

GUIDEBOOK FOR DEVELOPMENT OF VEGETABLE HORTICULTURE

WITH CAPABLE SEED PRODUCTION IN BANGLADESH

— Adaptable also in the countries having similar climatic condition —
— of the Subtropical Monsoon Area —

January, 1980

**CENTRAL EXTENSION RESOURCES DEVELOPMENT INSTITUTE
BANGLADESH**

JAPAN INTERNATIONAL COOPERATION AGENCY

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— Adaptable also in the countries having similar climatic condition —
— of the Subtropical Monsoon Area —

by

Dr. Suteki SHINOHARA
Former Japanese Expert

January, 1980

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PREFACE

This book has been written to show the way how to develop vegetable production in Bangladesh as well as in the countries having similar climatic condition of the subtropical monsoon areas, introducing promising vegetable varieties as well as developing capable seed production among them. The suggested Cropping Patterns showing the possible range of production season of respective vegetable kinds and varieties have been designed based on the results of a series of actual trials executed in Dacca and some other places in Bangladesh.

The description is divided into the following three Parts:

- Part 1. Table of Prospective Adaptation of Various Promising Introduced Vegetable Varieties Respectively
- Part 2. Report of Trials on Various Introduced Vegetable Crops in Bagladesh and Thereby Some Suggestions for Their Cultivation and Capable Seed Production
- Part 3. Agro-Climatological Review on the Diametrical Difference of Vegetation Between Dry and Rainy Seasons of Bangladesh

In Part 1, the Table covers 25 different kinds and sorts of vegetable crops which consists of Tables of possible range of Cropping Patterns for respective items together with a brief explanation of the nature of each crop as well as brief notices on each cropping pattern itself respectively.

In Part 2, the report consists of 11 Chapters and 2 Annexes covering the results and observations in the trials on more than 25 different kinds and sorts of vegetable crops as well as properly discussions and notices connected with the fact findings in the trials.

In Part 3, the climate of Bangladesh is precisely examined in connection with plant growth physiology comparing with those in the places where the introduced varieties have come from as well as a few related places.

Generally, it can be said that all the descriptions and suggestions in this series of papers are composed of crop ecology, in the other words, this paper as a whole expresses what is the crop ecology, the most useful science for the development of vegetable horticulture finding out the adaptability of crops.

There are two ways to find out the adaptability; that is, one is setting the place then find out the adaptable crops or varieties while another is setting the crop or variety then find out the adaptable places. In the case of Bangladesh, she consists of a plane land without any cool highland and has almost no diversity of climate condition in temperature. She is really as if a simple land as viewed from this point. Accordingly, the adaptation of vegetable production searched here is depended on the former manner, that is why a Year-Round-Supply Production designed here is settled by means of choosing various kinds of vegetable varieties instead of selecting the places for one kind. Therefore, it can be understandable that this description shows the adaptation to lowlands subtropics in other countries than Bangladesh.

This book is written by the expert arranging his fact findings during his stay in Bangladesh from April, 1977 to April, 1979. The expert wants herewith to express his sincerely acknowledgement for the persons helped him on his work. Dr. Shoichi Nakata of the Team Leader, Dr. Azizul Huq of Minister of Agr. and For. and Mr. Abdus Sattar of CERDI for their warm watching of his activities. For their special help of Dr. Altaf Ali of Planning Commission in wiping off the difficulties the expert faced, of Mr. Mofazzal Hossain of the counterpart of CERDI and Mr. Nobutaka Shioi of a member of JOCV in their earnest help in the examination of trials, Mr. A. Samad of Chairman, Mr. Huda of Manager of BADC and Mr. Kahn of Director of BADC Kashimipur Field in their execution of extension and seed production for the introduced S-E Asian vegetables and all the experts in the Team. The expert is also much obliged for their contribution of the vegetable seeds for those trials to Kasetsart University, Thailand, of their valued foundation seeds, to Chia Tai Seed and Agricultural Co., Thailand, of their plenty of Siamese variety seeds, to Known You Seed Co., Taiwan, of their series of Chinese variety seeds as well as Sakata Seed Co., Takii Seed Co. and Kyowa Seed Co., Japan, of their Japanese variety seeds.

December, 1979



Dr. Suteki SHINOHARA
Crop Ecologist cum Vegetable Horticulturist

Plate 1. Diametrical Difference of Views of Agricultural Land in Fully Flooded Season and Drained Season



A. Fully flooded view of agricultural land along the Mymensingh Highway about 60 km north from Daoca. Real river is only a part of this side, compare with right side of B. Most part of right side area is a brick production place in dry season, upper left side is a paddy field area in drained season, shadowed visible at left upper side of B Photo in August.

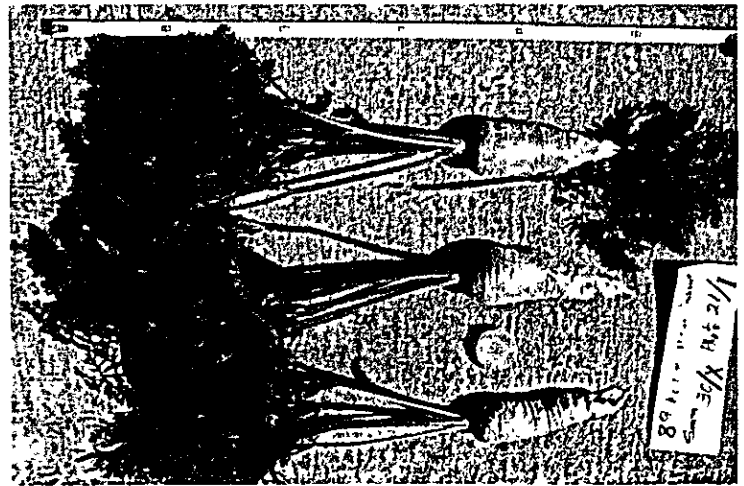
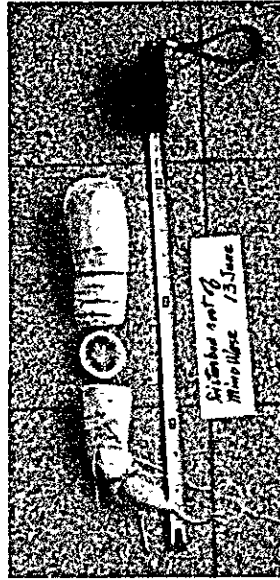
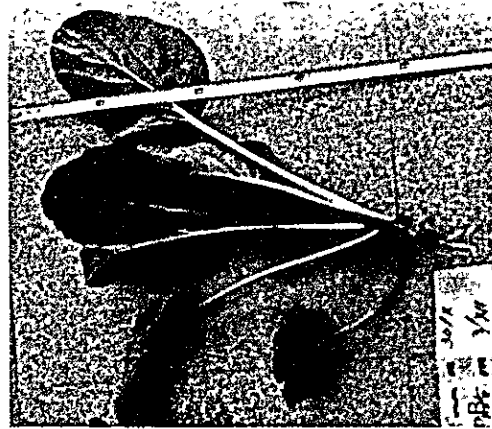
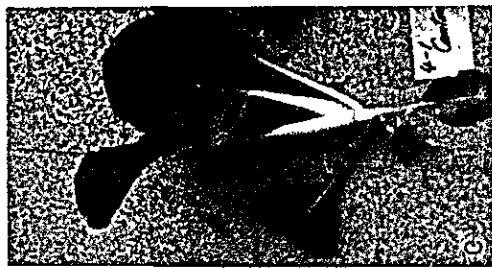


B. A fully drained view of the same place in April, a central part of A.



C. Another fully drained view of agricultural land in April, just opposite side of the land of A, acrossing the Mymensingh Highway. This view is almost the same situation as the upper left side of A, growing Boro rice by pumping up the irrigation water from the river.

Plate 2. Highlight of the Results of the Trials



Examples of Short Period Leaf Vegetables for Rainy Season

- A. Surugana
- B. Green Choisan
- C. Canton Petai
- D. Kangkong (Left, Thailand and Right, Taiwanese Cultivar)

An Example of Excellent Performance of Dry Season Vegetable.

