but less than 16 weeks, the fertilizer should be applied in 3-4 applications.

On clay and loam soils: (¼ R + ¼ R + ¼ R) = 3 applications. Apply ¼ of the recommended fertilizer at planting ¼ around 4 weeks from planting and the other 1/4 weeks later.

On sandy soils: (1/5 R + 2/5 R + 1/5R+1/5 R = 4 applications). Apply 1/5 of the recommended fertilizer at planting. 2/5 should be added after 4 weeks around 1/5 weeks and the final 1/5 applied about 10 weeks from planting.

Identifying and correcting nutrient hunger and excess.

In growing beans, as all other crops, the grower has to be always on the look out for deficiency of the 3 primary elements (N,P and K), the 3 secondary elements (Ca, Mg and S) and the 6 trace elements (B,Cu, Fe, Mn, Mo and Zn). He should then try to correct this.

There is also the problem of too much of these nutrients in the soil. This is most often due to over-fertilizing whether by the vegetable farmer or by someone who used the land before. This problem can be tackled in 2 ways, separately or better together:-

1. not applying any of that element in fertilizer until after signs of the deficiency is seen in crops.

2. growing crops which utilize plenty of the excess element in the area of the farm where the excess appears. eg. leafy vegetables in area of excess N.

But short supply of nutrients is more often the problem. Remember that with some diseases and where crops do not get enough water, signs resembling deficiency of some nutrients may be shown. Make sure that these are not the problems before starting to check for hunger signs and correcting them. If less than 10% of plants show these signs, do not be worried about the need to correct this.

(18:8)

Nutrient	Hunger signs	What to do*
Nitrogen (N)	1. Pale green to light yellow leaves 2. Drying up of leaves starting with lower ones. 3. Slow stunted growth 4. Reduced size of pods	1. Use higher percentage of the deficient element in fertilizer at the recommended rate for beans on soils of that nutrient level. See Table (18:7) The growing may be a single fertilizer containing the deficient element as a sidedressing. eg. Sulphate of Ammonia (N) Superphosphate (P) Muriate of Potash (K) or he may increase the % of deficient element in a double fertilizer (eg.NP) or complete fertilizer (NPK)
Phosphor us(P)	1. Slender, weak stems. 2. Slow growth 3. Delayed maturity of beans. 4. Poor yields.	
Potassium (K)	1. Mottling, curling and, or scorching of leaves. 2. Roots poorly developed and plants falling down. 3. Slow growth 4. Pods spongy with reduced yields	
Calcium (Ca)	1. Leafy margins light green and or, wrinkled. Young leaves may remain folded.	1. Apply in fertilizer (or liming material on acid soils) at recommended rates.

Nutrient contd.	Hunger signs	What to do*
	2. Short roots with excessive branching. 3. Slow growth and poor yields.	2. Calcium chloride (36% Ca) at approx. 3/4 lbs per 10 galls water. 3. Calcium nitrate (20% Ca) at approx. 1 lb. per 10 galls water. Spray 2 and 3 for each sq. chn.
Magnessium (Mg)	1. Mottling of leaves (yellow & green and or margins curled upward 2. Slender, weak, brittle stem. 3. Poor growth and yields	1. Dolomite lime for liming approx. 12 lbs per sq. chn. 2. Magnessium sulphate or epsom salt. (10% Mg) at approx. 1½ lb in 10 galls water per. sq. chn.
Sulphate (S)	1. Pale green to light yellow leaves in presence of sufficient N 2. Immature pods very light green	Use sulphate of ammonia, super-phosphate and Potassium Sulphate in NPK mixture at recommended rates.
Boron (B)	1. Leafy margins yellow or brown. 2. Stems tend to crack. 3. Poor yields	1. Apply Borox (11% B) at approx 6 ozs in 10 galls water per. sq. chn. 2. Soluber (21%B) not more than 4 ozs in 10 galls water.
Copper (Cu)	1. Leaves pale green to yellow and elongated in presence of sufficient N. 2. Poor growth and yields	Use Copper Sulphate or blue stone (25% Cu) at approx 6 ozs in 10 galls water per. sq. chn.

Nutrients Contd.	Hunger Signs (contd)	What to do.
Iron (Fe)	1. Leaves pale green to yellow in presence of adequate N. 2. Poor growth and production.	1. Ferrous sulphate (20%Fe) at approx. 4 ozs in 10 galls water. 2. Iron chelate (10%) at approx 3 lbs per sq. chn. plus filler
Manganese (Mn)	1. Pale green leaves with veins very green 2. Small number of pods formed	Apply Manganese sulphate at approx. 4 ozs in 10 galls water per. sq. chn.
Molybdenum (Mo)	1. Leaves pale, distorted in shape and narrow. 2. Poorly developed flowers and fruits	1. Sodium Molybdenum (40% Mo) at not more than 2 ozs in 10 galls water.
Zinc (Zn)	1. Buds pale to whitish colour. 2. Delayed flowering and fruiting	1. Zinc Sulphate (23% Zn) at 4 ozs in 10 galls water 2. Zinc chelate (14%Zn), not over 2 ozs in 10 galls water.

* Apply foliar sprays with same equipment used for spraying insecticides and fungicides. For trace elements, not more than 2 ozs above recommendations should be used except in correction of B, Mo and Zn hunger. Higher quantities of all materials might be toxic to the crop.

Buying and testing seeds

Seeds - Beans have large seeds, smooth and kidney shaped (Approx. ½ "long x ½ at widest pt x 3/16 thick,) Approx. number of seeds per ounce: Kidney bean - 100, lima beans - 50 seeds.

Quantity of good kidney bean seeds (%G / 75) needed for direct planting.

low pop^{n}: approx 3 lbs per sq. chain or 1.5 kg/400 sq. m.
medium pop^{n}: " 4 lbs " " " or 2 kg.
high pop^{n}: " 6 lbs " " " or 3 kg.

(Lima and broad beans would need about twice the above in each case)

It is best to buy seeds about 2 weeks before the crop is to be planted. Seeds should then be tested to determine the percentage germination (%G). If the percentage is below 95%, the grower will have to buy and plant seeds a little nearer in the row to get the required population. Between 75-95% G if a seed-planter is used, the seeds can be planted an inch closer in the rows. If the viability is as low as 50%, plant 2 seeds in each hole. More seeds than suggested above would have to be bought.

Land preparation

For growing beans, the land should be ploughed and harrowed one or two times depending on soil conditions i.e. if after the first harrow, the land is still not fine enough, then a second harrowing would benefit the crop. Remember that if organic manure is to be added mainly for improving the soil structure, it should be added after ploughing and harrowing into the soil. If hand planting is to be done, furrows should then be put at the required distance between rows. With a seed-planter, furrows can be cut further apart -

Note Try to keep within the recommended range of planting distance and as near to the recommended planting distance as workable. This applies to land preparation for planting any vegetable. But where it is time-wasting and difficult, except in an experiment, the furrows can be made at an average distance apart for that crop or groups of crops, and the different populations got by

changing the planting distance along the row.

Example: Beans to be grown whether at high, low or medium populations can be grown in rows 18 ins (45 cm) apart.

Low pop^{n} approx 4000 pl at 18" x 8" (45x 20 cm)
Med. pop^{n} approx 6000pl.at 18" x 6" (45x 15 cm)
High pop^{n} approx 9000pl at 18" x 4" (45x 10 cm).

Planting

The crop should be planted at the distance calculated to give the population that the grower needs. Before planting, the soil should be dusted or sprayed with an insecticide to prevent ants and other insects from destroying the seeds. If the grower did not buy pre-treated seeds, then he should pre-treat it himself, to protect seeds and seedling from certain disease and insect pests. (See pest control for beans).

If hand-planting is done, put 2 seeds in each hole and double the recommended distance along the row to get the required population. Example - 2 seeds per hole at 12 ins. apart instead of 1 seed per hole at 6 ins apart. If pole varieties are planted, stakes of about 6 feet may be put in after planting. One stake may do for 2 plants and it is easier to put them in after planting when the land is fairly soft:

Planting depth: 1½ -2½ ins or 4-6 cm.

Irrigation and drainage.

Beans should be irrigated as is needed on the farm. How often this is to be done and how much water should be applied each time, will depend mainly on -

- the stage of the crop, hence depth of root zone
- how often and how much rain falls during the crop
- how rapid is the evaporation in the area
- the soil type on the farm i.e. generally light soils will be irrigated more frequently than heavier soils.

Irrigating the field heavily once or twice every 1-2 weeks depending on the area soil etc. need sufficient to wet the top 12 inches (30cm) of the soil should be all right for beans, remember that it is better to make a single heavy application than a number of light ones, except when the crop is young or root system shallow. At the same time, the grower should make sure that his drainage is good. If not, he will have serious root rot disease and other troubles.

Remember that most vegetables need about 1½ inch (2.5 cm) of water each week from rain and or irrigation. A flow of 100 gallons per minute (litre per minute) will take about 3/4 hour to supply 1 sq. chain (400 sq. m) with this amount of water.

Disease and pest control in beans.

Soil treatment - For controlling ants and other pests from attacking the seeds, either spray or dust furrows with a chemical that control soil-borne insects. eg. Agrocide, Aldrin, Chlorodane, Dieldrin, Diptrex. This will be necessary particularly where seeds are not pre-treated.

Seed treatment - To control damping-off of seedlings, one of the following can be used 1-2 ozs capton, chloranil or thiram dust per 10 lbs of seed. This quantity can also be mixed with an equal quantity of aldrin, chlordane, dieldrin into a slurry. The seeds should be treated in this, dried and then planted. It is easier to use of dieldrin/ fungicide powder, but this may not be as effective especially on seeds like beans with their very smooth testa.

The pests below usually attack beans after emergence. A guide to identifying and controlling these pests is also given and should be of help to the grower.

(18:9)

Disease	Description and drainage done	Suggested control
Anthracnose	In early stage small circular or elongated areas of plant part attack have dark-pink colour. Later the areas sink and become darker in colour. The disease attack mainly fruits, but also the foliage.	Plant resistant varieties in addition to efficient rotation of crops. Spray with Dithane D-14 Polyram Combi.
Damping-off	Stem of seedling become black at the soil surface, or develops a water appearance in this area. The seedling will then fall over. Attack mainly seedlings.	Improve drainage, spray with captan, chloronil, thiram.
Mosiac (golden)	Young leaves become pale green to gold in colour in small patches. Later cover entire leaf and spread to older leaves. Reduce flowering and fruiting considerably and fruits will usually be poorly developed.	Remove plants from the field as soon as symptoms are observed. Improve insect control looking out particularly for small white fly. Avoid planting near poinsettia trees since fly feeds mainly on those. Plant resistant varieties in addition to efficient rotating of crops.
" (common)	In early stage, the plant part attacked becomes mottled (i.e. sort of network of dark and lighter shades). Later the plant part becomes distorted or wrinkled. Young leaves and fruits usually remain small and distorted. Older fruits will have lumpy appearance.	

contd.	Description and damage done	Suggested control
Powdery (mildew)	In early stage, upper side of leaf have a whitish appearance due to the mold or mildew on the surface. Later this becomes brown and dry. The powdery stuff will easily rub off on the fingers. Attack mainly leaves.	Plant resistant varieties. Spray with Dithane M-45, Karathane, Kocide, Zineb.
Root Rot	Foliage wilt due to rotting of root.	Improve drainage.
Rust	In early stage, small circular spots having a pale colour develop on foliage. Later these become redish-brown or rusty in colour. Hundreds of spots might be on a single leaf and in time, the distance cause leaves to fall. Attack mainly foliage.	Plant resistant varieties. In addition spray with Dithane M-22. Dithane Z-78 (zineb)
Insect Corn ear-worm	Small green or brown caterpillars (3/4-1½" long) Attack pods	Diptrex, malathion, phosdrin Sevin, Thuricide, Systemic, spray eg. Systex.
Bean leaf beetle	Small green, yellow or red beetles with black markings on their wings. (⅛-1/3" long) Cut round holes in leaves.	
Cutworm	Dark coloured worms (1-1½" long) living in soil will cut off leaves near to ground or cut down entire plant.	Aldrin, dieldrin, diptrex, toxaphene.

Insects contd.	Description and damage done	Suggested control
Leaf-miner	Tiny maggots which feed between the upper and lower surface of leaves. They make tunnels in the leaves which can be seen as a pale network beneath the leaf surface	Systemic sprays eg. systex, rogor.
Pest Bean pod borer	Small pink caterpillers (app. 1" long) Attack pods	diazion, malathion, Rhothane, phosdrin, Sevin Thuricide.
Armyworm	Large dark green to black caterpillers (1-1½" long) with light stripes along its length on both sides. Attack foliage and pods.	Chlordane, dieldrin, Dipterox, Linadane, Sevin, Thuriade, Systemic, spray eg. Perfecthion.
Aphids	Soft bodied sucking insects (app. 1/8" long) green to brown in colour clustering on leaves. Attack leaves.	diazinon. Kelthane, malation, systemic sprays eg. Rogor.
Leaf-hopper	Small wedge-shaped insects (app. ⅛" long) Attack leaves causing it to have yellow to bronze appearance.	Malathion, Sevin, Trithion.
Mites	Small spider-looking insects having eight legs. Attack leaves.	diazion, Kelthane, Karathane, trithion, systemic spray eg. Meta-systox.
Thrips	Tiny elongated insects (app. 1/16" long) Attack leaves causing it to have a silvery, whitish or bronze appearance.	Same control as mites.

Pest	Description and damage done	Suggested control
Weevils	Worms (approx 1/8" long) white to yellow in colour Attack pods.	Mirex, sevin, thuricide.
Nematodes Root knot	Plant stunted and sickly looking although there is no sign of damage to foliage. Roots show numerous large round swellings (knots) Attack roots.	Plant more resistant crops- corn, cabbage family, endive, lettuce onion and peanuts. For chemical control apply nematocide (eg Dow fume Nemagon before planting.)
Other pests Slugs and snails.	Animal with legless, slimy body (1-2" long) and have greyish appearance. The slugs do not have shells while snails have. Leave slimy trace wherever it goes. Feed mainly at nights. Attack foliage.	Apply a slug bait eg. Dieldrin, Musurol, metaldehyde as directed on label of container. Try to search out and destroy hiding places eg. piled of dry thrash and rubbish.
Rodents (Rats and mice)	Small four-legged mammals, long tail and have catlike appearance. Sizes from 3" long (mice to 6" long (rat) minus length of tail. Eat up matured plant part that is to be reaped or in storage.	Have one or two cats around the farm. In addition use rat baits like Rattex, Sorexa, Warfarin

Note that with all pests, clearing weeds around the edge of the field improves effectiveness of control.

Sprays should be applied at least once a week or as directed by manufacturer of chemical. Stop using systemic sprays about 1 month before reaping.

Use of Dieldrin and Chlordane restricted in some countries.

(18:10) (a) Mosiac vs normal plant (b) Mosiac effecting Pods.

Mosiac on beans.

Applying pesticides.

The pesticides can be applied either as dust or better yet as sprays. When sprays are used, it is best to add a spreader-sticker (eg Triton) to the mixture. When spraying, care should be taken to allow the spray to reach the underside of leaves.

Spraying should be done at 5-10 days interval after the first application. This will depend on how serious the attack is and on seasonal conditions. Generally the more serious the attack, the more regular spraying should be done.

Crop Rotation - Remember that one key point in disease and pest control is not to plant two successive crops of the same family at the same place. Depth of the root zone is another important factor. - See table 15:4)

Weed control in beans

Weeds can be controlled in beans using:-

(i) Manual control - i.e using hand tools to weed field

(ii) mechanical control - i.e. using tractor with special implements attached for weeding.

(iii) chemical control - i.e. using weedicide to spray the field. (This would include pre-plant control in which weeds are allowed to emerge, then sprayed with contact spray before the crop is planted).

(18:11) Chemical weed control in beans

Weedicide	Time to apply & weeks of effective control	Weeds controlled	Approx quan. per 10 galls (app 40L) water (H.V)	Remarks
Amiben Dymid	After planting but before emergence control 3-6 wks.	Develop emergence of most weeds.		Use on heavy soils. If weeds have emerged add Gramoxone to mixture at ½ pint per 10 galls (½L/40L) mixture. Use docthol mixture on light soil.
Dacthal + Dymid	As above		6 ozs. + 6 ozs (app 360gm)	
Dacthal	At or right after planting, control 3-6 weeks	Delay emergence of most	3/4 lbs (360gm).	
Eptam	Before or right after planting.	Delay emergence of most weeds including nut grass.	1 pint (½litre)	Spray all pre-emergence sprays on soil and irrigate after application
Gramoxone	After weeds have emerged and control is needed control 3-5 weeks	Kill nearly all weeds	½ pint (½L)	Do not allow spray to touch the crop.

Reglone)
Round-up)
or Glyphosate) Also contact weedicides

Mulching -

Covering the area around roots or the entire field with grass or other mulch can be quite helpful in dryer areas where irrigation water is limited. One must remember that using mulch not only conserve water, but also helps weed control and reduce diseases from fruit rot in vegetables with their fruits resting on the ground. It also increases the chance of insects damage to the crop due to a build up of these pests under the mulch. Dusting and spraying the field with insecticides and fungicides before mulching can help to control pests and diseases.

Many of the practices we have discussed before, has to be adjusted where mulching is used. For example, it is best to use one application of ' slow-releasing' fertilizers at plantingwith mulch than the methods recommended before. The alternative, is to use only materials which dissolve easily and apply them as suggested before, with 2 or 3 heavy wettings to dissolve the material and allow it to soak below the mulch.

Another difference is with inter-tillage. This cannot be done or has to be done in the early life of the crop and mulching done after.

Inter-tillage

Inter (row) cultivation should be done 1-2 times during the crop. This would depend on the soil condition. If it is soil that tend to crust, then it would be necessary to do two inter-ploughings. Remember that mechanical weed control is done while ploughing and it is best to do this immediately before or after a fertilizer application. All inter-row works are best done before beans start to flower, otherwise the grower stands the chance of knocking off the flowers and young fruits.

Pole beans should be staked before or as soon as the stems start to twine. This is usually when the crop is about 4 weeks old

Reaping

Most varieties of beans will be ready for first reaping in 8-12 weeks after planting. String beans would be earliest while the other kinds

would come in a few weeks later. The reaping time varies from 2-6 wks depending on the varieties and kind of beans.

For small scale operation, it is best to hand-pick beans. In this only beans at the required stage is reaped. So that if the grower needs green beans, he would pick only the mature pods and leave those that have no mature seeds in them. For string beans, the crop should be reaped when the pods are fully developed in size, but will snap when the grower bends it. If the fruits bends without breaking it is becoming fibrous and not suited as string beans. For dry beans one would have to wait until the bean pods are completely or nearly dry.

(18:12)

Dry beans, peas and corn takes a great deal of time and labour to shell by hand. There are different kinds of equipment, called shellers which can help with this job. Big shellers are usually driven mechanically, while small ones can be operated manually. But growers of legumes and corn should always try individually or collectively, to use a sheller to help with shelling the seeds of these crops. Care should be taken not to pull up the plant while reaping. The grower will have to develop his own technique to avoid this. Care should also be taken to reap the entire pod without breaking or damaging it. Remember that quantity, quality will go together to determine how much you get for your beans.