- E. Koizumi Gosun Carrot

Examples of Troubles in the Cyclonic Seasons

- F. Boron Deficiency on Mino Early Radish Happened in the First Cyclonic Season
- G. Terrible Virus Damage on Tropic Ace Tomato Happened in the Second Cyclonic Season

P A R T 1

PART 1
TABLE OF PROSPECTIVE ADAPTATION OF VARIOUS PROMISING
INTRODUCED VEGETABLE VARIETIES RESPECTIVELY

GENERAL REMARKS

This Table has been written as an accomplishment of the results of a series of the expert's works obtained in his own and supervised vegetable trials in Dacca, Joydevpur and Kashimipur as well as in his observations of vegetable growing at various Institutes and farmer's fields in several different Districts in Bangladesh which are precisely reported in PART 2.

1. BACKGROUND

The expert has realized Bangladesh vegetable horticulture in a short that her Dry season is a paradise while her Rainy season is a hell of their growth. That is, in the dry season from November to March, every one can easily succeed in almost all kinds of vegetable varieties cultivation including those temperate zone origin so that there is much possibility even to export some of them to neighbouring countries, while in the rainy season from April through October, the suitable vegetables capable to be grown are very much limited in the tropical and subtropical origin varieties and most of temperate zone origin varieties are very hard to be grown except very limited items like leaf onion, as far as the expert observed and experienced during those two years. The latter problem is to be the reason why the seasonal shortage in vegetable supply happens in Bangladesh.

Accordingly, the expert has concluded that the biggest problem in Bangladesh vegetable production could be how to achieve in increasing vegetable production by means of overcoming the rainy season condition in order to fulfill the shortage.

The countermeasure could be achieved by the following two ways:

(1) To introduce South East Asian short period vegetables into rainy season vegetable culture since most of present local vegetables take long time for harvesting after their planting which condition makes a gap of harvests between the previous and newly planted ones, that is, the shortage period.

(2) To introduce modern horticultural materials such as plastic film and nets, as sheltering and shading onto covering the nursery beds, to stabilize seed-germination and young seedlings growth during the rainy season especially in the cyclonic season, in order to avoid heavy rains and subsequent strong sunshine. It should be also helpful for the same purpose to introduce a pot raising seedlings method into cucurbitaceous crops such as watermelon, gourds, squash, cucumber etc. changing their cultivation manner from a direct sowing to a transplanting culture so that their sowing time could be very much extended by stabilizing the germination in April and May and thereby results in widen the harvesting time in remarkable extent.

2. DESIGN OF CROPPING PATTERN

Another side of problem in the present Bangladesh horticulture is that the seed sowing time of each vegetable seems to be very limited or only one time in their season so that the

period of harvesting time is thereby limited in rather short period than their potentiality under the available climatic condition. The sowing and planting times, however, can be extended in the possible range under the available climatic condition so that their harvesting period could be very much widened. By this manner, a fulfilling of vegetable shortage can be also achieved.

This Table has been designed aiming at to show clearly the above mentioned manner to extend respective vegetable production period as long as possible and also to show the following basic points of cultivations:

- (1) To show the concept of vegetable "Cropping Pattern" which could be settled so much wide range in each vegetable cultivation.
- (2) To show the range of adaptability of each vegetable under Bangladesh climatic condition.
- (3) To show the best growing season of each vegetable and its capable range, expressing both seasons per their own nature and per counting marketing benefit.
- (4) To show the right idea on the own nature of respective kinds of vegetables in comparison of tropical and subtropical sorts with temperate zone sorts, that is, the idea of "Crop Ecology" or "Genecology".

Inasmuch as vegetable culture is firstly affected by climatic condition, those cropping patterns have been designed referring the climate condition. The expert has classified the climate of Bangladesh into 4 seasons of 1st Cyclonic season, Dense Rainy season, 2nd Cyclonic season and Dry season which have been set up by referring firstly to his experience during those two years and secondly to his examination the Meteorological Data of Bangladesh (1967 - 1976), which is explained precisely in PART 3. Accordingly, those 4 seasons with their characterized components are clearly illustrated at the head of those cropping patterns.

This design, however, must be said but a foreigner's prospection. Accordingly, the designs of cropping patterns for respective vegetables in this Table might have some deviation from practical dates executing at the given place, although he guesses yet it suggests that those deviation could be fallen into within 10 days or two weeks according to his comprehensive knowledge of crop ecology and experience in his long research work. The expert would like therefore to hope you sincerely to confirm the real response of each vegetable variety by your own trials referring those designs shown here and adjust them under actual conditions at your given places.

REMARK:

The concept of so-called Cropping Pattern (SAKUGATA or SAKUKI in Japanese) is now a day very popular in Japan, using it to show clearly the possible range of growing season of the said crop on the level of said variety and said place. This pattern of expression can be seen everywhere in the guidances of vegetable cultivation in Japan, for example, in textbooks, pamphlets of vegetable extension, as well as those illustrations on catalogues and commercial seed package offered from Japanese seed companies.

This concept has been developed in the field of Japan's vegetable horticulture during and just after World War II which had helped tremendously for the development of "Year-Round-Supply Culture" in various vegetables in Japan, utilizing compound factors of climate and soil conditions as well as plastic film covering condition and so forth. The expert has been one of a

few leading horticulturists who developed this concept in Japan. The attached Annex figure of All-Year-Round Culture of Cabbage shows one of the examples of the concept which had been designed by him when he was devoted to promote to settle the year-round-supply of cabbage utilizing different climatic places of highlands, warm places as well as ordinary lowlands in Japan nearly ¼ century ago.

The expert, therefore, would like herewith to recommend you to introduce this idea into the fields of vegetable research as well as extension in Bangladesh for the arrangement of various conditions and ideas of vegetable cultivation into a single figure.

All the cropping patterns indicated in the Tables show the capability of range of growing seasons for respective vegetable kinds and varieties as viewed from climate condition. Those croppings can be therefore materialized only by means of elaborated intensive cultivation manners and if the cultivation is done carelessly and roughly, a part of suggested cultivation may result in failure, especially in the most severe season from April through June. In case of failed in, it should not be a blame of the cropping pattern itself but should be understood as the blame of careless and inexperienced cultivation manners themselves.

Annex:

Illustrations of all-year-round-supply cultures of cabbage in Japan explaining how to arrange combining various complicated factors and conditions to set up it. This illustration is extracted from the expert's paper, "Adaptation of Cabbage to Year-Round Culture in Japan" published in Economic Botany, 19(3), 1965, USA.

Fig. 1. Relation of Cultivation Types of Cabbage to the Mean Monthly Temperatures of Three Regions of Culture in Japan

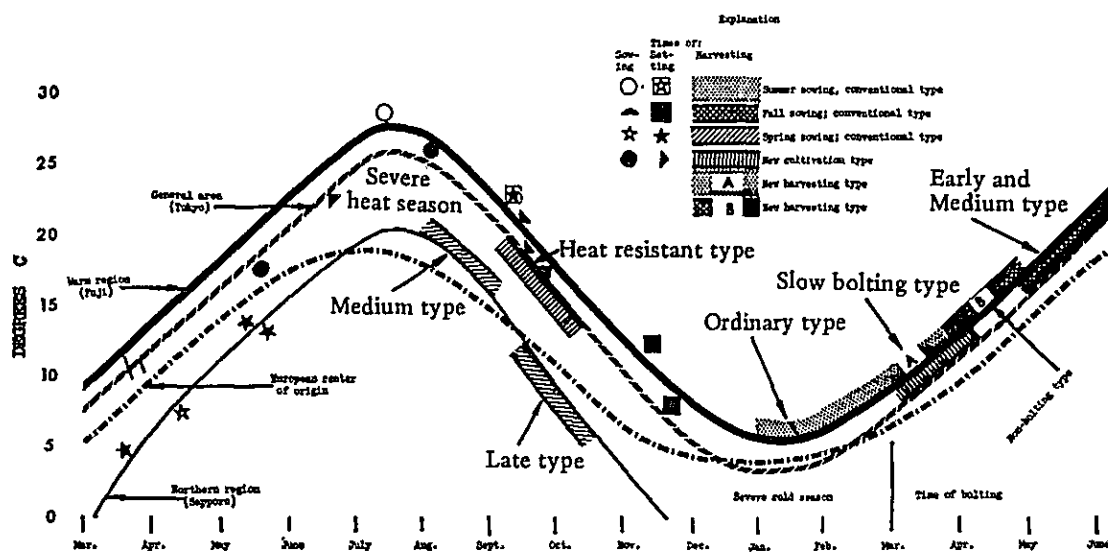


Fig. 2. Cultivation Types and Varieties of Cabbage Grown in the General Area (Middle Area) of Japan