(18:13)

Yields to expect	Average yield (kg/400 sq. m)	Good yield kg/400 sq. m.)
Broad beans	150-200	75-100	250-300	125-150
Kidney beans(snap)	200-400	100-200	600-800	300-400
" " (green)	150-200	75-100	300-400	150-200
" " (dry)	80-100	40- 50	150-200	75-100
Soya beans	50-100	25- 50	120-150	60-75

(Approx. 30 bushels of seeds ≡ 1 short ton)

Note that pole varieties are generally heavier producers than bush beans. However, the grower should take into consideration the longer duration of the bean crop. He should consider if it would not be possible and more profitable to grow say 5 crops of bush, in the time taken to grow 4 crops of pole beans.

Keeping notes and records.

Keep notes of observations during the crop. Records of production of the crop from the area reaped, is a must to calculate yields.Where it is practical, records of costs and sales such also should be kept. These notes and records are helpful to compare different crops of beans or different varieties or to compare production of beans with other crops. These are important both for technical as well as economic reasons.

18B. PEAS

(Legume)

Family:-

Kinds: 1. Cowpea or Marble pea
2. Garden pea or English pea or Pea
3. Pigeon pea or Gungo pea or Dal or Congo pea,

Uses - Peas are grown for the same reason as beans. Pods can be cooked and eaten when young, while mature seeds may be used either when green or dry. Leaves can also be cooked and eaten.

The food value, like that of beans, is noted for the high protein content. But among them, the garden pea has the highest, the cow-pea next and the pigeon pea having the lowest amount of proteins..

Seasonal Requirements.

- Both the cow-pea and pigeon peas are cool to warm season crops and give best yields between 65° - 85°F (18° -30°C) The garden pea is however, a cool-season crop and will not give good yields above 70°F (21°C). This means that it can be grown only in the cool seasons and cool hilly areas of most tropical countries. Pigeon-pea is sensitive to day length and has to be planted between February and April, and will start bearing in November to December.

(18:14) (a) Cow-pea (b) Garden-pea (c) Pigeon-pea

Selecting varieties.

(18:15) The varieties given below are the ones most widely grown.

Variety	Plant description	Approx. wks to 1st reap & to final		Pod description	Remarks.
Cow-pea					
Black-eye Brown Crow-er Cream lady	Dwarf variety grows upright, with length of stem about 18"-24" Pods bourne on long stalks (1-2ft) Total height of mature plant 2-3 ft. (or 0.6-1.m)	10-12 for dwarf varieties	2-6 depending on whether reaped as string green or dry peas	Pods 5-8 x¼-1/3" with 8-12 seeds	Blackeye has some resistance to elworm or root knot
Yard-long	Twining variety grows to 5-6ft (1.5-2m).	14-18	"	2-3ft long x 1/3-½ inch.	
Garden pea					
Daisy	Plants with			3-5"long	
Little marvel	stems growing	9-10		with 6-	
	to between 1½-2½ feet (0.5 -0.8m)	10-12	6-12	10 seeds which are round or wrink-	
Telephone (Alder-man) Melthing sugar	Taller variety may grow up to about 4 feet (app 1¼m)			led and green or yellow	These called sugar peas or edible podded suited for use like snap-beans
Dwarf gray Sugar		9-10			
Pigeon peas					
Bicolor	Tree growing	About 9	2-3mths	3-4 ins	Same plant

Variety (contd.	Plant description	Approx. wks to 1st reap & to final		Pod description	Remarks
	erect, branching and woody Height 6-8 feet	months		x3/8" with 3 to 6 seeds creamish with brown specks	can live and bear for 3 or 4 years (perennial)
Flavus	Semi-dwarf grows to height of 5-6 feet.	6-7mths		Seeds brownish	
Kaki	"				
Totiempo	"	6-7mths	4-6mths		Resistant to rust
UWI #17					

Growth habit

As we have seen with beans, this differs not only with the different kinds of peas, but also between different varieties. The table below can be used as a guide as to what to expect from dwarf varieties of cow-peas. The growing habit of the garden pea is fairly close to the cow pea, with the gungo being much different. The main difference in the case of the pigeon-pea is due to the longer life of this crop.

(18:16) Growth habit of dwarf cow-peas (Black-eye).

Time from plant (wks)	Approx. ht. of stem	Approx. ht. added	Crop description
2nd	3-5" (7-12cm)	4" (10cm) (NPK)* m	Emergence 5-8 days. Seedlings with 2-4 developed leaves.
4th	8-12" (20-30cm)	6" (15cm) (NPK)* m	Crop growing faster. Early signs of buds on elongated stalks, which will develop into flowers.
6th	15-18" (37-45cm)	7" (18cm)	Flowering and fruiting at different stages, with few pods reaching 3-4 ins.
8th	22-24" (55-60cm)	6" (15cm)	Reaping of green peas may have started from 7th week. Most plants bearing mature pods, 5-8 ins long, with developed seeds.
10th	24-26" (60-65cm)	2" (5cm)	Crop can be reaped for dry peas but some green mature pods present
12th	25-26 (62-65cm)	1' (3cm)	Leaves ripening, complete reaping.

Crop pH requirement - like beans, peas will do best on moderately acid to neutral soils. But the pigeon pea can also be successfully grown even on slightly alkaline soils.

Adding organic manure - These manures will improve nearly all soils and as long as manures are available, applications of a few hundred pounds to a ton of material, depending on the type and moisture content, can be useful on each square chain.

Fertilizers and planting populations.

The pigeon-pea is one of the few vegetables that hardly responds to fertilizer application as long as the soil already has a medium supply of nutrients. So that this crop can be grown well on most soils without applying any fertilizers. Where the soil is poor, add 1 or 2 hbs of balanced fertilizer NPK/10-10-10 up to 15-15-15. If the soil is very poor in one element, add a side dressing of fertilizer rich in that element at the rate given. Applying more than 1-2 hbs (50-100 kg is not likely to give any marked increase in yields.

The plant population can be between 500 plants per square chain (with a planting distance of 3ft x 3ft. or 4 ft x 2ft.) and as low as a half this density. At lower populations, some inter-cropping should be done.

The table below gives the same recommendations for both cowpea and garden pea. Low to medium populations and the fertilizer to go with these populations can be used for the taller varieties, while medium to high populations and fertilizers are best for dwarf varieties.

(18:17)	Pop^{n}	Planting distance
Low	4500	24"x 6" or (60 x 15 cm)
Medium	6000	21 x 5" (52 x 12 cm)
High	9000	18"x 4" (45 x 10 cm)

The general fertilizer recommendation is NPK/12-12-12 at a rate of 40 lbs per. sq. chn. (20 kg/400 sq. m). The suggested fertilizer applications for different soil nutrient levels are the same as for beans. (See 18:6 and 18:7)

The number of applications can be 3 for shorter duration varieties and 4 for those over 12 weeks in the field. As shown by the growth habit of black-eye cow peas, it seems that it is best to make equal applications at planting, and at 3 weekly intervals.

Nutrient hunger and excess - The symptoms of deficiency and excess, and the method of correcting these are basically the same as for beans.

The following jobs also have to be done:-

1. Buying and testing seeds - same as beans, except that because of the smaller size of the seeds and the lower planting population, less seeds are used in planting.

   For low pop^{n} - approx. 3 lbs. or (1.5kg)
   For med. pop^{n} - approx. 4 lbs (2 kg)
   For high pop^{n} - approx. 6 lbs. (3 kg)

2. Land Preparation) Basically same as Beans.

3. Planting) Check note under Land Preparation

4. Irrigation and Drainage - for cultivation of cungo-peas even in periods of low rainfall, there is not much need. It has an extensive root system which allows the pigeon-pea to grow well under poorer and dryer soil conditions than most other vegetables.

5. Pest and Disease Control) - again the pigeon pea is the one most

6. Weed and Inter-tillage) different from the beans. It is generally harder than the rest. But it is also more sensitive to certain chemicals - (phyto-toxic) eg. Sevin has bad effects on its leaves.

7. Reaping - like beans they are hard to reap. Pods have to be picked and shelled when they are allowed to mature. Most dwarf varieties of cow-pea are easier, since they produce their pods on long stalks about 6 inches above the leaves of the plant. They also allow easier mechanical reaping. Yields are also similar to beans ranging from 300-700 lbs per sq. chain for string peas, 200-400 for green peas and 100-200 for dry peas (divide by 2 to get yields in kg per 400 sq. m)

Records and Notes - These must also be kept to help the farmer to assess and improve production and economic returns from his crops of peas.

19A. CORN

Chapter 19.

Family: Gamineae (Corn family)

Kinds: 1. (Field) Corn or Maize
2. Sweet Corn

Uses: Corn can be used in many ways to provide food. The green mature ear can be cooked and the grains eaten by itself or mixed with other vegetables in a salad. Dry corn can be crushed into cornmeal, a cheap source of food in most tropical countries. Much of the corn produced in these countries and throughout the world is used in animal feed.

(19:1) The nutritive value for 3.5 ozs. (100gm) of dry seeds given below:-

Food value	Water (ml)	Carboh (gms)	Prot. (gms)	Ca mgs	Iron mgs	Vit.A I.U	Vit.B mgs	Vit.C mgs	Approx. Cals.
Corn	12	70	10	12	3	400	0.4	0	100

Corn also has a good amt. of fats approx. 5 gm in 100 gm seeds.

Corn is a warm season crop, doing best between 65°F and 85°F. (18-30°C). It is more sensitive to day length (photoperiodism) than many other vegetable crops. The best results are given when the crop has growing season with more than 11 hours of day light. When corn is planted in the 'short days' of November for example, its growing season would be in November to December to January. Plants will very likely be stunted and may start bearing within 2 months. The result is poor growth and poor yields.

The common practice for most farmers in the caribbean are to grow only 2 crops of corn for the year. There is a spring crop, planted in March to April, and there is a fall crop, planted in August to September. This planting pattern is done to get the benefits of the April

to May rains and September to October seasons in the early life of the crop. As with all other vegetables it is also important to avoid the need to be reaping corn in periods of heavy rainfall. But this pattern of planting also meets the day length needs of the crop. The fall crop would have fairly 'long days' in September-October to grow, so that by mid-November to December, the plants would be fully grown and ready for bearing.

The grower with irrigation can grow 3 crops for the year. He has to plant his first crop in mid-January to early February to avoid planting a crop too late in the year.

Selecting Varieties

(19:2)

Variety	Planting description	Approx. wks to 1st reap & final		Ear description	Remarks
Sweet corn					
USDA.34 Puerto Rico 50		11-12		Ear 7-8" long with yellow grains	Resistant to yellow stripe mosiac
Golden Bantam	Grow to height of approx. 6 feet or app. 2 m	11-12	13-14	6-8 & usually 8 rows	
Grant White Butter finger Corn				8-10" long 10-13 rows & 30-35 kernels per row	Jamaica selected
J S Y) J S R)	Grow to height of 7 to 9 ft.	12-14	14-16		yellow & red.
	Height 5 to 6 ft	10-11	11-12		
Pioneer Hibred x 302 x 304	Av. height at maturity app. 6 ft.	11-12	12-14	8 to 10"	

Contd.

& x 306 Presto		long 12-16 rows with 35-40 kernels per row	Hibred yield about 2 times as much as JSY and JSR under similar conditions

Growth habit

(19:3) Growth habit of corn (Hibrid x 306)

Time from planting (wks)	Approx ht.* of stem	Approx ht. added	Crop description
2nd	8-10 ins (20-25cm)	9 ins (22 cm)	Emergence 4 to 7 days. Crop with about 6 leaves
4th	2-2½ft (60-75cm)	1½ ft (45 cm)	Plants fairly uniform in height, root and shoot development
6th	4-4 3/4 ft (1.2-1.4m)	2 ft(NPK)* (60cm)	Developed leaves 2 to 3 ft. tall and those around bud form a upright whorl enclosing the young tassel. Stem about 5/8 in (cm) diameter
8th	5-5½ ft (1.5-1.7)	1 ft (30cm)	Approx 50 to 75% of field tasseling (app. 1 ft long) of ears appearing in most plants
10th	5½-6ft (1.7-1.8)	6 ins (15 cm)	Tasseling complete, with pollen falling on silks protecting from young ears
12th	6-6½ ft (1.8-2m)	None	Green mature ears ready for reaping (app. 12 ins or 30 cm) in thrash.
14th	6-6½ ft (1.8-2m)	None	Crop ready for reaping as dry corn leaves ripening crop dying down.

* Approx. ht of stem taken from ground level to level of upper leaves (crown) and to later to the base of the tassel. This is the point where the upper most leaf is borne on the plant.

Crop pH requirement corn like most vegetables does best on moderately or slightly acid to neutral soils (pH 5.5 to 7.0). Outside these ranges, one should not expect the best yields without use of liming or acid forming materials. Same rates as beans.

Applying Organic Manure.

Organic manure, properly applied will benefit all crops on nearly all soils. It is specially helpful on clay and sandy soils, at between 5-10 tons per acre.

Fertilizer and plant population.

General recommendations for corn are:-

1. Fertilizer grade approx. NPK/12-12-8
2. " rate approx. 30 lbs per sq. chn. (15kg/400 sq. m)
3. Plant pop^{n} approx. 1500 plants per sq. chn (1500 pl/400 sq. m)
4. Planting distance : 30" x 15" (75 x 38 cm).

Where the nutrient status is known from soil analysis or from soil survey and land capability maps, the suggested fertilizer rates and plant density per sq. chn (per 400 sq. m) is given below

(19:4)

Pop^{n} & planting dist.	Low pop^{n} app 1000 pl dist. app 36"x 18" (90x45cm)	Med pop^{n} app 1500 pl dist app. 30"x 15" (75x38)	High pop^{n} ap 1800 pl. dis app. 30"x12" (75x30 cm)
Rates) Low soil NPK	20 lbs or (10kg)	30 lbs (15kg)	40 lbs(20 kg)
For) Med soil NPK	10 lbs (5 kg)	20 lbs (10 kg)	30 lbs(15kg)
High soil NPK	-	10 lbs (5 kg)	20 lbs(10kg)

Depending on the status of each major element, the grade of the fertilizer can be adjusted. See section (18:6)

How to apply fertilizers.

The number of applications and the methods that can be used are similar to the short duration varieties of beans. One has to be careful when broad-casting the second application, to avoid allowing the fertilizer to be deposited in the bud or"heart' leaves of the plant.

Secondary and trace element deficiencies.

These are fairly easy to identify in corn. Matter of fact, it is good to plant corn in rotation on different sections of the farm to get some idea of minor elements deficient in the soil. These deficiencies can cause poor yields despite application of the correct grade and rate of NPK fertilizers.

Table (18:8) can be helpful in identifying and correcting plant element hunger.

Buying and testing seeds.

Except for hybrid varieties, the vegetable grower can easily select seeds from a previous crop or from a farmer who produce a crop of mature, disease - free kernels. Hybrid seeds have to be purchased from specialized seed farms which take the necessary measures to produce these. If a farmer plant seeds from a previous crop of hybrid corn, he will find that the yield and quality of each successive crop will become worse.

Seeds approx. ¼" x ¼" x 1/8 inch (½x½x⅛ cm) flat and tapered at one end, smooth with colours white, yellow, red, purple to black depend on variety corn seeds suitable for planting should not give less than 75% germination, although very good quality seeds give as much as 90%G.

No. of seeds approx 150 per oz (150 in 30 gm)

The quantity of good seeds (/ 75%G) needed for corn are:-

Low population	approx ½ lb per sq. chn	(app ½ kg/400 sq. metre)
medium pop^{n}	approx. 3/4 lb "	(app. 3/8 kg. " ")
high pop^{n}	approx. 1 lb " "	(½ kg or 500 gm)

Land preparation and planting.

Corn, like beans, have large seeds. Preparing the land and planting the crop are done basically the same way except, on clayey soils or under regular rainfall conditions, it is best to plant the corn in furrows. This crop has a fibrous root system, which if not well developed, the plants will tend to fall over. Moulding is needed in this case.

If planting is done in the furrows, hilling is easier and rapid drainage from the root zone would be reduced. This operation would fill up the furrows, and the roots would be properly covered without having to raise soil as much above the ground level as if the crop was planted on banks.

Pl. depth about 2 ins. or 5 cm
Direct planting only.
If 2 seeds per hole, double planting distance along rows.
Also pay attention to notes under Land Preparation on beans.

Irrigation

Irrigating corn as far as how regular and how much water to apply, is similar to the factors mentioned in dealing with beans. The main difference is that because corn has a fibrous root system, and feeds closer to the soil surface, while it will grow on shallow soils, it cannot stand up as well as some legumes to dry conditions. Regular rainfall or irrigation of at least once each week day must be at hand to soak the top 9-12" of soil. Sprinklers for irrigation of corn should not be less than 3 feet (app. 1m) but can be elevated to about 6 feet above the ground These are needed to avoid shredding of the leaves during irrigation.As the corn grows, whether by using flood irrigation or other means, the farmer should try to avoid damaging the leaves of his crop.

Disease and pest control.

The recommended soil and seed treatments for corn are the same as for beans. Crop and chemical rotation helps to control diseases and insects in all crops.

(Table 19:5)

Diseases	Description and Damage done	Suggested Control
Bacterial Wilt	Plants stunted and wilt despite regular watering of crop. Slimy, yellow substance foam from stalk when cut.	Plant resistant varieties control flea beetles with Sevin, Malathion, Dipterex
Smut	Large white galls which later turn black, burst and releases spores which spread through the field. May be found on stalks and tassels, but mostly the ears.	Crop Rotation Remove affected plants and bury them as soon as discovered.
Stalk Rot. Mosaic Virus) Rust)	Foliage wilt, due to rotting of stalk. Plant later falls over at point where stalk is rotting. See Beans p	Crop Rotation, Bury or burn affected plants See Beans Table 18:9
INSECTS		
Corn Earworm	Caterpillars with brownish and greenish colours, sizes from about 3/4 inch (cm) to 1½ inch. Feed on corn ears, living under the husk, and feeding from top of ears into the ear.	Use Sevin (carbaryl) Rothane (TDE) Cryolite spray silks as soon as over 50% plants produce silks. Repeat spraying twice, but not less than once each week
Corn-stalk borer.	Whitish caterpillars with black spots, bore into stalks.	Dust or spray with same chemicals used to control earworms.

Insects(contd.)	Description & Damage	Suggested Control
Army-worm	Black to grayish worms, usually growing to bigger size than the earworm. Feed on leaves, especially in the bud ("heart leaves"), throughout life of plant. Later attack tassel and ears. Soft mossy brownish materials deposited as worms feed.	Systemic spray (eg perfecthion) can be used if crop affected early stop use before tasselling. Sprays similar to above start control at first sign of attack, special effort to spray in bud.
Cutworms	Young plants cut down near ground level by dark coloured worms living in the soil.	Apply dieldrin or Chlordane bait to soil at planting time.
Wireworm.	Hard, shiny worms feed on roots and germinating seeds	
Aphids	Very small insects, (/ 1/8 inch) greenish in colour, soft bodied forming cluster of several inches on leaves and tassels.	Dust or spray with malathion or any contact or contact-gut chemical
Note:	1. When the corn is ready for reaping, if birds start to feed on the crop, it will be necessary to make M's 'bare-scows'. 2. Remember that the corn plant or parts of it should not be fed to livestock until the residual effect of the spray wears off. This is usually 1 week for most sprays. This is especially important for small farmers who cut out insect damaged and weak plants to feed animals during the crop.	