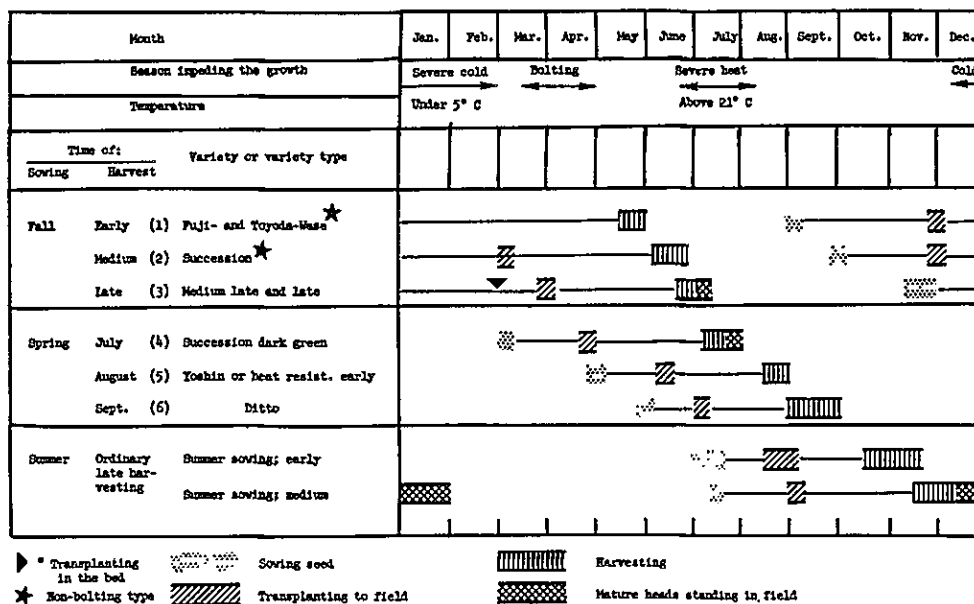
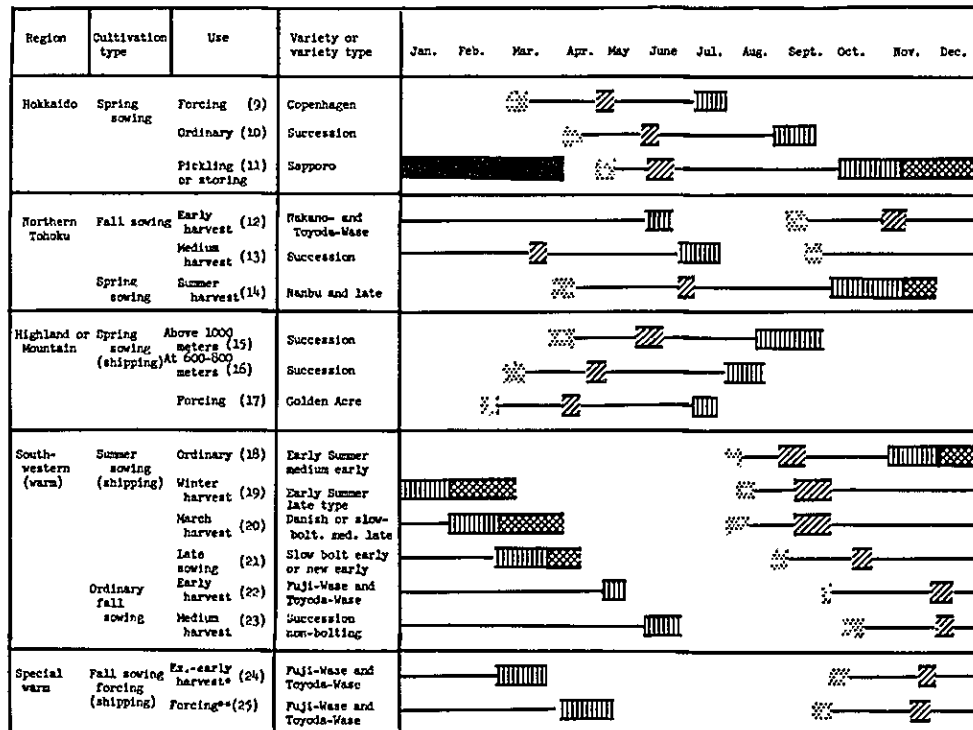


Fig. 3. Cultivation Types and Varieties of Cabbage Grown in Special Regions of Culture in Japan for Completing a Supply Throughout the Year



*At Hachijo Island ** At Fuji-shi

PROSPECTIVE ADAPTATION		
1. BASIC CLIMATE CONDITIONS OF VEGETABLES		
Calendar Time	Mar	Remark
	M E	
Weather Conditions	Four Seasons	Some times seasons are divided into 6 in Bangladesh but these 4 seasons may be enough to consider vegetable cultivation.
	Precipitation	a. 1st and 2nd cyclonic seasons are characterized by alternative happening of heavy rains and subsequent severe dryness by strong sunshine.
	Humidity	b. Dense rainy season is characterized by frequent long soft rains and small difference of daily maximum and minimum temperatures.
	Temperature	Both a. and b. much disturb vegetable growth, that is, like hell especially for temperate zone vegetables.
	Temperature in the Day between and Minimum	c. Dry season seems to be paradise for vegetation if irrigation facilities is available.
Daylength Condition (Astronomical Four Seasons equinox)		September to March functions to be short-day period and April to August functions to be long-day period in general speaking. Sep. to Dec. functions also less vernalizing for tropical Crucifers.
2. ADAPTATION OF SOUSAGE AT THE RAINY SEASONS		
Crop. Patt. No.	Kind and Variety Names, Origin and Title of Cropping Pattern	Remark
	Mar M E	
	CANTON PETSAL and GREEN CHOISAN	Scientific name: <i>Brassica chinensis</i> (n=10). The most popular brassica greens in S-E Asian countries especially in suburban vegetable production areas. Canton Petsal is a non-bolting harvest type and Choisan is a bolting harvest type with some 10 cm flowering stalk. Both can be harvested at 30 - 35 days after sowing and bundled for marketing. Very smoothly grown up in rainy season.
	(1) Beginning of marketing culture (2) Mid-season of marketing culture sowing at every 7 - 10 days interval (3) Best season for the growth but it is at competing with other better (4) Seed production cultivation	○ - Sowing time □ - Harvesting period ☞ - Seed-plant selection and transplanting time ▣ - Seed harvesting period
Characteristics and brief notice of the above cropping patterns	(1) The (2) Most at ev (3) Due a lon (4) This or ro	

PROSPECTIVE ADAPTATION (CROPPING PATTERNS) OF VARIOUS NEWLY INTRODUCED VEGETABLE VARIETIES INTO BANGLADESH

1. BASIC CLIMATE CONDITION CONCERNED TO SET UP FOLLOWING CROPPING PATTERNS FOR RESPECTIVE KINDS AND VARIETIES OF VEGETABLES

Calendar Time	Month	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Remark
	Decade Days	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	
Weather Conditions	Four Season in Weather Type	FIRST CYCLONIC SEASON			DENSE RAINY SEASON			SECOND CYCLONIC SEASON		DRY SEASON				Some times seasons are divided into 6 in Bangladesh but these 4 seasons may be enough to consider vegetable cultivature. a. 1st and 2nd cyclonic seasons are characterized by alternative happening of heavy rains and subsequent severe dryness by strong sunshine. b. Dense rainy season is characterized by frequent long soft rains and small difference of daily maximum and minimum temperatures. c. Dry season seems to be paradise for vegetation if irrigation facilities is available.
	Precipitation Condition	Cyclonic showery rains, more frequently come towards the end			Predominated soft but long hour rains			Heavy but short hour showery rains, less towards end		Almost no rain but a few rains come sometimes at the end of season				
	Humidity Condition	Gradually higher towards the end			Highest			Gradually being lower towards the end		Low	Lowest	Lowest		
	Temperature in general	Highest			High			High to Highest		Lowest		Low to Medium		
	Temperature Condition in the Difference between Daily Maximum and Minimum Temperatures	Gradually smaller towards the end			Smallest (sometimes 2 - 3°C on individual days)			Gradually larger towards the end		Largest (Sometimes more than 15°C per day)				
Daylength Condition (Astronomical Four Seasons)	12.00 - 13.40 hrs. Extending to long day Summer solstice			13.40 - 12.00 hrs. Long day to shortening Autumn equinox			12.00 - 10.20 hrs. Shortening to short day Winter solstice		10.20 - 12.00 hrs. Short day to extending Spring equinox				September to March functions to be short-day period and April to August functions to be long-day period in general speaking. Sep. to Dec. functions also less vernalizing for tropical Crucifers.	

2. ADAPTATION OF SOUTH EAST ASIAN SHORT PERIOD LEAF AND ROOT VEGETABLES AIMING AT THE RAINY SEASON IN BANGLADESH, SHOWN WITH VARIOUS PROSPECTIVE CROPPING PATTERNS

Crop. Patt. No.	Kind and Variety Names, Other Names and Title of Cropping Patterns	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Remark
		B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	
	CANTON PETSAL and GREEN CHOISAN													Scientific name: <i>Brassica chinensis</i> (n=10). The most popular brassica greens in S-E Asian countries especially in suburban vegetable production areas. Canton Petsai is a non-bolting harvest type and Choisan is a bolting harvest type with some 10 cm flowering stalk. Both can be harvested at 30 - 35 days after sowing and bundled for marketing. Very smoothly grown up in rainy season. ○ - Sowing time □ - Harvesting period ♡ - Seed-plant selection and transplanting time ⊞ - Seed harvesting period
	(1) Beginning of marketing culture (2) Mid-season of marketing culture, sowing at every 7 - 10 days interval (3) Best season for the growth but facing at competing with other better vegetables (4) Seed production cultivation													
Characteristics and brief notice of the above cropping patterns	(1) The earliest sowing time; Possible to grow but needs frequent watering during April and May. (2) Most promising time for marketing culture to fulfill the vegetable shortage from Jul. up to Oct. by means of continuous sowing and harvesting at every 7 - 10 days interval. (3) Due to getting lower night temperature and later flower bud differentiation by shortening day-length, this season delivers their best growth with a long standing and big plant performance for 60 - 80 days no bolting but not always promising by competing with other better vegetables. (4) This type of Brassicas can easily produce their seeds under Bangladesh condition under this cropping pattern but needed a seed plant selection or roguing to maintain the purity of variety.													

2. (Continued)

Crop. Patt. No.	Kind and Variety Names, Other Names and Title of Cropping Patterns	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Remark
		B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	
KAILAAN, Narrow Leaf or Stem Type	(1) Earliest sowing time for marketing													<p>Scientific Name: <i>Brassica albogabra</i> (N=9)</p> <p>One of the popular brassica greens in S-E Asian countries with its tolerant habit to heat and humidity of monsoon tropics and subtropics.</p> <p>Narrow leaf type is used its swollen juicy stem usually by one time harvest while Broad leaf type is used picking its young shoots with a few large tender leaves by a few times harvesting from the stump specially in home garden.</p> <p>○ – Sowing time ▽ – Setting time from nursery bed □ – Harvesting period/periods ⊗ – Seed-plant selection ♣ – Seeding stump after selection and harvest the top</p> <p>These two types of seeding plants can be transplanted in the seed production field after seed plant selection. Both types of Kailaan have white flower despite of yellow flowers in other cabbage group plants.</p>
	(2) Mid-season of marketing culture with continuous sowing and harvesting at every 2 weeks interval													
	(3) Best season for the growth but facing at competing with cauliflower etc													
	(4) Seed production cultivation													
KAILAAN, Broad Leaf or Leaf Type	(1) Earliest sowing time for marketing													<p>Characteristics and brief notice of the above cropping patterns</p> <p>(1) The earliest sowing time is possible to grow but needs careful frequent watering in the growing period.</p> <p>(2) Most promising growing time for marketing to fulfill the vegetable shortage from June through October.</p> <p>(3) Due to the reason mentioned in Canton Petsai, this season delivers the best growth also to Kailaan with stouter stem and leaves by means of later flower appearance but being competed with other better quality vegetables like cauliflower, broccoli and heading cabbage.</p> <p>(4) Differing from ordinary cabbage and Chinese cabbage, Kailaan can produce easily seeds under Bangladesh condition providing seed plant selection, it can produce seeds from the top harvested stumps.</p>
	(2) Mid-season of marketing culture with continuous sowing and harvesting at every 2 - 3 weeks interval													
	(3) Best season for the growth													
	(4) Seed production culture a. From stump b. From main stem													
CHINESE RADISH, 55 Days	(1) Earliest sowing time for marketing													<p>Scientific Name: <i>Raphanus sativus</i> (N=9)</p> <p>So-called Chinese radish mentioned here belongs to subtropical and tropical type of Chinese radish which is distributed from south China, Taiwan and all parts of S-E Asian countries.</p> <p>Variety, "55 Days" is a medium early variety popular in Thailand.</p> <p>There are several shapes of varieties of this type Chinese radish in Taiwan, that is, roundish one to long cylindrical one, and 55-Days is a medium long shape one belonging one of them.</p> <p>Almost all the varieties have tasty tender long leaves with entire margin without hair.</p> <p>♣ – Seed plant selection and transplanting time</p>
	(2) Mid-season of marketing culture with continuous sowing at every 10 - 15 days interval													
	(3) Best season for the growth													
	(4) Seed production cultivation													
Characteristics and brief notice of the above cropping patterns	(1) Chinese radish can start growing from this time. Getting a brown heart disorder with Japanese radish, radish cultivation in this season should be chosen Chinese radish but care of watering.													<p>(1) Chinese radish can start growing from this time. Getting a brown heart disorder with Japanese radish, radish cultivation in this season should be chosen Chinese radish but care of watering.</p> <p>(2) Most promising season for Chinese radish cultivation since local radish of Red Bombay doesn't grow good root in this season, that is, while Red Bombay delivers only leaf, Chinese radish produces both tender leaves and excellent roots during rainy season.</p> <p>(3) Due to the time of shortening of day-length, flower appearance very much retards even with Chinese radish, so, it grows larger and excellent quality root more than double size of summer products. In case of aiming at only root, Japanese radish may be more productive in this season but in case of aiming at both tender leaf and root, Chinese radish may be still choosable for market culture.</p> <p>(4) Differing from Japanese radish, Chinese radish can normally produce seeds under Bangladesh condition. To maintain good genetical quality of the variety, Seed-plant selection by means of selecting good shape of roots and transplantation into the seed production field should be essential.</p>
	(2) Most promising season for Chinese radish cultivation since local radish of Red Bombay doesn't grow good root in this season, that is, while Red Bombay delivers only leaf, Chinese radish produces both tender leaves and excellent roots during rainy season.													
	(3) Due to the time of shortening of day-length, flower appearance very much retards even with Chinese radish, so, it grows larger and excellent quality root more than double size of summer products. In case of aiming at only root, Japanese radish may be more productive in this season but in case of aiming at both tender leaf and root, Chinese radish may be still choosable for market culture.													
	(4) Differing from Japanese radish, Chinese radish can normally produce seeds under Bangladesh condition. To maintain good genetical quality of the variety, Seed-plant selection by means of selecting good shape of roots and transplantation into the seed production field should be essential.													