Weed control.

Weeding of corn does not present as great a problem as many other vegetables. Seedlings are fairly big, and the crop grows quickly compared to say, onion, cabbage etc. Sometimes, a single weeding or two operations should be good enough. The methods:-

i. Manual weed control - ie. using hand tools

ii. Mechanical weeding - ie using tractor and implements.

As mentioned earlier, it may be necessary to mould the corn, and this operation is best done at the same time as weeding the crop. This is more convenient and less expensive. Also chop out suckers or tillers, as they may reduce yields.

iii. Chemical control. ie. using weedicides on the field.

Mulching and Inter-tillage

Same as for beans.

(19.6) Chemical weed control in corn.

Weedicide	Time to Apply & wks of effective control	Weeds Controlled	Approx Quantity per. 10 galls water (H.V)	Remarks
2,4-D (Weedone)	About 3 weeks after planting when crop over 2 feet (cm) tall Control 6-12 weeks.	Broad-leaf weeds.	2/3 pint (0.33 L)	Avoid spraying on corn plants but will not damage lower 1 foot of stalk.
Dalapon	Same as above	Grasses	1 lb (0. 5 kg)	Kills crop if sprayed directly on crop or in water coming in contact with crop.
Gesaprim (Atrozine)	After planting, but before corn germinates control 8-16 weeks.	Delay emergence of grases and broad-leaf weeds and kills young weeds.	3/4 lb. (360 cm)	Should not be used with mixed cropping or if different crop to follow corn on same spot
Gramoxone	Before planting if weeding required then, or at any-time later control 6-12 weeks.	Nearly all weeds.	½ pint (0.25L)	Use spray shield to avoid contact with corn

Reaping

Green corn is usually ready for reaping in the 11th to 12th week. The grains are fairly well developed in size, but soft and can be easily cut with the finger nail. It is best to sample the field to get a very good idea of the size and appearance of the fit green corn. Reap a few and husk them or merely tear away a portion of the husk of the ears without removing it from the plant. If those sampled are not mature, they can remain on the plant for another week.

'Dry' corn can be reaped anytime after about 14 weeks. Mature ears can be removed and stored until they are dry. If pests, like rats and birds are not a problem, the corn can remain on the stalk if the whether is dry. This reduce the need for storage spaces. If birds are a problem, it is best to make 'scare-crows' to keep them away. (use cloth and stuff images in the shape of a man. Tie them to a pole about 10 feet tall and place them at different points in the field). Sometimes a brightly coloured bit of cloth tied to the pole can do the trick. As the wind blows, it keeps away the birds. Rats can be controlled by using baits.

A grower who has to reap dry corn every season should try to get a sheller to remove the grains from the cob of the corn. This equipment, even a small hand-operated one, reduces the time and labour needed to shell corn by hand.

Yields to expect.

	Av. yield	Good yield
Green corn	1 lb each- with husk -	1½ lb
	(500gm) " " "	(600gm)
	3/5 lb or ozs-without husk-	3/4 lb.
	(300 gm) husk " "	(360 gm)
	2000 ears -	3,000
Dry corn	200 lbs grain per sq. chain -	300 lbs
	100 kg grains per 400 sq. m -	150 kg.

Records.

Keep records of production, price, expenses etc. and whatever notes taken during the crop which might be useful for a better performance of later crops.

B. OKRA

Names: Okra, Lady Finger, Gombo or Bele

Family. Malvaceae

1. Uses - Young pods cooked and eaten with meat. Also used to thicken soup stew.

(19:7)

Value for	Water (ml)	Protein (gm)	Carbo (gm)	Ca (mg)	Iron (mg)	Vit.A (I.U)	Vit.B (mg)	Vit.C (mg)	Vit (mg)	d Fibre gm
3.5 ozs. (100gm)	90	2.0	6.0	70.0	1.0	150	0.1	25	0.1	1.0

Note: Most vegetables except for the grains - legumes and corn, have a very small amount of fat. Most are less than 2 gms per 100gm of the part eaten.

SEASONAL REQUIREMENTS -

Okra is a warm season crop which does best when grown under conditions of 70°F to 85°F (21°-30°C). It is a fairly hardy crop which can grow well on low lands and in hilly areas up to 3,000 ft (900 m) and under dry and wet seasons. Naturally, like most crops, it does best between these extremes, and a good shower sufficient to wet the root zone once each week or even every two weeks will give good results.

(19:8)

Variety	Plant description	Approx. wks to 1st reap & to final		Fruit/(pod) description	Remarks.
Clemson Spineless	Plant grows erect to height of about 5 ft (1.5m) when mature foliage green with large	8-9	18	Pods app. 6"x 3/4 (cm) matute angular spineless and green.Pod app. 8"xl round,smooth dark green, containing about 70-80 seeds.	All varieties should be reaped before pods reach maturity ie. about 2 ins (cm) less than length when mature
Emerald green		8-9	18		
Dyold coast	Dwarf variety max. 4 ft when mature	7	20	Pod app. 6"x 1" round, pole green	Heat tolerant Crop continue bearing over 6 months, but production usually falls off after 5 months
Louisiana) green velvet)	Pl. ht. app. 6 ft (2m)	9	20		
Perkins spineless	Dwarf variety 3 ft. mature	7	18	Pods app. 7"x3/4 very uniform, smooth	
Perkins Mommoth	Taller variety	8-9	20		
White velvet		9	20	Fruits white with thick walls	Gives very heavy yields.
Pusa Sawani	Heavy bearer, resistant to yellow-vein mosaic. This variety not widely grown in the Caribbean, but as a well-known variety in India.				

Growth habit

(19:9) Growth habit of okra (Emerald green)

Time from Planting	Approx. ht* of stem.	Approx ht. added	Crop Description
2 wks	4 ins (10cm)	4" (10cm)	Emergence about 8 days. Plant with about 4 leaves. Main root about 3" (cm) deep.
4"	6-8" (15-20cm)	3" (7cm)	Fairly slow growth
6"	12-15" (30-38cm)	7" (NPK) (18cm)	Plants bearing unopened flowers, or flowers opened in about 25% plants.
8	18-22" (45-55cm)	7" (18cm)	Very rapid flowering and fruiting. Pods at different stages of development. Ready for 1st. reaping.
10	24-30" (60-75cm)	10" (NPK) * (25cm)	Developed leaves 10" long x 12" at widest point Stem ½ to 3/4" in diameter
12	3-3½ft (90-100cm)	10" (25cm)	Flowering and fruiting continues well developed main root about 1 ft long (30cm)
12-16 (NPK) *	Crop continue steady growth, and reaches maturity and height of about 5 ft (1.5 m) very heavy bearing during this period but by the 5th month, yields and quality of pods becomes poorer		

* Stem height from ground level to terminal bud.

Okra does best on slightly acid to alkaline soil (pH 6.0 to 8.0). Liming should be done if the soil is too acid, while acidic fertilizers and sulphur can increase the acidity where the soil is too sweet. Use about 200 to 400 lbs (100-200 kg) lime (CaO) on very acid soils OR between 300 and 500 lbs (150-250 kg) Amonium nitrate or amonium phosphate per. sq. chain. 2/3 These quanities of urea or sulphate of amonia may be used instead. These should be applied in 3 to 4 applications throughout the year.

Applying organic manure

Apply up to 1 ton of manure per square chn. (1000 kg/400 sq m) as available throughout the year.

Fertilizer and planting populations

General recommendations are:-

Pl. population approx. 1200 plants per sq. chn
Pl. distance approx. 30"x18" or 75 x 45 cm

It is very important not to plant the crop less than about 18 ins apart except dwarf varieties. Over-crowding resulting in rapid stem growth, slender plants and poor yields. But worse, it is extremely difficult to reap even this poor yield since the fine course spines on the leaves makes reaping very uncomfortable even wearing tall-sleved shirt or blouse.

Fertilizer grade approx. NPK/8-12-8
at a rate of approx. 30 lbs per sq. chn (15kg/400 sq. m).

(19:10) Suggested fertilizer rates and plant pop^{n} on different soil NPK levels

population → pl. distance →	Low pop^{n} app. 900 pl. dist. app. 36" x21" (90x52cm)	Med pop^{n} app. 1200 pl. dist app. 30x 18" (75x45)	High pop^{n} app. 1700. Pl. dist app.21" x18" (52x45)
Fertilizer rates	These almost the same as for corn (see Table 19 4)		
No. of applications.	Make 4 applications at planting, 6th and 10th and 14th in the crop since okra is a long duration vegetable		

See recommendations under (18:6)

Plant element deficiencies.

Table 18:8 can be useful to identify and treat deficiencies of plant nutrients in okra. Special attention should be paid to phosphorous deficiency and potassium to a lesser extent. These cause the pods to grow shorter than usual and to become curled at the tips, twisted and become tough long before they are mature. As the plant gets older, this condition gets worse with the entire pod becoming deformed within a week after the petal is shed and the fruit begins to develop.

Other nutrient hunger, most noted are Calcium, Magnesium and Iron which affect leaf growth. The grower must be careful that these signs are not due to a virus mosaic disease. The disease usually starts on a few plants and spreads even when elements believed to be deficient are applied. The deficiency usually appears more widespread from the start and can be corrected.

Buying seeds.

Okra has medium size seeds, smaller than beans and corn, but larger than cabbage and tomato. (Size app 3/16"xl/8 xl/8, greyish and slightly hairy)

No. of seeds per oz. approx. 500
The quantity of good seeds (%G/ 50) needed for direct planting are:-

low pop^{n}:	approx.	2 ozs per sq. chn (60 gm/400 sq. m)
med pop^{n}	"	4 ozs per sq. chn (120 gm/ ")
high pop^{n}:	"	6 ozs per sq. chn (180 gm/ ")

Land preparation and planting

Land preparation basically the same as beans and corn. If a germination test is carried out and seeds are over 90% viable, one or 2 seeds per hole may be planted to get the same number of plants. But if it is below this, it is best to plant 2 and 3 seeds, then later thin to 1 or 2 plants per hole as required.

Irrigation and drainage

Similar to beans, but the crop is more tolerant to dry conditions.

Diseases - Okra is hardly affected by diseases in the dryer months or with proper irrigation. When affected, the main enemies are:-

1. Southern blight)
2. Leaf spot fungus)
3. Fusarium wilt.)

Crop rotation is the main method of control. Do not follow okra,with especially bean or peas and visa versa since they are all susceptible to root-knot nematodes can rotate with cabbage family, beet and carrots. Fungicides like Dithane can be tried for controlling (2) and (3).

Leaf spot fungus: Circular spots, light green with brown margins on leaves. Leaves will later become dry and fall.

Fusarium wilt: Ripening (yellowing) of leaves starting from lower leaves. Stem usually becomes darker in colour as wood beneath green tissue of stem turns brown. Leaves ripe, wilt and fall.

Insects.

Pink Bollworm: pinkish worms boring pods.

Green stinkbug: 3/4" long x ½" green sucking insect, shaped like a shield, feeds on juice from leaves and fruits.

Both can be controlled by Malathion, Sevin or any contact and or gut insecticide.

Other pests affecting okra are:-

Corn earworm)
Leaf beetles) Control same as in beans.
Leaf miners) See Table 18:9.
Aphid)
Thrips)

Note - Curling of fruits may be due to nutrient deficiency. But sometimes, the small sucking insects form a chester and feed on one side of the fruit. This cause the fruits to curl and hide the insects.

Weed control

Manual, mechanical and or chemical weeding can be used in okra. The two chemicals recommended are Dacthal and Dymid at the rate of 3/4 lbs (360 gm) in 10 galls (40L) water for high volume spraying or about 2½ lbs (1¼ kg) for L. V spraying. These are pre-emergent sprays. Grammoxone and round-up (glyphosphate) can be used for post-em.

Reaping.

This is done by cutting the stalk that joins the pods to the stem. These pods develop quite rapidly, reaching a length of 5 to 6 inches in less than a week after the petal falls off. Reaping has to be done every 3 or 4 days when the tips of the pods will snap easily. When these tips will bend without breaking, the pod is getting mature and fibrous.

Yields to expect.	Av. yield	Good yield
	1 ounce per pod	1½ oz (not mature)
	30 gm " " "	45 gm
	500 lb per sq. chn.	700 lbs
	250 kg per 400 sq. m	350 kg.

20A. THE CUCUMBER FAMILY

The crops which will be dealt with in this section are called cucurbits. They all belong to the same family cucurbitaceae or the cucumber family .

(20:1)

Crops	Other names	Uses
Cucumber		Fruits eaten raw, or steamed, fresh or puckled.
Cho-cho	Clayote, choko, sou-sou	Fruits sliced and cooked.
Pumpkin		)Young fruits can be puckled)eaten raw or steamed.)Mature fruits properly baked)or cooked before eating
Squash Muskmellon Watermellon	Chinese pumpkin, marrow Cantaloupe Mellon, Sweet mellon, Egusi	Inside of mature fruits eaten raw. Sweet with nice flavour seeds roasted after soaking in salt water

The nutritional values given below are for 3.5 ozs (100gm) of mature fruit

Table (20:2)

Food Value	Calories	Water (ml)	Prot (gm)	Carboh. (gm)	Fibre. (gm)	Ca (mg)	Iron (mg)	VitA I.U	Vit B (mg)	Vit C (mg)
Cucumber	14	96	0.6	2.0	0.5	15	0.3	neg-	0.04	10
Cho-cho	n.a	92	0.8	6.0	0.6	10.0	0.4	lig-	0.02	20
Pumpkin	n.a	90	1.0	8.0	0.5	20.0	0.8	350	0.05	15
Watermellon	33	94	0.4	5.0	0.1	5.0	0.3	30	0.02	5

Seasonal Requirement

The members of the cucumber family are all warm season crops (60 to 85°F or 16°-30°C) except for the cho-cho which does best under cooler conditions, not exceeding 75°F (24°C). These crops will do well at almost anytime of the year that sufficient rainfall or irrigation water is around.

(20:3)

Crops & varieties	Plant description	Approx wks to 1st reap & final		Fruit description	Remarks.
Cucumber					
Ashley	Vine branches near root, trail to length of app. 7 ft (2m) at maturity leaves and stem bear small spines.	7-8	12	Cylindrical Fruits app. 8x2, dark green skin with warts bearing small spines Slightly pointed at blossom end	Patches of grey along length of fruit, but differ in size in different varieties of cucumber.
Hybrid Ashley	More vigorous growth and heavier bearer.	7	10	Fruits app. 8½ x 2½" (app. 22 x 6cm)	Resistant to Downy mildew.
Gemini (hybrid)	Very vigorous plant	8-9	14-16	Fruits not tapered (app. 8x2)(app. 20x5cm)	Resistant to scab and tolerant to mildew, mosaic, scab and anthracnose
Long green		8-9	12-14	Fruit app. 10"x 2½"	
Marketer		8-9	12-14	Fruit app. 8"x 2" (20x5cm)	
Polomar				Fruit app. 9"x2½ wt app.2 lbs	Resistant to Downy mildew
Poinsett				Fruit app.7x2 (18-5cm)	Tolerant to many diseases
Straight-8		7-8	12	Fruit app. 8x2, cylindrical with rounded ends.	
Model) Pioneer) SMR) Varieties)	Mostly used for pickling Vines tend to be shorter and crop mature earlier	6-8	10-12	Most varieties bear fruits app. 6"x2½	Resistant and tolerant to different diseases.

Contd.

Colorado) Palmetto Shamrock	Generally vigorous vines frowing up to 10 ft (3m)	8-10	12-14	Some varieties of cucumber can produce fruits nearly 12"x3" with wt app. 3 lbs (1½kg) of fruit is allowed to grow for about 3 wks. eg. Ashley Palomar	These 4 varieties suitable to wide range of climatic conditions
Cho-cho					
Local varieties of 2 main types -green flesh - white flesh	Vines trail or climb to over 25ft. Mature vines 16-20 app. 1' near root to app. 3/8" mostly Leaves similar to cucumber, app. 6" x 4" or 15x 10cm)		Bear for 3 to 4 mths, each yr. Plant life 3 to 4 yrs.	Pear shaped, ridged, dark green to cream app. 5"x2½, with one large flat seed. Skin smooth to very prickly. Wt. ½ lb. to 1 lb. (120-500gm)	If crop is not cut down after the first year it will continue growth and bear for wall for 2 more years. (perennial crop)
Pumpkin					
Cushaw	Vines trail or climb to over 15 ft.			Smooth, ridged, large green fruits with	Pumpkins also called West Indian squash or "calabazas"
Japanese	Mature vines 12-16 app. 1' at root and app. ½' to 5/8 throughout mature leaves hairy, app. 10"x14" (25x35cm)		20-26	mottling and patches of white flattened heart shape with thick corky stalk (penduncle) attaching fruit to stem	Pumpkins usually are the varieties bearing bigger fruits, over 5 lbs. All fruits have yellow flesh when mature.

Contd.

	Large yellow flowers		Size app. 12" to 15"x9 to 12" Wt. app. 6 to 10 lbs.	
Large cheese & Dickinson			Creamy coloured fruits of different shapes.	
Warted Hubbard	Similar to above	14	Fruits have thick rough skin with warts colours from light to green, solid colour or mottled.	
Connection field			Yellow oblong fruit flattened at both ends.	
Pink Banana			Very outstanding variety. Takes about 14 to 16 weeks to maturity, fruits cylindrical and pointed (banana -shaped), approx. 18"x6" and weighing about 10 lbs at maturity skin (or rind) very smooth, thin and pink in colour.	

Crop & varieties contd.	Plant description	Approx. wks to 1st reap & final		Fruit description	Remarks
Squash Cocozelle	Buston variety does not have a vine, produce fruits attached to short stem app 6" (app. 15 cm) leaves similar in shape etc. to pumpkins, but have longer stalks.	7-8	10-12	Mature fruits cylindrical app. 12"-15" x 3"-4" dark green skin with yellowish stripes and whitish greenish flesh.	Like cucumber fruits reaped before maturity about stage when seeds formed but still soft. eg. 8"x2½.
Dixie	Bush variety	6-7		Crook-necked shape at stem end, light yellow rind, whitish flesh with sweet taste.	Dixie is hybrid development and have many plant and fruit features of summer crook-neck.
Cozelle	Bush variety	6-7	8-10	Mature fruits app 8"x3" Dark green rind with light shapes.	Hybrid variety developed from cocozelle
Summer crook-neck	Bush variety	7-8		Size 9"x3" mature reaped app. 6" long.	

Crop & Varieties Contd.	Plant description	Approx. wks to 1st reap & final		Fruit description	Remarks
Marrow Zucchini)	Both bush varieties				
Butternut	Vine grows similar to pumpkin app. 8-10 ft. or 2½-3m.	10-12	16	Bell-shaped creamish rind and yellow flesh, sweetish size app. 10x 5" wt. app. 3 lbs or 1.5 kg.	
Table Queen				Smaller fruits.	
Muskmellon					
Hale's best	Generally bigger than cucumber, smaller than pumpkin, stem, leaves vines etc.	12-14	16-18	Fruits rounded to oval skin rough netted light green and white. Flesh, yellow sweet, smaller seeds than pumpkin. Size 6"x5" (15-12 cm) Wt. 3-4 lbs (1½-2kg)	There are 2 or 3 different stories of this variety with different fruit size and time to maturity
Honey Dew)	Main difference	15-16		Rind smooth	
Edisto)	in size and	12-14			Edisto is tolerant
Smiths)	shape of leaves				or resistant to
Perfect)					mildew and leaf spot diseases.