2. (Continued)

C. P. No.	Kind and Variety Names, Other Names and Title of Cropping Patterns	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Remark
		B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	B M E	
	BROAD LEAF MUSTARD and TROPICAL CHINESE CABBAGE (1) Earliest sowing time for marketing (2) Mid-season of marketing culture with continuous sowing at every 2 weeks interval for rainy season (3) Best season for the growth (4) Seed production cultivation													Scientific Names: <i>Brassica Juncea</i> (N=18) and <i>Brassica Pekinesis</i> (N=10) These tropical types of mustard and Chinese cabbage have good tolerancy to heat and high humidity and widely spread in S-E Asia. They grow up 4 - 5 times bigger plants and tender and tasty than Chiosan and Petsai, so, they need 4 - 5 times sparer spacing and 50 - 60 days in rainy season and 60 - 70 days in dry season. Solted pickles of Broad leaf mustard with wide midrib is an important preserves for lacking season of green vegetables in S-E Asia since it can be preserved rather long period.
	Characteristics and brief notice of the above cropping patterns (1) Marketing culture can be started this period but it needs frequent watering up to June. (2) Most promising time for marketing culture sowing continuously at every 2 weeks intervals. Sparer spacing than Choisan and grown much bigger, these mustard and Chinese cabbage are harvested at 50 - 60 days after sowing during rainy season. (3) Due to the same reason mentioned in Canton Petsai, this season delivers best performance for them, so, good for marketing also in dry season since they are grown much easier than Japanese varieties. (4) They can produce seed easily in Bangladesh like Choisan and Petsai.													
	KANGKONG (ENTSAL) A. One time harvest culture (1) Earliest sowing time for marketing (2) Mid-season of marketing culture with sowing at every 2 weeks interval (3) Latest sowing time for marketing B. Several time harvesting culture (4) Start from seed sowing (5) Start from vine cutting (6) Start from root dividing (7) Seed production started from cutting	4	5	6	7	8	9	10	11	12	1	2	3	Scientific Name: <i>Ipomoea aquatica</i> The same species as local Kalmishak which is a wild type spread in Bangladesh and Thailand, but Kangkong is a cultivated type developed in south China and Taiwan which can be grown in the field and much more productive and has excellent quality leaf and stem with no fibrous and harshness. Some cultivar develops long vines but the good cultivar developed in Taiwan is a dwarf type and has narrow long shaped light green leaves, pale green stem and pure white flower, the best quality type, while local Kalmishak has roundish heart shaped dark green leaves brownish green stem and purple flower. Kangkong is also one of the most popular leaf greens in S-E Asia. It is mostly grown along canal or convenient places of irrigation since it prefers moisty air and soil. The best growing plant in rainy season, June to August.
	Characteristics and brief notice of the above cropping patterns Kangkong can be grown in two manners of one time harvesting and several time harvesting. The former is usually applied for marketing culture because the products with roots are more tolerant to withering in the market and the latter is more suited for home garden and local marketing because it can save the seeds and easier to manage. The former, every time sowing, start from B. of March (1), be mid-season from B. of May through M. of August at 2 weeks interval sowing (2) which performs the best growth and quality due to high humidity, and ends the sowing usually at B. of October since the weather is getting to be dry and starts flowering very early (3); the spacing may be 12" apart linear sowing. In the case of latter, once starts from seed sowing in April at 18" apart lines, thin up gradually and harvest several times picking the young shoots (4), be propagated by vine cutting like sweet potato any time of picking shoots (5), and also be propagated by root dividing when the plants are grown up too large and aged (6), that is, to be regenerated; the spacing may be 18" x 4". (7) Seed production cultivation may start from vine cutting selecting the good type of plants in August at a spacing of 24" x 6", after one or two time shoot harvests, allow flowering as it is arround in October, the seed-pods can be harvested arround in December some 30 - 40 days after flowering. Since Kangkong belongs to short-day plant the best time of seeding is autumn.													
	LEAF AMARANTH, (CHINESE SPINACH) (1) Earliest sowing (2) Mid-season of sowing for marketing (3) Seed production cultivation	4	5	6	7	8	9	10	11	12	1	2	3	Scientific Name: <i>Amaranthus mongastanus</i> Seems to be the same species as local Danta and Lalshak. While local amaranth are usually harvested at large stage of 2 - 3 month old plants, Leaf amaranth in south China and S-E Asia is usually harvested at young stage of some 30 days old plants. The best variety developed in Taiwan has large roundish shaped light green leaves, tender and no harshness.
	Characteristics and brief notice of the above cropping patterns This type of leaf amaranth, different to LARSHAK, is grown to harvest young plants of 8 - 10" height with 6 - 8 large roundish leaves at 30 - 35 days after sowing. Although it can be grown all year roundly, due to many othr good leaf vegetables are available in the market in dry season, interesting production period of this amaranth may be from April through November, as shown in the above cropping pattern. Best season of seed production may be harvesting in October counting its long-day habit and dryness.													

3. ADAPTATION OF SOME S-E ASIAN AND JAPANESE VEGETABLES WITHSTOOD UNDER RAINY SEASON CONDITIONS AS WELL AS DRY SEASON IN BANGLADESH INCLUDING SOME LOCAL VARIETIES

C. P. No.	Kind and Variety Names, Other Names and Title of Cropping Patterns	Apr B M E	May B M E	Jun B M E	Jul B M E	Aug B M E	Sep B M E	Oct B M E	Nov B M E	Dec B M E	Jan B M E	Feb B M E	Mar B M E	Remark
	SUPER SWEET CORN, DMR, K.U. No. 1													<p>Scientific Name: <i>Zea mays</i> This variety was bred at Kasetsart University, Thailand and is very promising to be grown in Bangladesh because of the following reason: With super sweet character (gene=bt₁), the corn is not only having excellent quality of tender and sweetness but also can be maintained the quality for 3 - 4 days after harvested, absolutely different to ordinary frint corn which can maintain fresh eating quality only 5 - 6 hours after harvested. This long life character delivers the products to be distant shipping in fresh marketing and also to be easier for processing. Moreover, with its resistancy to downy mildew, it shows very smooth growth and highest productivity during rainy season, to be a good member of rainy season vegetables. ♀ : Silking time (flowering of female ear)</p>
	(1) Best growing season for marketing, in rainy season (2) Winter harvesting culture, in dry season (3) Third growing season, harvesting in the hottest season (4) Seed production cultivation													
	Characteristics and brief notice of the above cropping patterns	<p>Since this variety has a short day habit, in case of sowing in March through June, it may not deliver flowers but continue only vegetative growth up to August, so, this season is not the cropping time.</p> <p>(1) The most promising growing season because it performs the smoothest growth and heavy yield from September through November with continuous sowing at every 2 weeks interval.</p> <p>(2) With its excellent eating quality, this corn may conquer the vegetable market also in January and February but it shows very slow growth during coolest time of December and January.</p> <p>(3) April and May harvesting culture may be also interesting because it is the second shortage time of vegetables. The performance, however, may be rather delicate or having a risk of retarded flower.</p> <p>(4) The cropping pattern shown in the above is the best season for seed production. In case of delayed sowing and maturity comes into December, seed may not completely mature due to low temperature.</p>												
	YARD LONG BEAN, Thailand	4	5	6	7	8	9	10	11	12	1	2	3	<p>Scientific Name: <i>Vigna sinensis</i> The same species as cow-pea but this is pole type with tender long pod for vegetable use. So-called Yard Long Bean here is a tropical pole bean spread widely from China through all part of S-E Asia and includes various types of varieties in their pod colour, seed colour and length and quality of pods but all of them have commonly cylindrical, thick, fiberless, tender and long pods. The Yard Long Bean mentioned here is introduced from Thailand and has short day sensitive habit being not suitable to grow under long day condition but have excellent quality of products.</p>
	(1) Autumn and winter harvesting culture, the main growing season. (2) Summer harvesting culture (3) Seed production culture													
	Characteristics and brief notice of the above cropping patterns	<p>Since Yard Long Bean mentioned here has a strong short day habit, this type of tropical pole bean can not be grown sowing from March through June.</p> <p>(1) The main growing season, sowing every 3 - 4 weeks interval, it can continue harvesting for several months performing very smooth growth, full flowering and heavy yield. However, the earlier sowing may be faced with virus disease and the later sowing may be faced with slow and less growth of pods during December to January.</p> <p>(2) This season may deliver also good result but the fault is very slow vegetative growth during December and January owing to the low temperature, and needs constant irrigation during dry season.</p> <p>(3) Seeds can be grown any time of cultivation but November is the best time considering virus disease and the worse maturing of seeds in cool season.</p>												
	LOCAL LONG BEAN, Bangladesh	4	5	6	7	8	9	10	11	12	1	2	3	<p>Local Long Bean mentioned here is also one of the type of the above pole bean but has worse quality pods than the above in its length, thin and somewhat tough. But with its less sensitive for short daylength, it can be grown during long day period starting from March. Accordingly, it is recommended that, using properly, Yard Long Bean should be grown during short day season and Local Long Bean should be utilized during long day period as shown in the cropping patterns, and complete a year round supply.</p>
	(1) Earliest growing season (2) Promising growing season for marketing													
	Characteristics and brief notice of the above cropping patterns	<p>Although this local Long Bean can be grown also the same season of the above Yard Long Bean, it is recommended to avoid the same production period of the above due to this type has worse quality of pods.</p> <p>(1) Earliest sowing time recommended to harvest earlier time, the second vegetable shortening time, but be careful for good watering and good management of aphid protection in young stage.</p> <p>(2) Most promising growing season for marketing.</p> <p>(3) The best time of seed production of this variety is the same as Yard Long Bean. In case of harvest seeds in August and September, be careful for virus infection since virus of bean will spread by seeds.</p>												

3. (Continued)

C. P. No.	Kind and Variety Names, Other Names and Title of Cropping Patterns	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar													
		B	M	E	B	M	E	B	M	E	B	M	E	B	M	E	B	M	E	B	M	E	B	M	E	
	<p>JAPANESE LEAF ONION, Nebuka and Kujo</p> <p>Adult plant growing: Nebuka and Kujo</p> <p>(1) Earliest sowing time for rainy season</p> <p>(2) Mid-season of cropping for rainy season sowing once in a month</p> <p>(3) Dry season culture</p> <p>Young plant growing using Kujo</p> <p>(4) Direct sowing culture on the bed sowing at every a few weeks</p> <p>Medium plant growing using Kujo</p> <p>(5) Seed sowing culture</p> <p>(6) Sucker planting culture dividing harvested large plants</p>																								<p>Scientific Name: <i>Allium fistulosum</i></p> <p>Differed from bulb onion and leek, this type of leaf onion is special one widely spread in North and East Asia and very much flourished in Japan as for variety development. Japanese Leaf Onion can be roughly divided into two types, that is, one stem type called "NEBUKA" and multistemmed type represented by "KUJO" variety. Both dark green type of Nebuka and Kujo performed very smooth growing during rainy season of Bangladesh, therefore, they must add into the rainy season vegetables.</p> <p>Although Nebuka needs several months for growing in case of aiming at adult plants of large compact blanched stem weighing 300 - 450 grams but utilizable its younger plants weighing 100 - 200 grams by about 3 months of growing. Earthing up is needed in case of blanching.</p> <p>Can be grown the same manner as Nebuka, KUJO is more suited to utilize younger plants due to having softer leaves, that is, sometimes 2 - 3 month old plants by direct sowing (4), sometimes harvested 2 - 3 months of growing weighing 100 - 200 grams without blanching, planting more dense spacing (5). It can be grown by suckering as shown in (6).</p>	
<p>Characteristics and brief notice of the above cropping patterns</p>	<p>The biggest problem in Leaf Onion culture is seed germination and raising seedlings, easier during dry or dryer season but almost no germination from May up to August. Linear sowing at some 15 cm apart on the seed bed. Since onion cannot be transplanted during very young stage, the seedlings grown for 50 - 60 days and the diameter become thicker than 0.5 cm are directly set in the growing field.</p> <p>The planting for the adult plant growing is spaced at 60 - 80 cm between rows and 4 - 5 plants per 30 cm. Earthing up at the bottom of rows to blanch the stem (exactly leaf sheath) after 45 - 60 days of growing. Harvest step by step from 80 days of growing according to the required size (1), (2) and (3).</p> <p>(4) In case of utilizing young plants measuring about 1 cm diameter and 30 - 40 cm height using Kujo, it is shown directly on the growing bed at about 20 cm apart lines, thinning up about 10 - 15 seedlings per 30 cm, it can be harvest at 60 - 80 days of growing.</p> <p>(5) In case of aiming at medium size plants weighing 100 - 200 grams, setting seedlings at 30 - 40 cm apart rows and 6 - 7 plants per 30 cm, no earthing up, the onion can be harvest at 2 - 3 months of growing.</p> <p>(6) Since Kujo tillers 2 - 3 stems or more, it can be grown planting its suckers by means of dividing the plants at the harvesting.</p> <p>Japanese leaf onion cannot grow seeds locally in Bangladesh, even if produces some seeds, it will regenerate and perform no good results due to making premature bolting.</p>																								<p>Y : Suckers divided harvested plants</p> <p>○ : Bulblet divided from the mass</p> <p>△ : Fallen down tops</p> <p>☐ : Natural bulblet-mass formation</p>	
	<p>SPRING ONION, Thailand</p> <p>(1) Basic cropping pattern, from bulblets aiming at harvest in rainy season</p> <p>(2) Second cropping pattern, from suckers</p> <p>(3) Bulblet production</p>		4	5	6	7	8	9	10	11	12	1	2	3		<p>Scientific Name: <i>A. fistulosum</i>, var. <i>caespitosum</i></p> <p>This type of leaf onion called Spring Onion in S-E Asia and "WAKEGI" in Japan, belonging to the same species as the above Leaf Onion but to different botanical variety <i>caespitosum</i>, is usually propagated by bulblets since it does not always produces seeds.</p> <p>Spring Onion mentioned here is a tropical type, somewhat resembling to the leaf onion grown from local Red onion, but quite different since it can grow almost all year round and is not suited to eat its bulblets. The top may fall down and produce bulblets naturally in January to February.</p>										
<p>Characteristics and brief notice of the above cropping patterns</p>	<p>Spring Onion can be grown almost all year round and harvested any time in growing.</p> <p>(1) In case of planting from March to May when dry bulblets are available, it is convenient to start planting from bulblets spacing at 30 - 40 cm between rows and 4 - 5 divided bulblets per 30 cm.</p> <p>(2) In case of planting in June to September, it is better to start from suckers dividing multi-tillered plants at their harvesting. In this case, better to dry the plants some extent to avoid diseases.</p> <p>(3) In January to February, when the tops naturally fall down, the bulblets can be produced by means of digging up the plants and dry up them. This bulblets may enter into dormance for 1 - 2 months but if kept dry and cool, the bulblets can be stored for several months. The bulblets can be produce any time from tillered green plants by drying up them if the condition is good.</p>																									