Contd.

Water-mellon Charleston Gray	Vine round, hairy, app. ½' diam. (1 cm) near root and 3/8" a-long most of its length Trails for app. 10 ft. Leaves app. 6" long (15cm) light green and hairy.	12-14	16-18	Oblong fruit, tough pale green skin with dark green veins. Flesh red and sweet. Seeds in rows in flesh. Size app. 24" x12 wt. app. 15 to 25 lbs.	Resistant to anthracnose and fusarium wilt.
Blackstone	Similar to above.	12-14		Round to Ovals fruit, dark green rind. Wt. 20 to 30 lbs. or app. 10-15 kg.	

Other varieties.

Congo - Oblong shape, dark green skin, bigger fruits than Charleston Gray.

Graybelle - Seedless and seeded varieties,oval to oblong, grey rind.

Blue Ribbon- Fruit have distinct dark green alternating with light green stripes, long cylindrical, weight average.

Sugar-baby - Fruits small rounded with dark green skin. Early maturity (app. 10-11 weeks) fruits about 7 to 10 lbs or 3.5 to 5 kg.

Dixie Queen)
Florida Giant)
(or Black Diamond) Differences in fruit colour, size, days to harvesting
Jubilee) etc.
Tom Watson)

Note All cucurbits bear male and female flowers on the same stem and cross-pollination occurs between different plants. Single plant in back-yard garden will reduce space occupied by these crops, but poor bearing can be expected from less than 3 or more plants.

Growth habit.

The growth habit of the different cucurbits follow basically the same pattern except for the bush varieties, which happen to be mainly a few squashes. The habit of cucumber will be used to illustrate the pattern of growth of the vine crops.

(20:4) Growing habit of cucumber (Polomar)

Time from planting	App. length* of stem	app. length added	Crop Description
2 wks.	4" (10 cm)	4 ins. (10 cm)	Emergence 4 to 7 days (other cucurbits take up to app. 12 days) Seeding bear 4 to 6 true leaves.
4 wks.	9"-12" (22-30cm)	7" (18cm)	About 10 true leaves, with stem approx. ½' diam. Branching may occur near to root, vine having 2 to 5 branches on each plant trailing just beginning
6 wks	4 to 5 ft (1.2-1.5)	3½ft (NPK)* (1 m)	Plant trailing, flowering and early fruiting. Fruits from 1' to 3" long, but few may be ready for reaping 7"x2' (All cucurbit crops bear yellow flowers with 5x3' of pumpkin to 3/4x½ of mellons)
8"	5½-6½ft (1.6-2m)	2½ft (75cm)	Reaping commenced from 7th week. Fruits average ½ to 1 lb (¼-½ kg). Flowering continues
10 wks	6½-7ft (2m-2.1m)	9" (22cm)	Reaping should be at peak with fruits growing app. 6 ins (15cm) within a week from fall of petals
12"	7 ft (2.1m)	-	Crop dying down. Leaves reaping then wilt.

* Measurement of stem from the root to the tip of the terminal bud for 3 longest vines on each plant. The longest vines may grow up to about 10 ft (3 metres) at maturity.

Crop pH requirement

(1)	Cucumber) Pumpkin) Squash	Acid to neutral soils pH 5.5 to 7.0
(2)	Cho-cho) Watermellon)	Very Acid to neutral soils pH 5.0 to 7.0
(3)	Muskmellon)	Acid to Alkaline pH 6.0 to 8.0

See beans for correcting soil pH to grow crops (1) and (2) and okra for growing muskmellon.

Applying organic manure.

Apply up to 1 ton per sq. chn or 1000 kg. per 400 sq. m. throughout the year. The manure would have to be added before each crop is planted since training of vines, if not grown on stakes, will create difficulties. The amount of manure applied before each planting will depend on what is available, but if this is not a problem, the same amount (eg 10 hbs per sq. chn before each crop).

Fertilizer and plant populations

General recommendations are:-

Cucumber

Plant population approx. 1500 pl. per sq. chn at pl. distant 36"x 12" (2 seeds at 36 x 24") (OR pl. pop^{n} approx. 1000 pl. per 400 sq. m at pl. dist. 90x30 cm (2 seeds at 90 x 60 cm)
Fertilizer grade approx NPK/12-12-16 at approx 40 lbs per sq. chn or approx 20 kg per 400 sq. metre. Apply 1/3 at planting and 2/3 in the 5th week.

Pl. pop^{n} approx. 200 pl./sq. chn at pl. dist. 60" x 36" or 1.5 x 1 m
OR
Fertilizer grade approx NPK/12-12-12- at 60 lbs / sq. chn or 30 kg/ 400 sq. m each Apply 10 lbs fertilizer (5 kgm) every 2 months.

Muskmellon and watermellon

Pl. pop^{n} approx 1000 pl. per sq. chn at 36" x 18 (2 seeds at 36"x36") OR pop^{n} approx. 1000 pl. per 400 sq. m. at 1 m x ½ m (seeds at 1 x 1m). Fertilizer grade approx. NPK/12-12-16 at 50 lbs / sq. chn or 25 kg/ 400 sq. m. Apply 1/3 at planting and 2/3 about 6 weeks, around the time that trailing begins. Although mellons and pumpkins are medium duration crops, one has to make only 2 applications since fertilizer application after trailing begins can damage vines.

Squash

Pl. pop^{n} approx 1000 pl. / sq. chn at pl. dist. 36"x18" or pop^{n} about 1000 pl 400 sq. m at 1 x½ metre. Fertilizer grade approx. 8-12-12 at 40 lbs per sq. chn or 20 lbs / 400 sq. m.

Pumpkin

Pl. pop^{n} approx 550 pl. / sq. chn at pl. dist 48 x 24 or 2 seeds at 48x48. Fertilizer grade approx. NPK/16-16-16 at 60 lbs per sq. chn.

See Appendix
Table 12:3) for different population levels, (10:10) for crop NPK requirement and (10:13b) for suggested rates and (10:13a) for adjusting grades.

Method of applying fertilizer

With cucurbits broadcasting of fertilizers should be avoided. The fertilizer should be spread as a circular band about 6 inches around the hole or the root after the crop is planted. It is good if about a quarter of this amount is put in the holes but the fertilizer should

be covered with soil to avoid the seed or young roots touching the material before it is dissolved. Because the plants are so widely planted, the fertilizer is not best used by the plant when scattered over the field.

Buying seeds and planting

Cucumber has large seeds size approx ¼ x 1/8".Seeds are flat,smooth and creamish colour, roundish at one end and pointed at the 'eye' Approx. no.of seeds : 1000 per oz.

The quantity of good seeds (% G > 80) needed for 1500 plants per sq. chn, approx 1½ lbs or 700 gm / 400 sq. m Seeds planted about 1½ inch deep (4cm) on banks, in furrows or in hills depending on soil and water conditions.

Cho-cho is grown mainly by planting a sprouting fruit. A big seed is borne in each mature fruit, which if put in a damp cool place or covered for about a month, will send out a small shoot and roots.

The fruit can be planted with the large end tilted downwards. 2 to 3" of soil should be used to cover the fruit depending on how much water the soil can hold. Since the crop does best under cool conditions, special care should be taken to plant the seed and avoid rotting.

Pumpkin and squash have larger seeds than cucumber. These seeds are similar in colour and shape, but not as smooth Seed size approx. 3/8"x½' Approx 100 seeds per oz for pumpkin and about 300 for squash. Plant on beds, or in hills (About ¼ to ½ lb seeds per sq. chn reqd.) Where a small plot of say, less than 1 acre or with seeds which are less than 80% viable, plant 3 seeds per hole and thin down to the 2 most vigorous seedlings if necessary. This applies to all cucurbits except the chayote.

Melons. Seeds of watermellon and muskmellon are about the same size or a little smaller than pumpkin seeds. Most are dark brown mottled with black, creamish or some mixture of cream and dark brown in parts. No. of seeds approx 250 per oz or 80 per gm. Amt. required for planting 1 sq. chain approx 6 ozs (180gm/400 sq. m)

Seeds should be planted in furrow under dryer soil conditions and in holes on beds or in hills under wet soil and rainy weather conditions.

Remember that for most crops, except for hybrid varieties, it is quite safe to take seeds from healthy ripe fruits, treat them with a mixture of insecticides and fungicide, and dry them for planting.

Land preparation, drainage and irrigation.

These are done basically the same as in other vegetable crops dealt with before. Flood irrigation creates special difficulties after the crop begins to trail. Vines block the furrows and may make the flow of water to certain parts of the field impossible. Also, diseases can be spread more easily by the water than in the case of erect crops.

Drainage has to be very good since poor drainage will encourage rotting of fruits which lay on the ground.

Remember that sticks and or wire will have to be used to make a trellis if the crop is not to be grown on the ground. Cho-cho especially needs this. The main advantage of a trellis is that because the fruits are not resting on the ground, there tends to be less problem with fruit rots. It also allows sunlight to reach the leaves of the plants more effectively. Fruits also tend to hang down and are easily reaped where square or round wire is used to make the trellis like a shed with the wire on top. If small wires, like 6"x6 ins square mesh is used, the leaves will trap the fruits on top. But where the holes in the wire is big enough, 1 to 2 ft (30-60cm) across, fruits will hang down and be easily reaped.

Wood and bamboo can also be used to make this kind of trellis. These materials are less expensive than wire, but rot before the end of the crop life .

Nutrient deficiency

It is best to read over the signs of nutrient hunger and suggested treatments given for beans.

Nutrient deficiency generally cause reduced growth and bearing. An element like phosphorous can cause all kinds of distortion in size and shape of fruits when it is in short supply. Fruits of cucumber become short, pointed at one or both ends, twisted or curled when affected by these deficiencies.

Blossom-end rot is a dreadful disease affecting mainly watermellon (and tomato) and is caused to a large extent from calcium deficiency. It is very difficult to control once observed affecting a crop, but can be applied to reduce it in later crops. This disease usually reduce yields by 25 to 75%.

Symptoms - The blossom end of the fruit becomes pointed. It then become soft and starts rotting until a large part or the entire fruit becomes a black mass.

Control - (1) Avoid planting melon on very acid soils where drainage is poor, and water likely to be limited at any stage of the crop.

(2) Use tolerant and resistant varieties.

(3) Add agricultural limestone ($CaCO_3$) if liming is needed.

(4) Use about 4 lbs (2kg) of calcium chloride mixed in 100 gallons (app. 400 litres) of water best before or at the first sign of the disease.

(5) Make sure that the crop gets a regular supply of water for the entire crop, but particularly at flowering and early fruiting.

These are very important since the disease is caused by the plant not being able to absorb enough Ca. It may be present in the soil but if water is not available, the plants just cant absorb the element.

Disease and pest control

(20:5)

Diseases	Symptoms and control
Anthrocnose)	Similar to beans.
Damping-off)	See Table 18:9
Mosaic	
Wilt	Similar to corn.
Blossom-end rot	See nutrient deficiency
Insects	
Cucumber beetle	Small black beetles with yellow stripes feeding on foliage) Control with most effective control/gut insecticide eg. Sevin, malathion
Melonworm	Pale green caterpillars with white stripes approx. 1 inch long feed on foliage and fruits.
Pickleworm	Creamish to pale green worms with black spots bore into flowers and fruits.
Squash bug	Stink bugs, shield-shaped and brownish, suck plants.
Other pests	Like leaf-beetles, aphids, cutworms leaf miners crickets and grasshoppers attack crops See Beans (Table 18:9).

Weed control.

Most of the weeding in cucumbers have to be done before the crop starts trailing. Some amount of hand weeding can be done later, but this takes a lot of time to avoid damage to vines, flowers and fruits.

Contact weedicides like grammoxone, Reglone and Glyphosate can be used before trailing, but they must not be sprayed on the crop.

Pre-em. weedicides, Dacthal and Dymid mixture at the rate of 2 ozs per gallon (60gm in 4 litres) Alanap can also be used at about ½ pint in 5 gallons or ½ l. in 20 litres of water. Remember that it is best to follow the manufacturers recommendation for mixing and using all agricultural chemicals.

Mulching

This helps the quality of cucurbit fruits a lot. See comments under beans.

Reaping

Fruits like cucumber which are reaped before they are mature, are harvested mainly according to size and appearance. But for Cucurbits reaped when fruits are mature, the following feature may be helpful to determine ripeness.

1. Size and appearance of fruits. These have been dealt with for different varieties. This is related to the length of time the crop and fruits are supposed to take to mature.

2. Ripe fruits give a muffled sound when the back of a finger is used to thump or knock the fruit. Before they are ripe, they give a louder hollowish sound.

3. Finally, check the tendril (or"cork-skrew") where the fruit stalk (peduncle) is attached to the stem. If it is dry, the fruit is usually ripe.

Great care should be taken in removing fruits from the field whether using box, wheel-burrow or tractor trailer. They should be carefully handled since if they drop damage will be done, the fruit might become useless.

All cucurbits are fairly perishable. They can be stored for up to a week under cool conditions. Longer storage require refrigriation. Mature pumpkin and squash will store for the longest period of up to a month under cool conditions without refrigeration.

Yields to expect

Crop	Average yield		Good yield
Cucumber	800 lbs per sq. chn	-	1200 lbs
	(400 kg per 400 sq. m	-	600 kg)
Melons	1000 lbs per sq. chn	-	1500 lbs
	(500 kg	-	750 kg)
Pumpkin	1100 lbs per sq. chn	-	1700 lbs
	(550 kg	-	850 kg)
Squash	900 lbs per sq. chn	-	1300 lbs

Keep records and notes of important observations production, prices, expenses, propt. etc.

20B. THE TOMATO FAMILY

In this section we will deal with the members of the tomato family which produce fruits used as vegetables. We should bear in mind that the flesh potato is also a member of this family, but will be discussed later under root vegetables. The crops belong to the family Solanaceae and are often called the Solans

(20:6)

Crops	Other names	Uses
Tomato	Salad	Fruits eaten raw or cooked in soup, meat etc.
Egg-plant	Garden-egg, Abergine Melongene, Brinjal	Young and mature fruits cooked and eaten in various dishes
Pepper		Eaten raw or cooked as seasoning for meat, other vegetables, soups etc.

Nutritional values for 3½ ozs (approx. 100 gms) are given below.

(Table 20: 7)

Crops & Food Values	Cal-ories	Water (ml)	Prot. (gm)	Carboh (gm)	Fibre (gm)	Ca (mg)	Iron mg	VitA I.U	VitB mg	VitC mg
Tomato	app. 20	94	1	4	0.6	5	0.4	app. 550	0.06	25
Egg plant	app. 240	93	1.0	4	1	10	1	ne-glig	0.05	15
Sweet pepper	app. 30	90	2.0	6	1	20	1	app. 500	0.06	app. 100

Seasonal requirements

The solans are all warm season crops doing best between 70° and 80°F (21°-27°C) although pepper. Although pepper and tomato can do just as well even down to 65°F (18°C). This condition requires the strickest disease control since damp conditions whether from rain, fog etc, tend to encourage more disease problems with these crops.

In rainy seasons, apart from diseases, the fruits of these crops especially, tomato hardly ripes, while in temperatures above the 80's °F, suffer from reduce yields due to poor flowering,

Selecting varieties

Tomato varieties fall into 3 main groups. These are:-

1. - Tall plants, reaching 4 to 7 ft (1½ - 2m) at maturity most varieties producing large fruits, / 2 x 2 ins (5 x 5 cm).

2. - Short or dwarf plants, growing to as much as 2½ ft (75 cm) at maturity. Most varieties produce small fruits / 2 x 1" (5x2½cm).

3. - Medium size plants reaching 2½ to 4 ft. at maturity, most varieties produce small fruits or medium size fruits app. 2"x1"-2"

(20:8)

Crops &	Plant description	Approx. wks to 1st reap & final.		Fruit description	Remarks
Tomato Manalucie	Tall plants, grass to about 5 ft. hairing stem app. 3/4 (app. 1½cm) near root, and ½".	12-4	16-18	3 to 5 fruits per bunch large globe shape fruits app. 3"x3" (7x7cm) green change to yellow then red when ripe. Smooth skin, slightly pegged appearance, red flesh	Both varieties resistant to fusarium wilt leaf spot and tolerant to early blight, blossom and rot and some nematodes.
Manapal	Throughout most of its length. Leaf green size app. 6"x4" made up of about 5 leaflets.	11-12	16	Manapal produce slightly smaller and earlier fruits.	More than(1)one variety.

(20:8 contd.)

Ace (vars.)	Tall plants	11-12	15		
Marion	"	11-13			
Marglobe	"				
Ox-heart	"	12-15		Oxheart fruit	
Homestead	"			heart shaped, up	
(vars)				to app. 4"x3"	
Pearson	"			Fruits globe	
				shaped but	
				slightly flattened	
Ponderosa	"	12-13		Fairly resistant	
				to fruit	
				crocking.	
Roma	Dwarf plant	9-10	12-14	Small, red plum	Resistant to
Red top	grows to a-			shape fruit	fusarium
	bout 2 ft.			app. 2"x1"	wilt.
Anahu	stem, leaf,				
	root etc.				
	similar to				
	manalucie				
Amateur				Other varieties	
Tecumish)	Dwarf			range from	
VF (vars)				orange to red	
				when ripe.	
Floradel	Medium height	10-12	14-16	Globe shaped,	Resistant to
	, grow to a-			medium size	wilt.
	bout 3 ft.			fruits app.	
	Stem, leaf, etc.			2"x2". About	
	similar to			5 fruits per	
	manalucie			bunch.	
Heinz (vars)	Medium size				
San Marz)					
ano)	Varieties				
Supermarket)					
Urbana					

The time to first harvest is from direct planting. With transplanting, the crop may be 2 to 4 weeks later.

Crop & Varieties	Plant description	Approx wks to 1st reap & final		Fruit description	Remarks
Garden-egg					
Black beauty	Woody, erect plant grows to ht app. 3 ft. Stem app. 1 inch near root and leaves app. 6"x5 (app.	11-13	6to* 12 mths for all		6 mths for one reaping, 12 months for 2 reapings
Long Purple	15x12cm) mature	10-12		Long fruit	Some varieties
Long Black	surfaces pow-			vars. can	a little ear-
Long green	dery. Main root			reach 9"-	lier
Long white	/ 12 ins (30cm)			12"x3"-5"	
Round purple				app. (23-30	
Rosita	Similar to above			x7-13cm)	
Puerto Rican Beauty	except some differences in plant height			Fruits smooth , skin co- lour accor- ding to name, flesh	
Matale				whitish	Resistant to
Kopek				Av. wt. app. ½-3/4 lb.	Bacterial wilt.
				Rosita- pinkish lo- ng fruits.	
Florida mkt.	Plant ht. app. 4 ft. or 1½m	12-15			

Contd.

Sweet pepper California* wonder(Vars) Yolo Wonder* (vars) Florida giant	Plants grow erect to 2-3 ft. Stem app½", and leaves app. 4"x3" (app. 10x7cm) dark green , smooth	12-14	4 mths	Large fruits app. 3"-4"x 2"-3" (Av. 8x5cm) Wt. 4-6 ozs. Divided into 4 pobes (C.Wonder) and 3 or 4 pobes or segments (Yole) smooth green skin, hollow segments bearing seeds inside.	Most of these varieties are resistant to tobacco mosaic. Most fruits green at maturity and red when ripe.
All-big Cubanella Chato Large Bell		10-12 10-12	4mths 4½mths	Approx 5"x3" Approx 5"x2" more pointed at blossom end.	
Hot pepper Scotch Bonnett Chilli(vars) Cayene Casabella Hungarian Wax Jalapeno	Plants erect, grow about 3 ft. in first year, up to 5 ft in 2nd or 3rd year More branching, and smaller leaves than sweet peppers	10-12	1,2or* 3 yrs	Small fruits * 1-2"x1"-1½" Many lobed, thinner wall than sweet peppers Fruits green when mature ripen white, yellow, purple or red according to variety	*Crop can be kept for 1 to 3 years depending on yield over period.

Some varieties of Cayene, Chilli and Hungarian Wax have much longer fruits than say, Scotch Bonnett. Sizes usually 4 to 5 inches (10 to 15 cm) long and 1 to 1½ across (3 to 5 cm) at its widest point.

Growth habit

The growth habits of the members of this family are not quite as close to each other as the Cucurbits. Most varieties of peppers and garden egg tend to come into bearing by around 3 months, they may produce two crops for the year for 2 or even 3 years depending on how the crop is maintained, climate etc.

On the other hand, tomato usually bears for one season and after 6 months at most, the crop is over.

The growing habit of Manalucie, will be used to show the pattern of most medium and tall varieties.

(20:9) Growth habit of Manalucie tomato

Time from planting	App. ht. of stem	Ht. added	Crop description
2 wks	4 ins	4" (10cm)	Emergence - 5 to 12 days. (Same for garden-egg,but more for peppers) Slender seeding with 4 to 6 true leaves.
4"	6-8ins	3" (7cm)	Plants ready for transplant at about end of 4th week. 4 to 6 well developed leaves, stem app. ¼ inch, main root app. 2½ ins deep.
6"	12-15	6" (15cm)	Plants tend to "lie down", weak succulent stems cannot bear up foliage. Flowering app. 25% of plants.
8	16-20	6 (15cm)	Flowering app. 100% plants, small yellow flowers app. ¼"x3/4" diam. (Peppers about same, but garden-egg have mostly big (1"x1½") purplish flowers). Fruiting app. 80% of plants.
10	24-30	8" (20cm)	Fruits in clusters, 2 to 5 each. Size app. 2"-3"x1½-2½". Stem app. ½ - 3/4" diam. bush foliage.
12	33"-36"	8" (20cm)	Fruits globe shaped app. 3"x3". Wt. 6-8 ozs. Crop ready for first reap. Fruits yellowish to red.
14-18	48"-60"	12-24" (30-60cm)	Flowering and reaping continues. Between 18-20 weeks most tomato plants begin to die back.

Note 1. Dwarf tomato fall off in bearing and die-back 12-14 weeks, sweet peppers about 5-6 months, while other peppers and garden-egg can bear for 1 to 3 or more seasons.

2. Under conditions of rich soil and adequate moisture, some varieties of tomato may produce 2 crops. The plants may start flowering again before reaping of one crop complete or branches near to the root produce a second set of flowers and fruits.

Crop pH needs

These Solans do best on acid to neutral soils (app. pH 5.5 to 7.0). For correcting soil reaction the farmer has to apply similar methods to that required for beans.

Adding organic manures. - Up to 1 ton per sq. chn. throughout the year for all crops.

Fertilizer and plant populations

Tomato Pl. pop^{n} app. 1400 pl. / sq. chn or 1400/400 sq. metre
pl. distant app. 30" x 15" (75x38 cm)

Only 1 plant should be grown in each hole, direct or transplanting. It is best to grow only one plant per hole for most heavy feeders and crops grown from transplants. The population of dwarf plants can be increased by 10% above that of tall plants for the first crop. The grower can then try to step up his population of dwarf or tall plants by another 5% in the next crop, and depending on this performance he should decide whether to go up by 5% in a later crop. Populations of dwarf plants should not exceed the population of the tall varieties, by more than 25% using same fertilizer grade, rates etc. Over this level, problems that go with over crowding usually start to show up. with nearly all vegetables.

General fertilizer recommendations for tomato:-

Tomato is a heavy feeder, its nutrient needs are high.

Fertilizer grade approx NPK/16-16-16
@ rate of 60 lbs per sq. chn (30kg/400 sq. m) Use about 20% less for dwarf varieties. Suggested fertilizer rates and plant populations and different soil nutrient levels.

Population ⟶ Pl. distance ⟶	Low pop^{n} app. 1000 app. 36"x18" (90x 45cm)	Med pop^{n} app. 1400 30"x15" (25x38 cm)	High pop^{n} app.2000 27"x12"(68x30)
Rates for)low soil NPK	80 lbs (40 kg)	90 lbs (45kg)	100lbs (50kg)
)Med soil NPK	50 lbs (25 kg)	60 lbs (30 kg)	70 " (35 kg)
)High soil NPK	40 " (20 kg	50 " (25 kg)	60 " (30 kg)

Notice that if tomato or other heavy feeders are not selling for a high price, it is not as profitable to produce it on poor soils since the fertilizer needs are so great and costly. A crop can take as much as 1 hb per sq chn. (50lbs/400 sq. m) on poor soil.

The same 16-16-16 fertilizer can be used on different soils, but adjusting the % of N, P or K according to the amount of each in the soil, may give better results. (See Table 18:6 under beans)

The fertilizer should be applied by broadcasting or better yet, by spreading it along the furrow or around the holes whether direct planting or transplanting of seedling will be done. Most varieties of tomato are of medium duration, since reaping is completed within 4 months. On clay and loam soils, 3 applications should be made as follows:-

¼ of total rate at planting or transplant
½ of total rate at about 6 weeks or when flowering begins
¼ of total rate at about 12 weeks.

On sandy soils, 4 applications should be done. These can be a quarter of the total amount at about 3-4 weeks apart.
OR approx. 1/5 at planting, 1/5 at 3-4 weeks, 2/5 at 6 - 8 weeks and 1/5 at about 12 weeks.

Dwarf vars. should get 2 applications 1/3 at planting and 2/3 at flowering on clay and loams. They should get 3 applications ¼, ½, ¼ at planting, 4th and 8th week.

Fertilizer and plant populations

Garden-egg and hot pepper

Plant population approx 1200 pl. per sq. chn @ pl. dist, 30"x18" (only 1 plant per hole) OR app. 1200 pl. per. 400 sq. m at dist. 75 x45 cm

Fertilizer grade app. NPK/12-16-12 @ app. 50 lbs per sq. chn in 6 months. Apply 10 lbs fertilizer (5 kg) every month.

Sweet pepper

Plant population approx. 2800 pl. /sq. chn @ pl. dist 24" x10 (only 1 plant per hole). Fertilizer grade NPK 8-20-8 @ 30 lbs per sq. chn in 6 months. Application same as dwarf varieties of tomato.

Nutrient hunger

The signs of these conditions and how to deal with them are similar to beans. See Table 18:8.

Buying seeds and planting

These 3 Solans have small seeds size approx 1/8"x1/8". Seeds are flat, light brownish, have a flattened globe shape and smooth except for tomato which is slightly hairy and lighter in weight.

Tomato

Approx no. of seeds 11,000 per oz or 11,000 per 30 gm, approx 400/gm
Quantity of good seeds (% Germination > 75) approx 1/3 oz per sq. chn or 10 gm/400 sq. m.

Garden egg

Approx no. of seeds 6,000 per oz or 200 per gm
Quantity of good seeds (> 60 % G) approx 3/4 oz per sq. chn. or 20 gm per 400 sq. m.

Pepper

Approx. no. of seeds: 4500 or 150 per gm.
Amount of good seeds (/ 55% G) approx 1½ oz per sq. chn. or 45 gm. per 400 sq. m.

Seeds can be planted directly in the field at not more than about 1 inch deep (/ 2 cm) where rainfall or irrigation provides enough moisture, and weeds etc will not be too much problem. Otherwise, the seeds are to be sown in a nursery, in shallow furrows about 6 ins (or 15 cm) apart, watered every day till emergence and every 2 days after for 3 to 4 weeks. Seedlings should be transplanted when they have about 4 to 6 developed leaves and between 4 to 6 ins (10-15 cm) tall. They should be 4 to 6 weeks old.

Note that seeds can be planted in peat pots and then planted in these pots in the ground. This is more expensive than sowing the seeds on the beds in the nursery.

With direct planting, a seed planter is best for these small seeds which have to be planted at over 6 ins (15 cms) apart in the row. The practice of mixing the seeds with sand is not recommended hire and is best used with crops, eg. root crops which are planted about 2 or 3 inches apart. If this method is used for the Solans or crops planted so far apart, much of the seeds will be wasted as they are most likely to be spaced too closely. However, if these seedlings can be transplanted elsewhere, the method might be tried. But, if the grower does not have a seed planter, it is best to sow in nursery and then transplant these crops.

Seedlings should be planted 2 to 3 inches deep, with deeper planting under dryer conditions.

Land preparation

Preparing the land irrigation and drainage are basically the same for most vegetables.

Irrigation

These crops are not as hardy as beans and are deep feeders. The root of the tall varieties of tomato may grow to more than 4 ft. (about 1⅓ m) This is also true for garden egg and peppers growing for 2 or more seasons. The dwarf vars and sweet peppers have shallower root systems of about 3 ft. deep (1 metre).

The very deep feeders like tomato have to get sufficient water almost every 5 days to properly wet the top 1 foot of the soil (near to field capacity) After flowering, the top 2 feet should be wet by rain or irrigation/about every 10 days. This is more water than required by any vegetable crop we have discussed before.

The crops with the shallower systems need water from rain and or irrigation at least once per week, and this should wet the top 1 foot (30 cm) to field capacity.

Pruning and staking

Tomato is one of the few crops that vegetable growers practise to prune. For many farmers, it is a tradition more than anything else. Pruning is done on medium and tall varieties, by cutting side branches as they appear, leaving only 1 or 2 main branches.

In some varieties, this practice may produce longer and more uniform fruits. But in most tomato crops, this practice does not cause increase in overall yields and in fact, may cause a reduction in yields. In addition, under damp conditions or in areas where diseases are serious, pruning may encourage certain diseases.

Staking of tomatoes are done as soon as the crop is well established 6 to 7 weeks and before it begins to flower. The stakes or other forms of support prevents the fruits from resting on the ground where they will more easily suffer fruit rot on wet soils or sun-burning and cracking on dry hot soil. Where mulching is done, this job is not needed and dwarf varieties are seldom staked. Like most other practices, the farmer has to sum up the costs in output and money of staking and pruning against the benefits to decide on whether or not these are needed.

In staking, do not tie the plants directly to the stakes since this will cause bruising of the stem as the wind blows. Disease may infect the damaged portion of the plant. The cord to the plant loosely and then tie the other end to the stake. Cord or wire can be used to make a trellis whirls can serve as a substitute for the stakes especially where stakes are limited.

Mulching can improve the yields and quality of tomato fruits considerably. Where mulch is used, there is absolutely no need for staking or making a trellis. See further notes under beans.

Disease and pest control

Tomato is attacked more seriously by a larger number of disease insects and nematodes than any other vegetable crop. The other members of the family are also affected by most of these same diseases and pests

(20:11)

Diseases	Symptoms and control
Anthacnose)	Similar to beans
Fruit rot)	See Table 18:9
Leaf spot)	
Mosaic	Mosaic sometimes does not affect the plant seriously, but has dread effect on fruits. The fruits may be smaller, having tough portions which appear yellowish while rest of fruit is red ripe. The stink-bug is the main carrier of this disease and controlling this insect, crop rotation, planting resistant varieties are the main ways of combatting this disease.
Scab -	Parts of fruits appear rough, corky especially in garden-egg. Plant resistant vars.
Black scarf	Portions of stem turn brown then black. Branches die-back produce many side-branches. Leaves start to droop, then start decaying on the plant. Rotate crops.
Blossom end rot)	Similar to watermellon

Contd.

Diseases	Symptoms and control
	Spraying for control of diseases is best started in the nursery. Apply fungicides at weekly or 2/ weekly intervals at most.
Pests	
Hornworm -	Big green caterpillars, grow to 3 ins long x ½ in (app. 7x1 cm), with small pointed and curved structure resembling horn on forehead. Very destructive especially to young stems and leaves. Control by hand-picking and spraying with gut/ contact insecticide eg. Sevin, Removing crop remains after harvesting from field or ploughing under these remains, help control this pest, very helpful for all pests and diseases.
Pinworm -	Very small worms app. ½'x1/16' attacking leaves and fruits. The larva hatch from eggs laid on leaves by a small grey moth. Caterpillars feed between leaf surface like leaf-miners, when young. Later they feed on the flowers, tie up the leaves with a gummy stuff, and tunnel into fruits leaving a small pin-hole on the surface. Control with phosphil, Dipterex or Lannate. Follow manufactures instruction especially with Lannate which is very toxic.
Other pests are:-	
Leaf miner, Aphids, Crickets, Beetles) Similar to Beans, and corn.	
Corn Earworm-(tomato only affected)	
Nematodes.)	

Weed control - Similar to okra. For unstaked tomatoes, weeding should be completed before the plants start to spread and flower, since weeding is difficult and damaging then.

Harvesting

Most varieties of the solans will be ready for reaping within 5 months and continue bearing for another 2 or 3 months. Hot pepper and garden-egg will produce several crops. Details for different varieties have been mentioned before. All of these crops are reaped when their fruits are mature and just beginning to ripe* or when ripe.

Generally, the fruits of tomato apart from their sizes, will now appear full changing colour from green to yellowish to red when ripe. This is also true for most varieties of pepper. Reaping usually done 2 to 3 times each week depending on how crop is bearing. Garden-egg is reaped mainly according to its size and appearance.

Yields to expect

Crop	Average yield		Good yield
Tomato (large vars)	1000 lbs per sq. chn	-	1500 lbs
	OR 500 kg per 400 sq. m	-	750 kg
Peppers (large vars)	400 lbs per sq. chn	-	500 lbs
	OR 200 kg		250 kg
Garden egg	800 lbs per sq. chn.	-	1000 lbs
	400 kg		500 kg.

* The term, "fruit turn" is used in Jamaica to describe this condition.

ROOTS AND TUBER VEGETABLES

Chapter 21

In chapter 21 and 22 we will discuss the root vegetables. (See note under Table 18:1) These crops will not be discussed in so much detail as with the fruit crops, since much of the general practices are done in almost the same way. It is advisable for the student to read and become familiar with the growing of at least one of the beans and corn to fully understand the background to much of the information which will be given for these root crops and later the leafy vegetable crops.

21A. ROOT

Common names: Beetroot, garden beet

Family: Chenopodiaceae

USES - Beet or beetroot as it is sometimes called is grown mainly for its swollen root. This can be cooked and used as a vegetable. It can also be grated and the juice sweetened into a tasty drink. The portion above the ground (top) can be cooked and eaten.

(21:1

Food value	Wt.	Calories	Prot (gm)	Ca (mgs)	Iron (mgs)	Vit A (I.U)	Vit B (mgs)	Vit C (mgs)	Vit G (mgs)
Beet leaf (steamed)	3.5oz. (100gm)	53	2.0	95	3.3	Good	Good	18	0.63

Seasonal needs - Beet is a cool season crop that will give the best yields when grown at temperatures of 60° - 80°F. (16° - 27°C) The grower should try to avoid growing the crop more than 5°F outside the range as this will reduce yields markely. The crop does best in the cool hilly areas throughout most of the year and on the lowlands during the cooler months from October to March.

Soil requirements - All root crops does best on the rich lighter soils where drainage is adequate. Poor drainage usually cause much loss from root rot. Reaping of the crop is also more difficult on the heavier soils.

Selecting varieties

(21:2)

Variety	Plant description	Approx wks to 1st reap & final		Root* description	Remarks
Asgrow wonder Crosby Egyptian	Tops grow to about 15 ins (38cm) from ground to brown leaves green app. 15"x3" or 38x8cm	8-9	12-14	Root has semi-globe (round to global shape when mature 2"x1½ to 3"x2ins.	Most varieties of beet are reaped according to age & size ie. 2-3 (app. 6 cm) in in size.
Detroit dark Red	Tops grow to ht. of about 12 ins. leaves green with dark red spots and veins.	9-10	12-16	Root has shape of a globe and dark red in in colour throughout. Sweet taste.	
Detroit perfected	Tops grow to ht. of 15" to 20 ins (38-50cm)	9-10		Root is globe shape.	*Mature roots
Early wonder	Tops green with red veins and steak of red on leaves.	8-9	app. 12	Root is globe shaped with dark red outside and purple red inside.	

contd.

Flat Egyptian Green top bunching	Top green with dark red veins	8-9		Root flat globe in shape
Red-pack	"	about 10		Root has globe shape.

Growth habit (Read section in beans)

Growth habit of beet. (Detroit dark red.)

(21:3)

Time from plant(wks)	Approx. ht. (ins)	Approx. ht added (ins).	Crop description
2nd	1-2" (3-5cm)	1" (3 cm)	Emergence 4-8 days. Seedling with 3-4 dark red leaves.
4th	3-4" (8-10 cm)	2" (5 cm) (NPK)	Leaf colour gradually changing to green. Roots start to swell and might bulge above soil surface.
6th	6-8" (15-20cm)	4" (10 cm)	Crop enters period of rapid growth around the 5th week. M ulching might be needed to cover roots.
10th			Roots should be ready for 1st reap from 9th week. Diameter 2-3 ins or 5-8 cm.
12th			Reaping should be completed. Not more than 3 or 4 reapings shoul be needed.

Crop pH requirement

For best results, the farmer should try to grow his beet on slightly acid to slightly alkaline (pH 6.0-8.0) soil conditions. Outside this range the grower should try to correct his soil reaction. Similar to okra.

Applying organic manure (Read section in Beans.

Adding manure to the soil, will improve the quantity and quality of the yield from beet.

Fertilizer and plant population

The general recommendations are:-

Plant population	approx. 12,000
Pl. distance	approx. 18x3" or (45x8 cm).
Fertilizer grade	approx. NPK/16-18-20
Fertilizer rate	approx. 50 lbs per sq. chn. or (25kg/400 sq. m)

Suggested populations and fertilizers where soil analysis is known. Range of planting distant 15x24"x2-4" or 38-60 cm x 5-10 cm Low population approx. 8,000, Med. population approx. 12,000, High population approx. 18,000. The fertilizer rates and how to adjust grades are the same as for corn.

Number of applications.

Beet is a short duration crop as most varieties will be completely reaped within 12 weeks from the planting.

On clay and loam soils (1/3 R + 2/3 R = 2 applications) Apply 1/3 of the recommended fertilizer rate at planting. The second application should be made about the 5th week when the crop starts to grow rapidly.

On sandy soils: (½ R + ½ R + ½ R = 3 applications).
Apply ½ of the recommended quantity at planting, ½ about the 4th week and the third application around the 7th week from planting.

Fertilizers can be applied by broadcasting, but care should be taken not to allow any of the solid material to settle in the 'heart' leaves since this could damage the plant.