4. ADAPTATION OF SOME JAPANESE AND EUROPEAN VEGETABLE VARIETIES (TEMPERATE ZONE ORIGIN) IN BANGLADESH, MAINLY UNDER DRY SEASON BUT SEARCHED ON ALSO UNDER RAINY SEASON													
Calendar Month and Decade Days	Apr B M E	May B M E	Jun B M E	Jul B M E	Aug B M E	Sep B M E	Oct B M E	Nov B M E	Dec B M E	Jan B M E	Feb B M E	Mar B M E	Remark
Four Seasons	1st Cyclonic Season			Dense Rainy Season			2nd Cyclonic Season		Dry Season				
Conditions of Diseases and Pests Emergence	Severe emergence of virus on okra, tomato, cucumber			Least emergence of leaf worms and aphids			Emergence of viruses and leaf worms			Severe emergence of aphids			Fruit borers on bringal and gourd groups emerge almost all year round.
CABBAGE, Japanese Varieties	4	5	6	7	8	9	10	11	12	1	2	3	<p>Scientific Name: <i>Brassica oleracea</i> var. <i>Capitata</i> (N=9)</p> <p>Since cabbage prefers mild climate, in case of summer culture in the tropics it is usually grown in the high-lands, about 1,500 m above sea level.</p> <p>In Bangladesh, it has been proved that cabbage performs very good results in case of maturing in December through February while almost impossible to grow to be maturing from April through June.</p> <p>The breeding of cabbage is very much developed in Japan, not only its uniformity and vigorous growth with F₁-hybrid but also involving the highest heat and humidity resistant varieties in the world. Accordingly, only Japanese F₁ varieties can be recommended for the cultivation in Bangladesh.</p> <p>In case of the earlier cropping, early and heat resistant varieties are recommended while medium varieties are recommended when maturing in January to February because they can be kept long period, about one month, in the field in order to watch the market price up.</p>
(1) Earliest cropping with early varieties													
(2) Mid-season of cropping with both early and medium varieties													
(3) Last cropping with medium varieties													
(4) Possible cropping pattern during rainy season													
Characteristics and brief notice of the above cropping patterns	<p>Cabbage has to be cultivated radically in autumn and winter in Bangladesh.</p> <p>(1) With the above meaning, this period is the earliest cropping pattern, successable but having some risk of failing on its raising seedlings (of course the nursery beds are covered by shelter), less yield than the latter. Early and high heat resistant varieties like K-K Cross and Leo are recommended.</p> <p>(2) The best season for cabbage cultivation in Bangladesh. In the earlier cropping early varieties may be chosen aiming at the earlier harvesting, while medium varieties like O-S Cross, N-S Cross, Titan, Shogun etc. are recommended aiming at their heavy yields and long standing ability in the field.</p> <p>(3) The latest cropping for dry season culture. Easier raising seedlings but needed to choose long standing and heat resistant at maturity, and more frequent irrigation during growing period.</p> <p>(4) This period could be a single possible cropping pattern to cultivate cabbage during rainy season of Bangladesh, aiming at somewhat lower temperature and dense soft rains at the head developing period, yet the yield may be expected only one fourth of the winter. Early and high heat resistant varieties are recommended. The biggest problem in this cropping pattern is the raising seedlings, therefore, the nursery beds should be sheltered to avoid cyclonic heavy rains and subsequent severe dryness by sun.</p> <p>(5) Cabbage cannot produce seeds economically in Bangladesh owing to no effective low temperature.</p>												
CAULIFLOWER, Japanese and Local Varieties	4	5	6	7	8	9	10	11	12	1	2	3	<p>Scientific Name: <i>B. oleracea</i> var. <i>botrytis</i> (N=9)</p> <p>Since cauliflower was originated in Mediterranean coastal place, it is well adapted and spread in Indian Subcontinent as well as S-E Asian countries.</p> <p>Since cauliflower needs some extent of low temperature around 17°C in the mean for its head formation, it can be grown only from autumn to winter in Bangladesh.</p> <p>Japanese F₁-hybrid varieties involving all the types of varieties are excellent in the world with their remarkable uniformity and vigour but Local varieties can be also acceptable in Bangladesh, if their uniformity is improved. Special tropical type of varieties has been developed in India and Taiwan which can produce head under higher temperature condition, several °C higher than ordinary varieties, this type can meet the cultivation of (1).</p>
(1) Earliest cropping with special varieties													
(2) Mid-season of cultivation with both early and medium varieties													
(3) Last cropping with medium or late varieties													
(4) Seed production cultivation													
Characteristics and brief notice of the above cropping patterns	<p>(1) Earliest cropping pattern. Only the special earliest varieties can be acceptable in this season. Take more caution on quick growth throughout the growing period; if the growth is checked, it produces only tiny inferior quality heads. Setting younger seedlings and constant irrigation would be the key of successful result.</p> <p>(2) The best growing season. The earlier harvesting can be with early varieties and the later harvesting be with medium or late varieties. Don't choose the earliest varieties after October sowing.</p> <p>(3) The latest cropping. Medium and late varieties should be chosen since heading time is rather limited.</p> <p>(4) Cauliflower can produce seed normally in Bangladesh but providing a purification breeding to set up real foundation stock seeds. In this respect, the original stock population should be divided into 3 classes of pure earliest, medium and pure late groups with which they could meet to cover all the 3 cropping patterns mentioned in (1), (2) and (3).</p>												

4. (Continued)

C. P. No.	Kind and Variety Name, Other Name and Title of Cropping Patterns	Apr B M E	May B M E	Jun B M E	Jul B M E	Aug B M E	Sep B M E	Oct B M E	Nov B M E	Dec B M E	Jan B M E	Feb B M E	Mar B M E	Remark
	BROCCOLI, Japanese and American Varieties													<p>Scientific Name: <i>B. oleracea</i> var. <i>italica</i> (N=9)</p> <p>Broccoli is somewhat similar to cauliflower but more developed stage of green bud mass (Head) are utilized. Most of present varieties develop single large head on the main stem but after the main head is harvested, it develops again several small heads on the regrown axial branch shoots being also utilized.</p> <p>□ : Harvesting time of main heads ▨ : Harvesting of axial bud heads ○ : Heading time ✱ : Flowering time</p>
	(1) Suitable growing season in Bangladesh													
	(2) Seed production cultivation													
	Characteristics and brief notice of the above cropping patterns	<p>(1) This period is a sole range of growing season of Broccoli in Bangladesh since the earlier sowing does not result in the earlier harvesting and the later will result in poor head formation. The big heads on the main stems are suited to send central markets and regrown small heads be used locally.</p> <p>(2) For commercial purpose, seeds are grown without harvesting main heads aiming at heavy yield but in case of foundation seed, the selected elite mother plants are transplanted removing the main heads.</p>												
	BRUSSELS SPROUTS, Japanese Varieties													<p>Scientific Name: <i>B. oleracea</i> var. <i>gemmifera</i> (N=9)</p> <p>Brussels sprout cannot produce seed in Bangladesh due to the same reason as cabbage.</p>
	(1) Suitable growing season in Bangladesh													
	Brief notice	Due to some extent of low temperature is necessary for compact, the maturity of sprouting bud heads must be adjusted in the coolest period in Bangladesh, both too early and too late sowing may result in no good performance.												
	RADISH, Japanese Varieties													<p>Scientific Name: <i>Raphanus sativus</i> (N=9)</p> <p>Japanese radish belong to Far East Temperate zone type which has flourished very much in Japan and most of the varieties produce the largest good roots, highest yielders, in the world. They are grown usually for root purpose except young stage for leaves when thinned up. There are various types of varieties which are roughly divided into 3 types, long, stump rooted cylindrical and round. All of them eaten boiled, pickled and raw. Belonging the same species as Japanese, Red Bombay is quite different to them in their flower formation physiology and development and quality of the roots, much earlier development of pithy tissue. Local Red Bombay does not develop good root but grows very smoothly its leaves during rainy season, that is, as a leaf vegetable it is very good rainy season vegetable as Petai. In dry season it can be grown both root and leaf purposes.</p>
	(1) Earliest cropping with Mino Early													
	(2) Best growing season with both Mino Early and other Medium varieties													
	(3) Last cropping with Mino Early													
	RADISH, Red Bombay (for comparison)													
	(4) Rainy season culture for leaf use													
	a. Early cropping													
	b. Late cropping													
	(5) Dry season culture for root use													
	a. Early cropping													
	b. Late cropping													
	(6) Seed production cultivation													
	Characteristics and brief notice of the above cropping patterns	<p>Getting a brown hearted physiological disorder on the root when grown under alternative exposure of heavy rains and severe dryness, Japanese radish, even Mino Early, are not suited harvesting from Apr. to Sep.</p> <p>(1) Earliest sowing time: Having the highest heat tolerancy and earliness among Japanese varieties, Mino early must be chosen in the earlier sowing and be harvested somewhat younger stage of 45 - 50 days.</p> <p>(2) Best growing season: Aiming at better quality and heavy yields, such medium varieties (60 - 75 days) as Miyashige (long rooted), Ookura (stump rooted cylindrical) and Shogoin (large round) are recommendable.</p> <p>(3) Last sowing time: Being exposed high temperature at the maturing time, Mino Early must be chosen. Take highly caution on protection from aphids especially in young stage and constant watering is needed.</p> <p>(4) Cropping time of Red Bombay as a leaf vegetable: Very promising for covering vegetable shortage.</p> <p>(5) Ordinary root production season for Red Bombay: Take care for its early development of pithy tissue. The later sowing may cause premature bolting since January is the flowering time of Red Bombay.</p> <p>(6) On the seed production of Red Bombay, mother plant selection with good shaped roots and subsequent transplantation in the seed production field should be essential for maintenance of root uniformity.</p>												
	TURNIP, Japanese Varieties													<p>Scientific Name: <i>Brassica rapa</i> (N=10)</p> <p>Belonging the same group of species as Choisan and Petai, turnip is characterized with developing tender and soft root.</p> <p>Japanese turnip can be adapted only in dry season culture in Bangladesh, but the characteristics of Japanese varieties is having much tender leaves which can be utilized as if other brassica greens. Turnip Shogoin will perform better yield and better quality than Purple Top White Globe.</p>
	Suitable growing season in Bangladesh:													
	(1) Early sowing													
	(2) Late sowing													
	Brief notice	<p>(1) At the early sowing, Japanese small turnip (Kokabu) may be good to utilize leaf and root at half/half.</p> <p>(2) At later sowing, Shogoin may be better aiming at its heavy yield and usage of young plants at thinning up.</p>												