Buying and testing seeds

Seeds - Beet have large seeds, brownish rough and round approx. ¼" (½ cm) diam. Approx. number of seeds per ounce: 1,600
Quantity of good seeds (% G/ 65), needed for direct planting -

Low pop^{n}	approx.	10 ozs.	)
Medium pop^{n}	approx.	12 ozs	) per sq. chn
High pop^{n}	approx.	16 ozs	) or for planting 400 sq. metres.

It is best to buy seeds about 2 weeks before the crop is to be planted. The seeds should then be tested to find the percentage germination. If it is below 65%, the grower might need to buy a few more ounces of seed and plant them closer along the rows. Some thinning might be needed later.
The root crops dealt with in these chapters, rarely produce viable seeds under tropical conditions.

Land preparation

The grower should take special care in preparing land for root vegetables. If the soil does not have a fine tilth (well refined) the quality of the beetroot will not be as high as with well prepared soil. The tubers will tend to push up above the soil surface. This would make mounding necessary and increase total expenses. In addition tubers will be deformed and less attractive. For the same reason, where possible, avoid planting root crops on stoney or heavy clay soils.
(Also read section in beans.

Planting

Read section in beans.
Planting depth : ½ - 1". The crop 1 is grown from direct seeding.

Irrigation and drainage

Except for sweet potatoes, the root crops have a shallow root system of between 1 and 2 feet. Their water requirement is less than beans, but generally have to get water more regularly. They need sufficient water to properly wet the top 6 inches (15cm) about every 5 days.

Mulching - Remember that in dryer areas where grass is plentiful, mulching can be done. But it is best to dust or spray an insecticide (eg Dieldrin, Agrocide) over the entire field to reduce the chance of insects becoming plentiful under the mulch and destroying the roots of the crop.

Disease and pest control in beet

Soil treatments Same as beans
Seed

(Table 21:4)

Disease & Pest	Description and damage	Suggested control
Disease Black root	Root turns black and tough outside.	Seed treatment with captan, dichlone or Thiram
Leaf-spot	In early stage, circular or irrigation shaped spots on leaves. Spots usually light brown with dark brown borders. Later leaves will dry up and fall.	Crop rotation, improve drainage, plant resistant varieties. In addition spray with Bordeaux, maneb, Zineb, Ziram.

Contd.

Insects Flea beetle	Small jumping beetles (1/16" -1/8 long), black brown or striped in colour. Many small holes eaten in leaves. Attack mainly leaves.	Spray with Sevin, Malathion, Systemic spray* eg Netasystox.
Leaf miner Spotted cucumber beetle	Small jumping beetles (1/16" long) of small black flies. Miners make small winding tunnel between upper and lower leaf surface. Tunnels have whitish appearance on leaf. Serious attack cause leaf to wilt. Attack mainly leaves. Black beetles with yellow makings on back. Attack entire foliage.	Spray with systemic spray eg. Rogor diazion, Malathion Phosdrin, Sevin Systemic spray. eg Nankor.
Webworms	Small light green catapillars that web leaves together around themselves. Attack mainly leaves.	Systrex, Sevin.

* Stop using systemic sprays about a month before reaping begins.

Weed control in beet

Weeds can be controlled in beet using:-

(i) manual control)
(ii) mechanical control) Read section in beans
(iii) chemical control

Chemical weed control in beet

Weedicide	Time to apply& wks of effective control	Weeds controlled	Approx. quantity per 10 galls water - HV	Remarks
Common salt	Apply when crop have 3-5 true leaves control weeks.	Most annual weeds	20 lbs	Most effective on small weeds Not effective on weeds over a few weeks old.
Gramoxone	Same as beans	Most weeds	Same as beans	Contact spray.
Stoddard	Apply about 2-3 days before emergence of crop	Some seedling weeds		Gives good control with a later common salt spray.
Varitox (TCA)	Apply about 2-3 days before planting crop.	Delay seedling weeds.		Grain seedling

Inter-tillage. Read section in beans.

It is also important that inter-cultivation, whether mechanical or manual, for weed control or moulding, this be done in the early life of

most root crops. After the first half of the crop life, roots and tubers start to develop more quickly and if the root system is disturbed in any way, growth of the food storing organ will be setback

Reaping

Most varieties of beet would be ready for 1st reap in 8-10 weeks. Some later varieties will take up to 12 weeks. By then the tuber should be made 2-3 ins in diameter i.e. at its widest point. If smaller beetroots are needed, then the crop should be reaped earlier. Where seeds were well spaced along the rows at planting roots would be fairly uniform in size. This would make it possible to make 1 or 2 reapings to complete the crop. At the very most, reaping should be spread over 4 weeks. This is because roots will easily become tough or woody, hence reducing quality of yields. Most root crops are reaped by pulling up or forking up the entire plant taking care not to damage the food. Soil should be slightly moist at reaping as this makes the operation easier and can be done more quickly. If the leaves are to be eaten, care should be taken not to crush them while reaping the crop. The roots should then be cut leaving not less than an inch of leaf stalk. They should then be washed (avoid trimming as it might cause "bleeding"), and packed for market.

Expected yield: (Average) 8 hbs./sq. chn. = 400 kg/400. sq.m
(Good) 14 hbs/sq. chn. = 700 kg/400 sq. m.

Keep records and notes of production, sales, expenses and any other information which might be of help in later crops.

After reaping care of the field should be carried out to help general sanitation and control of disease and pests on the farm.

21.B. CARROT

Family Umbelliferae

USES : Carrot is grown mainly for its swollen root which is eaten raw, cooked or made into a drink. The tops can also be cooked and eaten

Food value for 3.5 ozs. (100 gms) of roots; approx 90 ml water, 1 gm protein, 7 gm carbohydrate, 40 mgm. Ca, 0.7 mgm iron, 3000 I.U Vit. A, 0.03 mg Vit. B, 6 mg Vit. C and approx 45 calories.

Seasonal needs : Like beet, carrot is a cool-season crop. Their requirements are very similar except that carrot will do well under a little wider range of climate and soil conditions. But high temperatures and dry conditions produce woody roots even before maturity, while wet conditions followed by dry weather or soil conditions cause roots to split and may later rot or affected by other diseases.

Selecting varieties

(21:5)

Variety	Shoot description	Approx wks to 1st reap & final		Root description	Remarks
Danvers* ½-long	Tops grow to ht app. 15 ins (30cm), with 6 to 10 compound leaves app. 12"x4ins (25x10 cm)	10-12	13-15	Hight orange topering roots, size app. 6-8" x1½in (15-20 x4 cm)	*Other vars. eg. Danvers Red core with deep orange roots
Carcusel (hybrid)	Most varieties of carrot grow to between 12 and 18 ins (30 to 45 cm)	9-10	12-14	Size app. 9"x 1½ in. app. (22x4cm)	Some varieties of carrot show resistance or tolerance to a few diseases
Chantenay (vars)		about 10	"	Size app. 6-8"x1½-2" app. (15-20x4-5 cm)	
Imperator (vars.)	from ground level to crown level	10-12	13-15	) Most vars.) orange in) colour,)size app. 8"-)10"x1½-2"	
Early gem	All have compound leaves with mony leaflets.	8-9	10-12		
		10-12			
Express		11-14	12-16		
		8-9	10-12	Tall roots up to 11 ins.	
Favourite					
Highlight		9-10	10-12	Roots short, av. 6 ins x1½ in.(15x 4cm) Sweet taste.	
Nantes (vars.)					

Growth habit -

Carrot grows almost the same way as beetroot (See Table 21:3)

Crop pH needs.
This crop does best on slightly acid to neutral soils (pH 5.5. to 7.0). The requirements are similar to corn.

Fertilizer and plant populations.

The general recommendations are:-

Pl. pop^{n} approx. 12,000 pl/sq. chn @ app. 18"x3" (app. 12,000 pl. on 400 sq. m. @ 45x8 cm)
Fert^{r} app. NPK/16-12-20 @ app. 50 lbs per sq. chn. (app. 25 kg per 400 sq. m)

Where soil nutrient status is known, see tables 12:3 (10:13a and b) for recommendations.

The fertilizer can be applied in the same way as for beets. ie. 2 to 3 applications by broadcasting.

Buying, testing seeds and planting.

Carrot has small seeds, greyish in colour, pointed with small ridges. No. of seeds approx. 20,000 seeds /oz or 700 seeds per gm. Amt. of good seeds (% G $>$ 55) needed for direct planting approx. 1½ oz. per. sq. chn. (40 gm for 400 sq. m.)

The seeds are to be mixed with sand or dry soil to get a good planting distance. The required amount will have to be scattered along shallow furrows at a speed and with a seed and sand mixture needed to get close to the required population. The more sand used and the quicker this is scattered in the furrow, the further the plants will be spaced along the furrows.

It is best to use a seed-planter especially for direct planting of small seeds. Seeds should not be planted more than about ½ inch (1cm)

deep whether in furrows or on beds since the seedlings are very weak. Land must be well prepared or roots will become branched, twisted or deformed in other ways. In some cases, these deformities can be due to nutrient deficiencies. Practices like irrigation, mulching weeding can be done in almost the same way as with beets.

Carrot seeds can grow fairly well from broadcasting the seeds and lightly raking them into the soil. Pre.em. weed control is very helpful here. The seeds should be scattered on beds about 3 ft. wide (app. 1 metre) with a path of about 12"-18" between beds. This will enable weeding, spraying, reaping etc. to be done without need to walk in the beds.

Disease and pest control

The main diseases are:-

1. Root rot - bacterial disease which attack roots causing them to decay or to become soft foliage wilts Improved drainage and crop rotation should help

2. Yellows or wilts - virus disease causing young leaves to become yellow and then spreading to older leaves. Roots usually stunted. Leaf-hoppers are the carriers of this disease. Control them with gut or contact sprays. eg. Malathion

3. Leaf spots - small spots on leaves, light brown with darker borders. Control same as beet

4. Collar rot - brown rot around collar of root, sometimes with base of leaves covered by whitish growth Control with fungicide eg. Dithane, Polyram Combi.

The main insect pests are:-

Cutworms, leaf hopper, caterpillars: Ants can damage seeds. The control measures are the same as beans - Table 18:9

Nematodes cause root-knot in carrots. Affected roots, have small knowt or galls on its side, tend to be smaller, branched and may have paler colour than healthy roots. Control by crop rotation and use nematicide on soil for later crops.

Weed control - same as for beet
Linuron (Lorox) or Prometryne (Gesagard) can also be used for pre-emergence control. Follow manufacturers instructions. Where manual weeding is done, roots which can be seen should be moulded to prevent them growing green and woody at the top.

Reaping

Most varieties of carrot would be ready for reaping between 10 and 12 weeks. Then, roots should be about 6 ins (15 cm) by just over 1 inch (app. 3 cms) depending on variety. (Also see section on reaping of beet)

Yields to expect from roots	Average	Good
	10 hbs - per sq. chn -	16 hbs
	or (500 kilo - per 400sq.m-	800 kg)

21 C. PARSNIP

This crop belong to the carrot family and is grown in almost the same way. The tuber has whitish flesh which is cooked and eaten rather than used for making drink.

The crop is usually of longer duration than carrot. It takes 4 to 6 months to final reaping. Seeds may take about 2 weeks to germinate and is good for only a short time. Buy fresh seeds each planting.

Varieties

Hollow Crown - Roots grow to about 9"x12"x2"-3 ins, yellowish in sweet. Sweetish in taste.

Guernsey)
Harris model) These differ mainly in shape, size and colour of roots from hullo crown
White model

CRUCIFER ROOT VEGETABLES.

(Turnip, Rutabaga, Radish and Kohl-rabi*)

Family: All 4 crops belong to the family Cruciferae or Cabbage family. They are called Crucifers.

Uses: Swollen roots and tubers sliced and cooked with meat or in soups. Leaves can also be steamed or cooked in soups.

(21:7)

Food value (3.5 oz or 100 gm.	Water (ml)	Prot. (gm)	Carboh. (gm)	Ca (mg)	Iron	Vit.A. (I.U)	Vit.B. (mg)	Vit.C. (mg)	Approx Cal.
Turnip (roots	90	1.0	8.0	30	0.4	negl.	0.03	25	35
Radish	94	1.0	4.0	30	1.0	negl.	0.03	25	30
Rutabaga	) Slightly richer in most nutrients								40
Kohl-rabi*	)								n.a.

Crucifers are sometimes called cole. crops.

Seasonal Req.

Turnip, Rutabaga and Kohl-rabi are cool season crops and will do best between 60° and 75° F (16° - 24° C). Radish is a warm season crop, requiring temperatures of 65°F to 85°F for best results. But these crops are quite hardy and will grow fairly well on a wide range of climatic and soil conditions. They are the quickest and easiest root crops to grow, ideal for students or farmers to use to get in their eyes to root crop cultivation.

Selecting varieties.

(21:8)

Crops & Varieties	Plant description	Approx wks to 1st reap & final		Root description	Remarks
Turnip					
Purple top-White globe	Grower to ht. of 12" to 15" (app 38 cm) from ground to crown level 6-10 green leaves clustered on short stem. Size app. 15"-18"x3-5" Plant diam. app. 24"	6-8	8-10	Reaping Size app. 3"-5 x2"-3", globe shaped purple on top and white bottom on outside white flesh colour. wt. 3-6 ozs. Av. max. app. 8-12 ozs.*	*When overgrowth, roots tend to become corky.
Amber globe	Tops of these vars. usually grow taller than above.	9-10	10-12	Top root green, yellow globe Roots bitterish and become harsh (pungent)	These vars. grown mainly for tops.
Gevin top		5-7	8-10		
Shogoin					
Milon					
Vars.					
Rutabaga					
American - Purple Top	Tops grow to about same ht. as turnips but have less leaves which are blush in colour	10-12	12-14	Roots usually bigger than turnip app. 4-6"x3-4" app. (10-15x 7-10 cm) sweetish taste	
Purple yellow top.					

Contd.

Kohl-rabi					
Early white Vienna and Early Purple Vienna	Grows to about 9"-12" tall, with swollen Stem above the ground light green thick leaves app. 6-9" tall plants app. 12-15" diam.	8-10	10-12	Stem-tubers, about 2-3x2-3 when ready for reaping. Tend to be stringy when older.	Very tasty crop

Radish is a smaller plant hardly growing to more than 6"-9 ins (app. 15 -22cm) from ground to level of upper leaves (crown). Roots vary in shape from round to long and slender with colours from white to deep red. Size approx. 2"-4"xapp. 1".

Varieties - Champion, cherry belle, early scarlet globe, red devil, scarlet knight, lobak, chinese white and white Cycle.

Most vars. ready for reaping in 3-4 weeks. Become spongy and harsh in taste as the roots get older.

(21:9)

Crops	Em. Fert^{r} Recommen-dation	Plant pop^{n}	Pl. Dist-ance	Seeds Reqd.	Common diseases & control	Common insects & control
Turnip	NPK/12-12-12 @ 40 lbs/sq. chn (20kg/ 400 sq.m)	18,000 Pl/sq.chn	18"x2" 45x5cm	1½ ozs 40 gm	Black rot) Black leg) All Mosaic) Crops	Aphids Cabbage looper Diamond-back moth Cutworms.
Rutabaga	NPK/12-12-12 @ 40 lbs	18,000	18"x2"	1½ ozs	Mildews Symptoms and control similar	Control above pests with contact and gut poisons.
Radish	NPK/8-8-8 @ 20 lbs	30,000	15x1½"	1 lb.	to beans and other fruit crops	
Kohl-rabi	NPK/12-12-12- @ 40 lbs	12,000	18"x3"	2 ozs.		Aphids Leaf miners Control with systemic sprays for 1st month.

Contd.

Crops	Weed control	Yields	Comments
Turnip	Manual) (See Mechanical) beet) Chemical.	8-10 hbs or 400-500 kg	Seeds of most crucifers closely resemble, small, roundish
Rutabage	eg Dalpon for grasses Grammoxone for all weeds	12-15 hbs	Than 1/8 in. (app ⅛ cm), brown mottled with purple. Av. app. 8000 seeds.
Radish	All weeds. Linuron or Promy tyne as pre-em. @ app. ⅛ lb in 10 galls H.V.	10-14 hbs.	per oz Radish app. 2000 Direct planting ½" (app 1 cm) deep.
Kohl-rabi	Amiben or Tok-E as pre-em. @ app. 1 pt. in 10 galls water H.V.	8-10 hbs	for all crops. Can broadcast seeds similar to carrots.

Notes
1. Most practices done in the similar way as in growing beet and carrot.
2. All figures are for 1 sq. chn or 400 sq. metre.
3. Soils with pH 5.5 to 7 acid to neutral most suitable for these crops.

Chapter 22. 22A. POTATO

Kinds - 1. Potato (non-sweet) or Fresh potato or Irish potato
Family: Solanaceae

2. Sweet potato
Family: Convolvulaceae

Uses - Tubers boiled, roasted or fried and eaten.

(22:1)

Food value (3.5 oz or 100 gm)	Water (ml)	Prot. (gm)	Carboh. (gm)	Fat (gm)	Ca (mg)	Iron (mg)	VitA. (I.U.)	Vit B (mg)	Vit C (mg)	App. Cal.
Potato	80	2.0	17	neg.	10	0.7	neg.	0.1	30	120
Sweet Potato	70	1.5	26	0.3	25	1	app 2000	0.1	30	85

Seasonal needs.

The fresh potato is a cool season crop which does best between 60° and 80°F (16°-27°C) during the crop. It will hardly bear tubers at temperatures outside this range. This means that it will grow in the cool hilly areas throughout most of the year as long as rainfall or irrigatic is adequate, and on lowlands in October to March. The sweet potato is a harder crop, and is warm seasonal. It does best between 65° and 85°F (18°-30°C), but will produce even at 90°F. Potatoes are fairly sensitive to day length. Some varieties will produce good vegetation in longer days but poor tubers.

Soil requirement

As mentioned before, most vegetables does best on the lighter soils where drainage is good. Water should be able to enter the soil and drain relatively free so that roots have both a good supply of water and air.

With all root crops and especially potatoes, the light free draining soils are best. On heavy soils and poor drainage, root crops suffer terribly from low yields due to poor aeration, root rot and other diseases. For planting potatoes, especially the non-sweet varieties, on heavy soils, manures, preferably dry manures should be added to improve nutrients and drainage of the soil.

Selecting varieties

(Table (22:2)

Crops & Varieties	Plant Description	Approx wks to 1st reap & final		Tuber Description	Remarks
Fresh potatoes					
Sebago	Plant has weak stem, grows semi-erect to ht. of about 2 ft. (60cm)* Stem about ½ inch, with leaves app 3"x 2".	12-14	lor 2 reap-	Cream skin and flesh roundish to elongated Size app. 2"-4"x2"-3" app. (5-10x5-8cm) Wt. 4 to 8 ozs. Av. 5 to 8 tubers at root of plant	All table pota to bear "eyes' (buds) on tubers. They are underground stem tubers.
Green mountain Red Bliss Triumph Red Pontiac Kennebec Netted gem. Arran (vars) Spunta	Most vars. simi-lar to above (*ht or length of stem is average from ground level to terminal bud on main branches).			Red skin, white flesh	These 3 vars. suitable for warmer conditions. Netted gem one of hardest vars.
Sweet potato					
Flagall	Stem branches a lot, trails top to 15 ft. (4.5 m)* app. ¼ inch diam. with leaves about 4"x2" produce pink flowers	18-22	24-30*	Long globe shaped tubers, pointed at both ends. Produced from adventitious roots along the stem,	*Possible to have longer reaping period if rainfall or irrigation adequate

Contd.

Red velvet	about 1"x1½ diam.		,20-30 tubers per plant. Av. wt app. ½ -1 lb. Tubers have ..? skin and .....?	
Porto Rico Totiempo Virousky	This var, does not trail much, bush-like*	14-16	flesh colour.	Bush like vars produce tubers in bunch around root like fresh potatoes.

Crop pH requirement

The crop can grow well on neutral to very acid soils (pH 5 to 7). But these acid soils must not be too easily waterlogged and should have good drainage. See beans for correcting soil reaction.

Fertilizer and plant population

The general recommendations are for:-

Non-sweet potato

Plant population	approx. 1400 pl. per sq. chn (1400 pl /400 sq. m).
pl. dist.	approx 30" x 15" or 75x38cm
Fert^{r} grade	approx NPK/16-16-20
Fert^{r} rate	approx 60 lbs per sq. chn. (30 kilos per 400 sq. m)

Like its sister tomato, the potato is a heavy feeder. Where the soil NPK status is known, the plant population and fertilizer recommendations are the same for both crops.

Sweet potato

Pl. pop^{n} approx 800 pl./sq. chn @ app. 36"x24"
OR (800 pl. in 400 sq. m. at 90 x 60 cm)

Fert^{r} recommendation app. about the same as fresh varieties.

The fertilizer can be applied in equal quantities about every 4 weeks for both crops. For sweet potatoes, broadcasting has to be done after the crop starts to trail.

Planting materials and planting

The non-sweet potato is usually grown from small tubers about 2 ins x 1½" (5x3½ cm). Larger tubers may be split down its length to give halves about the same size or weight as the small seeds. It is not good to split the seeds into more than 2 although some farmers practise this. Too much cut surface is exposed to the soil when the crop is planted. This encourages rotting and diseases. Make sure that each piece has at least 4 eyes. After splitting, the cut surface should be put in the open but not too much sun to dry. A little dry ash may be sprinkled over this surface and in a week, they should be ready for planting. A fungicide is better, but more expensive for this job eg. Polyram combi. It can be dusted or used as a dip.

A tuber or a half of tuber is planted at the required distance in furrows not more than 6 ins (15 cm) deep or in holes on banks and planted 4 to 6 ins deep.

About 200 to 300 lbs of seeds would be needed to plant a sq. chn. (100-150 kilo per 400 sq. m) depending on population.

Remember to dust or spray open furrows and holes with an insecticide since unlike most crops dealt with before seeds are not pre-treated. Dieldrin or chlordane EC at about ½ pint in 15-20 gallons water (¼ litre in 60-80L of water) could spray a sq. chn or 400 sq. m. of potato land. Sprouting or emergence of young shoots will take 1 to 4 weeks depending mainly on moisture in the soil and vigour of planting material Remember that fresh potato will not germinate well and

will tend to rot. They should be stored for 2 to 3 months, to allow some drying out. It is usually best to buy certified planting material from expert producers. Do not allow more than 2-3sprouts to grow from each tuber.

The sweet potato can also be grown from the tuber. Most of what has been said above would also apply in this case. But the more common way of growing sweet potato is from stem cuttings called'slips'

The slips about 1 to 1½ ft. (30-45 cm) can be taken from any part of the stem , but those closer to growing points or ends of branches tend to root and grow easier. About 6 ins (15 cm) of the cutting should be put in the ground, taking care to put the more mature part ie. the portion which was nearer to the root of the parent plant, in the ground.

Dipping the cut portions in a rooting hormone mixture should help rooting considerably.

Caring the crop.

Potatoes are grown in many ways like most other vegetables. Irrigation, drainage, mulching are basically the same as a crop like tomato. Moulding may be needed as sometimes tubers of the non-sweet potato tend to grow above the soil surface. They turn green and tough. If this task becomes necessary, it can be done at the same time as manual weeding or about a month after planting when shoots are about 1 foot (30 cm) tall.

If the crop is planted in furrows, moulding, weeding and a fertilizer application can be done at the same time and much easier than when the crop is planted in hills or holes on banks.

Generally, sweet potato does not need as much care as the non-sweet vars., but they should not be neglected during the growing stage of the crop.

Disease and pest control.

The sweet potato is a fairly hardy crop compared to most other vegetables.

The irish potato is a Solan and like tomatoe is attacked by many pests and diseases. It is a common saying in the caribbean that prevention is better than cure. This is so true for the fresh potato.

Spraying should start even before any signs of disease are seen on the crop. This is usually started when the crop is about a month old. But where conditions are damp or the crop is widely grown on an area, after emergence and continue on a weekly or 2 weekly cycle at most for the entire crop. Tomato spraying sometimes start in the nursery, so it is not surprising that such care has to be taken with a sister crop.

Insect control can be started with disease control, but one can wait until signs of these pests are seen.

Disease include, late and early blight, Fusarium wilt, Virus diseases, rust, root rot, stem and rot and scab.

Insects include Aphids, cutworms, hornworms, leaf beetles, leaf hoppers mites and weevils.

Symptoms and control similar to tomatoes. The crop is also affected by nematodes which cause galls on tubers reduced yield and the plant to appear droopy. Use Nematicides for control in later plantings.

Crop rotation is very useful in controlling disease and pests in these crops. Biological control of cutworms and the hornworm can be of some help,but are most successful as part of a general programme throughout a district, rather than by an individual grower. The main predators are some species of wasps and flees. They feed on the harmful pests. Tachnidflies are among the predators, but has to be introduced in an area for a year or more to build up its population and become effective.

Weed control

Manual can be used throughout crop, mechanical control in early stages of crop. Chemical - Eptom, Prometryne or Lenuron as pre-emergence sprays.

Grammoxone or Round-up can be used for contact chemical weeding,

Reaping

Both sweet and fresh potatoes are reaped by forking up the tubers. The fresh varieties produce their tubers at the root of the plant and are dug up when the crop is about 3 months old and the foliage has begun to ripen and dry. This is also true of busk like vars. of sweet potatoes which also produce yields close to fresh varieties.

With most sweet potatoes, one has to search the vine to see where it sends down the roots which develop into tubers. One can wait until about 8-9 months time. When the vines begin to die down, then reap all the tubers since ripe tubers can remain in the ground and develop for 3 months or more.

Otherwise, the grower can start reaping from about 5 months by searching the vines for suitable tubers. Most farmers reap according to size of tubers. Sizes 4 to 6 ins long by 2 to 4 ins or more (> 8-15 x5-10 cm) are suitable for eating. These will usually crack the ground or cause a little hill to form on the surface.

Potatoes can be stored in a cool dry place with plenty of ventilation or in cold storage for 1 or 2 months.

Yields to expect	Average	Good
Fresh potato	1000 lbs-per sq. chn -	1400 lbs
	(500 kilos per 400 sq. m -	700)
Sweet potato	1200 lbs - per sq. chn -	1400 lbs
	(600 kg.	800 kg)

22B. THE ONION FAMILY

(22:3) Family liliaceae

Crops	Other names	Uses
Onion Escallion Leek Garlic Shallot	Globe, onion Skellion, bunching onion or Welch onion Yabba	The entire plant or the bulb is mostly used as seasonings Sometimes bulb sliced and eaten raw or cooked.

Food values - The values for 3.5 ozs or 100 gms of onion is 87 ml water, 1.5 gm protein, 30 mg calcium and 0.5 mg of iron, fats and vitamins in very small quantities compared to other crops. The other crops have close nutritional values.

Seasonal needs - The lily vegetables are generally cool season crops. They do best at temperatures of 60° to 80°F (16°-27 °C) during the crop. They are also sensitive to day length and most varieties will grow tops very well at any time of the year, but will bulb only in the longer days of Summer to Autumn, (April to September)

Most lowland areas are too hot for onions to bulb in Summer. But all crops of this family will produce good tops at anytime of the year.

Selecting varieties

Some varieties are not as sensitive to temperature and day length as others and may bulb at any time of the year in the Caribbean. These include the New Mexico White Grano, New Mexico Yellow Grano, Yellow Spanish, Loredo Yellow, Granex Yellow and Dessex hybrid.

The varieties listed below are the more widely grown varieties of the onion family.

(22:4)

Crops & Varieties	Plant description	Approx. wks. to 1st reap & final		Bulb description	Remarks
Onion					
Texas Early Grano Granex (hybrid vars)	Light green top. Entire length of top usually reach 12"-16" (30-40 cm) 6-10 hollow leaves Stem like portion app. ½ -3/4" (1-2cm) Fibrous roots app. 3 ins long (8 cm)	14-16	20-24	Globe-shaped Bulb produced partly above ground Size app. 2-3 "x2-3" app. (5-8x5-8cm) Dry brown outer-scaley leaves when mature with white inner fleshy leaves.	Mature bulbs can store in cool dry place for 1 to 2 months. If reaped before maturity they will not in 1 or 2 weeks.
Crystal wax) (or white)) (Bermuda)) Ecel) (or Yellow)) (Bermuda)) Red Bermuda) Red Creole) Bombay Red) White Creole)	Similar to above, but outer leaves have colour described by name	16-20	20-26	Bulbs of different varieties	Top falls over just about bulb and dry up when mature
Escallion					
Evergreen Bunching Beltsville Bunching Long White Bunching vars.	Stem like portion branch into 3-5 sections joined at root Same as onion.	about 12	20-26	Swollen portion near root, but no distinct bulbs.	These vars. can be reaped for up to 1 year by leaving sets or sections of shoot to continue growth.

Leek varieties - American Flay, Broad Flat, Italian Giant and Mussel burgh.

The plant is the biggest in the family, with total length of up to 2 ft (app 60 cm). The lower portion is allongated bulb, is usually 1½ - 2 ins (3-5 cm) and develops below the ground. Each plant usually has a single'stem' like the onion.

Garlic and shallot vars - Few varieties, names not well-known. Garlic resembles onion, usually smaller leaves and bulb covered by dry brownish or whitish thin leaf sheath. Bulb divided into 10 to 20 hard bulblets or cloves.

Shallot, differs from garlic in that the plant is branching like skellion, and the bulblets are loose.

(22:5)

Crops	Gem Fert^{r}. Recom^{ms}.	Plant Pop^{n}.	Pl. dist.	Seeds Reqd.	Common Diseases and control
Onion	NPK/12-12-12 @ 40 lbs/sq chn (20kg/400sq.m)	20,000 Pl./sq.chn or (400sq.m)	16"x2" 40x5cm	2 ozs (60 gm) plant / ½" deep	For all crops:- 1. Damping-off seeds may rot just before or after emergence. Plant
Escallion	/12-12-12 @ 40 lbs	20.000	16"x2	1½ ozs	fall over at ground level Control Better drainage Dust seeds with Captan or Thiram.
Leek	/12-12-16 @ 40 lbs	1?,000	18"x3"	2 ozs	2. Purple Blotch Small whitish spots on leaves develop to form large purplish blotches. Leaves yellow and die.
Garlic & Shallot	NPK/9-12-16 @40lbs/sq.chn	25,000	12"x2"	2½ ozs	Control- Maneb, Zineb or Dithane every 7-10 days. 3. Bacterial soft rot
					Bulb start rotting usually from neck. Control- Reduce watering near harvest

(22:5 contd

Crops	Common Insects and control	Weeding	Yields	Remarks
Onion	For all crops:- 1. Crickets) Control 2. Cutworms) with 3. Army worm) gut-contact	Weed control can be very hard in these crops especially in first ½ of crop.	10 hbs or 500 kg	Reaping by pulling up plant and using fork for leek
Escallion	4. Leaf miner 5. Thrips-does most damage. Small brownish or yellowish sucking insects leave whitish	Control 1. Manual 2. Mechanical	4hbs in 6 mths	Remove outer leaves with dirt. Trim roots and tops of onion , garlic and shallot before storage
Leek	silvery or bronze patches on leaves	not recomm. 3. Chemical - (a) Dacthal (b) Eptam	6 hbs	Transpl. leek about 6 ins deep Other 1-2 ins deep.
Garlic & Shallot.	Control spray with contact gut or (systemic- before bulbing) eg. Malathion,	(c) Tok-E	4 hbs	
	Basud , Perfeck-Thion Use sticker eg. Triton and Catowett.			

Notes. 1. Figures for 1 sq. chn See Tables 10:13a and b, 12:3 and 4 for details on pop^{n} and fert^{r}.

2. The general practices are carried out similar to beet and carrot.

3. These crops can be grown by planting seeds directly in field. But transplanting 3-5 wks old, reduce water and weed problems where these could be serious in the early stages of the crops. Garlic and shallot usually grown from sets or bulblets. Plant root end down. Seeds of all crops, small, almost square, > 1/8" x 1/8 in. (⅛ x⅛ cm), approx. 10,000 seeds per oz.

4. Soils with pH 6 to 8, acid to alkaline, most suitable for these crops.

THE LEAFY VEGETABLES.

Chapter 23.

In chapter 23, we will deal with the last main group of vegetable crops. (See Note under Table 18:1) Again, it is a good idea for the student to learn the details of how to grow one or two varieties of beans and corn or some other fruit vegetables. Both the information given especially in Chapter 18 and the experience gained in growing the crop will make the grower better able to see the background to much of what will be suggested for growing the leafy vegetables.

23A. CRUCIFER LEAFY VEGETABLES

(CABBAGE, BRUSSELS, SPROUT, COLLARD, KALE, MUSTARD,)

CAULIFLOWER, BROCOLLI

Family: Cruciferae or Cabbage family.
These crops are also called cole crops.

USES. The stems and leaves or head of all crops are eaten raw, steamed in a salad, cooked with meat or in soup. With Brocolli and Cauliflower, it is for the big inflorescence borne at the top of the shoot that the crop is usually grown.

Table (23:1)

Food value 3.5ozs (100gm)	Water (ml)	Prot gm	Carboh gm	Fat gm	Ca mg	Iron mg	Vit A, I.U	VitB mg	VitC mg	App. Cal
Cabbage (leaf)	93	1.5	4	0.2	40	0.5	30	0.05	40	50
Kale (leaf)	85	5	4	0.2	40	0.5	30	0.05	40	n.a
Cauliflower (flower &leaf)	90	3	5	0.2	30	1.0	20	0.1	80	30

Brocolli is very rich in Vit A app. 1000 I.U. in 100 gms

Seasonal requirements

The cabbage family are of cool season crops. They will do best between 55° and 75°F (13°-24°C), but can tolerate warmer climates with good results, except for cauliflower and brocolli where flower quality may be poor

Selecting varieties

(23:2)

Crops & Varieties	Plant Description	Approx wks to 1st reap	& last	Head Description	Remarks
Cabbage					
Early Jersey Wakefield	Plant grows to about 10 ins (25cm) ground to crown level by 18ins (45cm) diam. excluding 2 lowest whorls of	10-12	14-16	Size app. 6"-8"x4-6 ins or app. 15-20x10 15 cm Wt.app 2-4 lbs.	*Jersey Queen resistant to cabbage yellow or fusarium wilt.
Jersey Queen*	leaves. The leaves green app. 8"x12" in size Stem app. 1 inch diam.			ready for reaping inverted heart or cone shaped, form head	Plants grown from direct seeding usually ready for reaping about 2-3 wks before trans-
Charleston-Wakefield	Plants app. 12" x 18"	10-14	14-16	Lot app. 3-5 lbs.	plants. But problem of water and
Copenhagen-market	Smaller plants than above	10-12	14-16	Wt. app. 2-3 lbs.	weeds with direct planting may re-
Round Dutch	Plants app 10" x 18"	10-12		Round heads app. 3-5 lbs	duce different
Flat Dutch	" app. 8" x18"			Flat heads app. 5-10 lbs	
Danish Ball-head.) Badger vars) Globe vars.) Golden Acre.) KK KY	These vars differ in size and shape of plants, leaves from light to dark green			Flat globe or round heads, with weights from 5-10 lbs	Globe resistant to leaf yellows.

(23:2 contd)

Red)	Plants purplish	12-16	16-18		
Red Dutch)	to deep red				
Red Hollander	colours.				
Chinese Cabb					
Michihli	Plants resmble			Nearly cylin-	Other vars.
	cabbage but			drical size	Pak-choy do
	leaves thinner	7-10	10-12	12"-15" x3-5"	not fold.
	and does not			(30-35x7-12	Petsai
Chihili	fold as easily			cm) Av. wt.	Wong-Bok.
	as cabbage.Main			app. 1 lb.	
	root 6"-8" deep.				

Crops & Varieties	Plant Description	Approx wks. to 1st reap & final		Head Description	Remarks
Brussels Spout. Long Island-Improved Catskill Jall cross (hybrid) Covent garden Fillbasket	Plant grows 3-4 ft. ht (ground level to terminal bud (1 to 1.3m.) bear buds which develop into heads on a large stem. Leaves very large app. 15"x18 on long stalks	12-16 12-14	16-20 14-16	30-50 heads per plant with lower ones maturity earlier Size app. 2" diam. when ready for reap.	
Collard Georgia	Grows to ht. 2-3 ft (app. 70-100 cm) from ground to crown level. Stem and leaves resemble cabbage but bigger and vary with longer stalks	10-12	12-15	Leaves do not fold to form tough head. Diam. app. 18 ins	Collards more hard than cabbage not as badly affected by seasonal, pest disease conditions.
Green glaze) Vates Morris heading Houisiana-sweet	Plant ht app. 18-24"	9-12			

Contd.

Kale Siberian Improved Dwarf Siberian Green Scotch Blue curled Blue Scotch Moss curled	Grow to ht. 12-18" Leaves much divided along mydrib, curled with frills. Most vars. differ only in colour and size in frills of leaves.	8-10	10-13	Leaves do not fold to form a tough head	Leaf colour of different vars. usually dark green or bluish green. Frills may be fine and very curled or larger and less curled.

Mustard varieties. The most common are:- Florida Broad leaf, Green wave, Southern giant curled, Tendergreen, Plants grow to 18-24 ins with fairly flat or winkled green leaves.

Brocolli varieties

Plants resemble cabbage but leaves smaller and more elongated. Produced large green flower at terminal bud with smaller ones to form a cluster. Crop grown for flowering head Size 4-6 ins across when ready for reaping. Reaped before flower stalks start to elongate, separating the cluster.

When this happens, the plant is ripe and ready to seed. Varieties include:- Atlantic, Coastal, Calabrese, Grand, Harvester, Primo, Propogano, DeCicco, Waltham 29, Green sprouting and purple sprouting. This last varieties produces purplish heads. First Reaping 10-12 weeks, continuing 3-6 weeks.

Cauliflower varieties.

Plants similar to cabbage, with smaller more elongated leaves. Flowers more compact than brocolli, white in colour, size 4-8 ins in diameter.

Upper most leaves usually tied over flowers to form a shade since flowers of most varieties will turn brownish when exposed to plenty

sunlight or hot weather over 75°F. White flowers best for market.

Varieties include:- Early Patna, Snowball vars. Early market, Southern Cross, Maincrop Banares.

Flat reaping 8-10 weeks with direct seeding, but may be 2-3 weeks later from transplants. Reaping may continue for 2-4 weeks.

Growth habit

Bean section on growth habit of beans. Chapter 18.

(23:3) Growth habit of Cabbage (Early Jersey)

Time from planting	Approx ht. gnd to crown	Approx Diam.	Crop Description
2 wks	2 ins (5 cm)	2 ins (5 cm)	Emergence 4-7 days. Later when planted deeper than ½ inch. Plants with 3-4 true leaves
4 wks	3-4 (7-10cm)	4-6" (10-15cm)	Plants have 4 to 6 true leaves and is ready for thinning and or transplanting.
6 "	6-8 (15-20 cm)	10-12 *(NPK_H) (25-30 cm)	Plants growing rapidly. Leaf growth very marked, size app. 5"x6". Stem nearly ½" diam., main root 4-5"
8 "	8"-9 ins (20-22 cm)	12"-15" (30-38 cm)	Heads folding. Rapid leaf growth continues, size app. 6"x9"
10	9"-10" (22-25 cm)	14"-16" (35-40 cm)	Heads continue to fold, becomming harder, size app. 6"x4 ins (15x 10 cm), inverted cone shaped.
12	9"-10" (22-25 cm)	15"-17" (38-42 cm)	Heads firm, ready for reaping, size up to app. 8"x5". Stem app. 1 in. diam, main root 6"-9" deep.
14-16	9"-10 (22-25 cm)	16"-18" (40-45 cm)	No marked increase in growth, but heads become harder and heavier. Complete reaping during period.

(23:4)

Crops	Gem. Fertlizer Recommendation	Plant pop^{n}	Pl. Dist.	Seeds Reqd.	Common diseases and control
Cabbage	NPK/12-12-12 @ 40 lbs/sq.chn (20 kg/400 sq.m)	2000 pl. @ 1 plant per hole	24"x14" or 60x35cm	3/4 oz Plant / ½" deep	For all crops- 1. Black leg 2. Black root Control by rotation
Brussels Sprout	/16-12-12 @40 lbs	1500 pl. "	30"x15" or 75x38cm	Pl. in nursery peat pot	and pre-treat seeds by dipping in hot water about 120°F for 20 mins. + dust with fungicide
Collard	/12-8-12 @ 40 lbs	2000 pl. "	24"x14"	app ½ oz	3. Downy mildew 4. Fusarium wilt (or yellows)
Kale	NPK/12-12-8 @ 30 lbs	2800 pl.	15"x15"	app. ½ oz	Spray with fungicide 5. Mosaic
Mustard	NPK/12-12-8 @ 30 lbs	5800 pl.	18"x6"	app. 3/4 oz can broad-cast on beds	
Brocolli	/16-16-12 @ 50 lbs	2000 pl.	24"x14"	app. 3/4 ozs	See fruit crops eg. beans, tomato for description of diseases and pests
Cauliflower	NPK/12-16-12 @ 40 lbs/sq.chn	2000 pl @ 1 plant per hole	24"x14"	app. 3/4 oz	

(23:4 contd.)

Crops	Common insects and control	Weed control	Yields	Reaping
Cabbage	1. Cabbage looper. Pale green worm app. 1½" long (app 3 cm). fully grown	For all crops Manual Mechanical	10-12 hbs (500-600 kg)	Reap hard heads by cutting stem Trim loose or damaged leaves
Brussels Sprout	Forms loop when it crawls. 2. Diamond back moth worm.	& Chemical Similar to Crucifer Roots.	8-10 hbs	Pick firm heads or sprouts from plant starting with lower ones.
Collard	Light green, slender worm app. ½" long Wriggles when touched and may drop from leaf, but hang	Since crop has small seeds which produce small seedlings, transplanting	6-8 hbs	Reap loose heads by cutting stem leaving lowest 2 whorls of leaves which may
Kale	by silken thread Small white moths flying around the	helps to deal with this problem.	5-6 hbs	be hard. Trim damaged leaves.
Mustard	field, laying eggs on plants 3. Gulf white Butterfly larva		5-6 hbs	Mustard reaped like collard
Brocolli	Yellow with 4, purplish stripes, app. 1½" long. All 3 pests feed and bore plenty		6-8 hbs	Cut flower stalk from stem Flowers should be tender and have right col- our

(23:4 contd.)

Cauliflower	ragged holes in leaves. Control - Use contact or gut sprays.		6-8 hbs	

All figures, for 1 sq. chn or approx 400 sq. metre

Notes. 1. Seeds of these crucifers similar to those grown for roots. Small, round, brown with reddish mottling, approx. 8000 per oz. Plants hardy produce seeds under tropical conditions.

2. Seeds of Chinese cabbage and mustard will grow easier from direct seeding than the others. Scatter on beds about 3 ft. wide allowing 1 to 1½ ft between banks rate in seeds.

3. Remember not to make nursery under tree or in areas shaded for the entire day. Hardening cannot be done and this will set back plants, or make shading necessary for some time in field. Sow seeds in shallow furrow or broadcast on beds, allowing about 1 inch between seedlings. If they are too thick, they will grow tall and slender. <u>This is so for all crops</u>.

<u>Plant tall seedlings deep</u>, leaving only about 1 inch (3 cm) of stem below the lowest leaf above the soil. If this is not done as soon as the head begins to develop, the plant may fall over or moulding has to be done.

4. Leafy vegetables, unlike fruit and root vegetables do well with frequent light rain or irrigation 2 times or even 3 times weekly where workable, watering can be done This helps leaf growth. But drainage must be good and too much water must not be applied. Try to keep top 9-12 inches (23-30 cm) moist, but not soaking wet for more than a few hours

5. Apart from the cabbage looper, diamond-back moth and gulf white fly, other pests like leaf miners, aphids cutworms and crickets damage the crops. Very important to spray under-side of leaves where these pests usually hide and feed. One must start spraying before or at the first sign of these pests. A pest like the Diamond-back moth, when it takes hold of a field literally turns the crop into shambles within a few days.

23B. LETTUCE, ENDIVE, CELERY, PARSLEY, CHARD, SPINACH AND CALALOO

(23:5)

Crops	Family	Uses	Seasonal needs
Lettuce)	Compositae	All crops	Cool
Endive)		eaten raw,	Cool
Celery)	Umbellifereae	(except calaloo)	Cool
Parsley)		steamed or	Warm
Chard)	Chenopodiaceae	Cooked in	Warm
Spinach)		Soups or with	Warm
Calaloo	Aramanthaceae	meat	Warm

The food values for the leafy portion of the crops is given below

Food value (3.5ozs or 100mg)	Water ml	Prot gm	Carboh gm	Ca mgm	Iron I.U	Vit A mgm	Vit B mgm	Vit C mgm	app. cal.
Lettuce	94	1.4	3.0	35	1.0	300	0.1	15	20
Celery	93	0.9	4.0	50	1.0	negl	negl.	15	20
Chard	91	2.0	4.0	80	2.5	1000	negl	50	30

Selecting varieties

(23:6)

Crops & Varieties	Plant Description	Approx. wks to 1st reap & final		Head Description	Remarks.
Lettuce					
(a) Head Lettuce vars.	Grows to ht. app 8 ins (20cm) from ground to crown level.			Folded head and loose leaves except for outer	*Under hot summer condition heads will not
Great-lakes vars.	Most leaves folded around short stem to produce a	8-10	10-14	whorl reaped Wt. app 1-2 lb	fold, will produce flowers on long stalk
Iceburg	head* leaves wrinkled, green, containing milk,	10-12		Iceburg heads heavier and firmer	app. 2 ft high developed from terminal bud.
Caravan	size up to 9"x6" (app 23x15cm)			Wt up to 3 lbs	
Calmar.	Plant diam. app 12"-15 ins Main root app.				Calmar resistant to downy mildew
Big Boston		8-10			Other head-lettuce vars. include - Bibb, white-Boston, Valmaine, Tom Thumb.
Golden Ball					
Imperial 44					
Mesa 659					
Minetto					
Mignonette	Small plant	7-9	10-12	Small heads app 4-6" diam Wt app ½ lb	

(2[illegible]:6 contd)

(b) Leaf lettuce vars. Black-seeded - Simpson Early Curled-Simpson Prize-Head Salad Bowl Slobolt Ruby	These vars. rarely fold, usually smaller and will grow under hotter conditions* Leaf colours from dark green to reddish green	6-8	9-12	Heads do not fold usually/than smaller above.	*Lettuce leaves usually slightly better, but except in a few vars., leaves very bitter when grown during hot weather.

Crops & Varieties	General Description	Approx wks to- 1st reap	& final
Endive Green curled Exquisite curled Batavian	Small plant like lettuce, producing a thick rosette of wrinkled or broad leaves depending on variety. Leaf margins rugged.	10-12	13-16
Celery Golden self-Blanching Green Pascal Summer Pascal Giant Pascal Ultah vars. Golden Plume White gem	Plants grow to 1½ ft ground to crown level, mainly due to very tall leaf-stalks. These stalks and leaves green or yellowish depending on variety. Small compound leaves. Celeriac is a type of celery (or group of varieties) with swollen stem and root.	9-14	15-18

Contd

Parsley			
Green Italian Moss curled	Small plant, hardly grow to over 1 ft Leaves may be curled, frilled or flat and smooth depending on variety	9-12	13-16
Hamburg -Rooted Plain Paramount	Roots in some vars. eg. Hamburg, Swollen, tapered, white, length up to 12 ins, Cooked and eaten with leaves		
Chard			
Lucullus Ford-hook giant Large-Ribbed	Plant grow to about 1 ft (30cm) tall ground to crown, diam app. 6 ins. Green leaves with large thick main rib, main root 6-8 ins (15-20cm) tall, white or purplish. Av. wt. app. 8-16 ozs. depending on var.	7-10	10-12
Spinach			
Blomsdale vars. Dixie Market Aden (hybrid Marathon(") Packer (hybrid) New Zealand vars.	Plant may be bush -like, erect, semi-erect or trailing to more than 6 ft (app 2 m.) Leaves 3"-4"x2. Plants produce cluster of small greenish flowers. Crop reaped by cutting stem 3-6 ins above ground.	12-16	20-26 or for up to one year, depending on how crop is maintained.
Calaloo or Chinese Spinach	Plant grows to 1-2 ft, erect with green or reddish leaves		
Tampala Native	Stem succulent, branching a lot, grows rapidly. Crop reaped by cutting about 6 ins above ground. The plant will spring again, producing more branches after each cutting.	6-8	16-26

(23:7)

Crops	Gem. Fertilizer Recommendations	Plant Pop^{n}	Pl. Dist.	Seeds Reqd.	Common Insects and control
Lettuce	NPK/12-8-12 @ 40 lbs/sq. chn. (20 kilo/400 sq. m)	4500 Pl. @ 1 plant per holes	18"x8" or (45x15 cm)	App. 1/3 oz Plant ½" deep	1. Aphids 2 Caterpillars 3. Leaf Hoppers
Endive	NPK/12-8-12 @ 40 lbs	3400 pl.	21"x9"	in nursery or direct	4. Leaf miners Control with contact gut or systemic sprays
Celery	NPK/12-16-16 @ 50 lbs	7000 pl.	18 x 5	app. ½ oz	1. Leaf miner 2. mites 3. Control with systemic sprays up to about
Parsley	/12-8-8 @ 20 lbs	11,000 pl.	15"x4"	app 1 oz	month before reaping eg. Rogor.
Chard or Seakale	/12-12-12 @ 40 lbs	4000 pl.	18"x9"	app ½ lb.	1. Flea beetle 2. Leaf miner Control-same as above
Spinach	/16-16-12 @ 50 lbs	11,000 pl*. bush vars.	15"x4"	app 6 ozs	
Calaloo or Chinese Spinach	NPK/16-12-12 @ 40 lbs/sq chn (20 kilos per 400 sq. metre)	12,000	18"x3"	app ½ oz can broad-cast seeds	1. Caterpillars 2. Web-worms. Spray with con-tact or gut insecticide

(23:7 contd)

Crops	Common Disease and Control	Weed Control	Yields	Remarks
Lettuce	For all crops:- 1. Black root 2. Downy mildew 3. Mosaic	1. Manual 2. Mechanical 3. Chemical eg. Stoddard	8-10 hbs per sq. chn or approx 500 kg	All crops except Some Spinach vars and Calaloo reaped
Endive	Control as in other leafy vegs. 4. Big vein affect mostly	Solvent as postem selective spray. Try to avoid direct spray-	6-8 hbs per 400 sq.m	by pulling up plant and trimming off roots and damaged leaves.
Celery	lettuce Control- crop rotation and resistant vars.	ing on crop, but not expected to injure crop.	8-10 hbs	Celery requires plenty organic manure and moisture in soil.
Parsley	All crops hardy compared to other vegetables	Grammoxone for Pre-plant weeding or post-em contact weedicide	5-8 hbs	
Chard or Seakale		Do not spray on crop.	6-8 hbs	Crop has large round rough seeds like beet Direct planting.
Spinach			10-12	*½ recomm. popn for trailing vars.
Calaloo or Chinese Spinach	(* All data for 1 sq. chn or 400 sq. metre.)		8-12	General practices like land prepn etc same as Beans

Section 5. SOME PLANTS WITH PARTS USED AS VEGETABLES.

Chapter 24.

This chapter will deal with certain vegetable crops that are not familiar to most people as vegetables. We pass them daily along the streets, in our homes, and we want food to eat, yet we do not know that these plants can be eaten. Not much details will be given on how to grow them. As we have seen earlier, few people even know that they are crops.

Individuals who have never eaten these, may try to do so. However the aim of this book is to bring these crops to the attention of governments and farmers organizations in tropical countries. Then work could be done on what part of the plant is best and how to prepare it as food. Here again the school can be helpful to the community. Students could grow small plots of the crop on the farm. Then, in their cooking class, they work on how to prepare food. After this, farmers could be encouraged to grow these crops for market.

Reference - Most of the information in Chap. 24 has been taken from "Tropical Vegetables" by Prof. G.J.A. Terra, Director NEDERF. Communication No. 54e of the Department of Agriculture Research. (Netherlands) 1966. Much of data is from Indionesia.

Asparagus

Asparagus is a perennial herb (grow for more than one year, with flesh underground root. The plant sends up young shoots which are reaped as vegetables when 4-6 ins high. The first reaping is usually done about 1½-2 years after planting and lass for 4-8 weeks season. The crop might last for 5-10 years. Leave to grow up later from seed or organs.

Arrow-root

Arrow-root is a perennial herb with big leaves and small white flowers. It produce a fleshy root system. This can be cooked in soups and sauces or used to make flour. Protein content: tuber 0.1-1.7%.

Banana

Banana grows well in most tropical countries. The plant grows to heights of 8-12 ft and is known for the fruits eaten both green and ripe. The young flowers and leaves can also be eaten. The leaf sheath and stalk can be made into a paste which is then baked into a kind of bread. Protein content: fruit 1-2%, young flowers 0.5-1.9%.

Bread-nut

The breadnut tree is one that if not pruned will grow into a large plant. It produce small fruits that can be eaten. Young leaves and shoots can also be cooked and eaten. Protein content: young leaves and shoot 3.2%.

Cashew

The cashew tree if not pruned will also grow into a large plant. Its fruits and seeds are eaten and is a favourite particularly among children in the tropics. The young leaves and shoot can be eaten as a vegetable. Protein content: young leaves and shoot 3-8 -5.2%.

Chives

Leafy part of the plant used for seasoning like onion

Coconut

The coconut tree is well known in tropical countries for the fruit it produces. The water is wonderful for quenching the thirst. The flesh (meat) is used for a number of purposes, ranging from making coconut oil to grater-cake. However, as a vegetable, the palm cabbage ie. the young unfolded leaves are very useful. Protein content: palm cabbage 1.7% flesh 7%, water 0.3%.

Dandelion

The wild dandelion can be eaten as a leafy vegetable. If is commonly found as weed in pastures where it tend to kill out grasses. But it is cultivated in certain parts of the North America and Europe. The most commonly cultivated varieties resemble Endive and are developed from the wild dandelion.

Dasheen (or Taro)

Dasheen is a plant known to most tropical peoples for its underground parts. Not only the root part, but the young leaf and leaf stalk of most varieties can be eaten. When cooked they are somewhat slimy. Protein content: young leaves 3.5-7% stalk 0.3 - 1.5% and tuber 1.3-3%.

Garlic

Garlic is a crop known for its swollen stem. In many ways it is grown like onion, and is also used mainly for seasoning. Protein content: bulb 5-7%, leaves 2-2.5%.

Garden Cress

The plant is a herb with small leaves. These can be steamed or eaten raw as a salad. Protein content: 4-6%.

Jack-fruit

The jack fruit plant if not pruned, usually grows into a very large tree. It produces big fruits which are prickly on the outside.

Both the ripe fruits and cooked or roasted seeds can be eaten. This is well known to most tropical peoples. What is not well known is that the young fruits and shoots can be used as a vegetable in sauces and soups. Protein content: young fruit 1.5 -2.6%, ripe fruit 2%, young seeds 2.5%, ripe seeds 8%.

Jerusalem artichoke

Jerusalem artichoke is fairly well known as a vegetable. Its underground portion can be eaten in a variety of ways.

Mango

Mango is known by most if not all tropical peoples for its ripe fruit. People look forward each year for mango season. Then, life is usually so hard for many people as mango replace much of the regular diet. Not only ripe fruits, but also young ones and shoots can be eaten. Protein content: young leaves and tops 3-4%, young fruit 0.1-1%

New Zealand Spinach

The plant is a small perennial herb with fleshy leaves and yellow flowe These leaves and tops can be eaten as spinach. Protein content: 1.5-4%

Papaw

Papaw produces large hollow fruits which when ripe are orange to red inside and quite tasty. Although older leaves are bitter, the young leaves, shoot and fruits can be eaten as vegetable. Sometimes, the swollen roots are eaten by some people in the tropics. Protein content: young leaves 2.5-8%, young fruits 1-2%

Rhubarb

Rhubarb is fairly well known in the tropics as a vegetable. It produce long leaf-stalks which can be used in sauces and soups.

Sorrell

Sorrell is most known for the drinks made from the leafy portion covering the fruits. However, in some varieties, the leaves can be used as a vegetable. Protein content: 1.5-3%

Tamarind

There are different types of tamarind that can be eaten as a vegetable. The ordinary tamarind is most known for its ripe pods, a favourite among children and adults alike. However, its young leaves can also be eaten. This is also true of horse tamarind (also called wild tamarind). The young pods and flower of tamarind can also be cooked and eaten. Protein content: leaves 6-10%, young pods 4% and flowers 4-7.3%.

Yam

Yam is commonly grown in the tropics for its root tuber. The leafy above growth is usually thrown away. This is actually throwing away food as the young leaves of some species can be eaten.

Part 3. LIST OF MAIN REFERENCES

(In addition to those used in Parts I & 2).

1. "Agricultural Science for West African Schools"

by Adegbola, Are, Ashaye & Koniolafe.

2. " Asgrow Seed Catalogues."

3. "Caribbean Farming (1970)"

by Faculty of Agric. (.U.W.I).

4. " Farmlife - Oct.1969"

by Farm-life Publications

5. " Papers from Vegetable Seminar 1974"

by Crops and Soils Division (Ja.)

6. " Keystone Seed Catalogues

7. " Tropical Vegetables

by G. Terra.

8. " Vegetable Growers Handbook"

by Agricultural Information Service (Ja.).

FECHA DE DEVOLUCION