4. (Continued)

C. P. No.	Kind and Variety Names, Other Name and Title of Cropping Patterns	Apr B M E	May B M E	Jun B M E	Jul B M E	Aug B M E	Sep B M E	Oct B M E	Nov B M E	Dec B M E	Jan B M E	Feb B M E	Mar B M E	Remark
	CARROT, Japanese and European Varieties													<p>Scientific Name: <i>Daucus carota</i></p> <p>Developed many types of varieties in Europe, China and Japan, the most popular type of carrot varieties at present in the world is "Chantenay", medium sized medium variety group. Among Chantenay, the highest heat resistant varieties producing good coloured tender roots have been bred in Japan, that is, KURODA, SHIN-KURODA and KOIZUMI. Owing to less tolerancy to heat, other European varieties cannot perform good coloured root under high temperature condition.</p>
	(1) Earliest cropping for dry season													
	(2) Best season for carrot culture in Bangladesh													
	(3) Summer harvesting culture: a. Beginning b. Latest													
	Characteristics and brief notice of the above cropping patterns	<p>Since carrot prefers mild and dry weather, it cannot be grown in rainy season and does good on sandy soil.</p> <p>(1) Due to starting in hot, Japanese heat resistant varieties must be chosen. Take care the germination.</p> <p>(2) Due to the best growing season, any variety can be acceptable in this season. Caution for watering.</p> <p>(3) Due to hot at the maturing time, the heat resistant varieties are necessary. Although early stage is rather easy but caring only watering, but need some mulching to avoid heat rot on shoulder of root in the last.</p>												
	TABLE BEET, European Varieties	4	5	6	7	8	9	10	11	12	1	2	3	<p>Scientific Name: <i>Beta vulgaris var. rubra</i></p> <p>Since Table Beet prefers rather mild and dry weather, it is adapted to be grown in dry season in Bangladesh. Table Beet is not always high yield crop among root vegetables but is important with its high nutrition and good taste.</p>
	Adaptable cultivation season in Bangladesh													
	Brief notice	<p>By means of sowing at every 15 days, it can be harvested continuously for about 4 months. Harvesting can start at some 60 days after sowing but be kept growing for one month or more by favour of size.</p>												
	CHARD, Local Summer Spinach	4	5	6	7	8	9	10	11	12	1	2	3	<p>Scientific Name: <i>Beta vulgaris var. flavescens</i></p> <p>Completely differed from normal spinach, Chard or so-called summer spinach belongs to the same species as Beet. Its varieties can be divided into two large types of European and Oriental. The former called Swiss Chard is large planted late type but not suitable in Bangladesh. Bangladesh local Chard belongs to the latter and suited to grow in rainy season due to its high heat resistancy.</p>
	(1) Summer culture with some risk of premature-bolting or earlier flowering													
	(2) Autumn culture, the best growing season													
	Characteristics and brief notice	<p>Although Chard can be grown all year roundly but it should share only rainy season and pass it to real spinach in winter. Earlier sowing in summer (1) may cause premature-bolting because local chard belongs to tropical type and very early flowering. In this respect Japanese variety (Fudanso) can be recommended.</p>												
	SPINACH, Japanese Varieties	4	5	6	7	8	9	10	11	12	1	2	3	<p>Scientific Name: <i>Spinacea oleracea</i></p> <p>This is the real spinach. Dietitians are putting importance on its owing to its nutritive value as a greens. But unfortunately preferring a mild climate, spinach can be grown only during winter in Bangladesh. Chard, Petai, Kangkong, Amaranths etc. are chosen for rainy season.</p>
	Adaptable cultivation season in Bangladesh													
	Brief notice	<p>Japanese F₁-hybrid varieties such as Pasific and Oriental can be highly recommended with their quick growth, deep green colour and high productivity by tillering vigorous growth. Since all the Brassica greens badly suffered from aphids around February, spinach is much promising with its free from aphid.</p>												
	WATERMELON and SWEET MELON	4	5	6	7	8	9	10	11	12	1	2	3	<p>Scientific Name: <i>Citrullus vulgaris</i> and <i>Cucumis melo</i></p> <p>Japanese F₁-hybrid varieties are no doubt recommendable with their high productivity, highest quality and uniformity but the problem is their costly seeds. To save expenditure of seeds and better growth, pot raising seedling is suggested.</p>
	Suitable growing season in Bangladesh													
	Brief notice	<p>Since Watermelon as well as Sweet Melon prefer dry weather and high temperature for their fruit growth, the cropping pattern is to be designed as adjusting the fruiting time be fallen into March through May. Harvest at exact maturity is highly recommended by means of putting the flowered day mark at the fruit.</p>												
	TOMATO	4	5	6	7	8	9	10	11	12	1	2	3	<p>Scientific Name: <i>Lycopersicon esculentum</i></p> <p>Preferring mild and dry weather, suitable growing season of Tomato in Bangladesh may be limited in dry season. Suffering from severe infection of virus disease, it is almost impossible to grow tomato from May through September. To solve the problem, research work is badly expected.</p>
	Suitable growing season in Bangladesh													
	Brief notice	<p>When grown in April, May and September, Tomato plants are severely infected by virus diseases and most of them may die. This severe damage may be caused not only virus infection but also due to a kind of physiological disorder caused by alternative exposures of heavy rains and subsequent severe dryness with strong sunshine and high temperature, may be a minor element deficiency.</p>												

P A R T 2

PART 2
REPORT OF TRIALS ON VARIOUS INTRODUCED VEGETABLE CROPS IN BANGLADESH
AND THEREBY SOME SUGGESTIONS
FOR THEIR CULTIVATION AND CAPABLE SEED PRODUCTION

CONTENTS

		Page
Chapter 1.	GENERAL REMARKS	33
1.	General Purpose and Management of the Trials	33
(1)	Purpose	33
(2)	Relation between the Trials and the Cropping Patterns in Part 1	33
(3)	Executive Condition of the Trials	33
(4)	General Status of the Trials	34
2.	Common Field Preparation and Cultivation Process	34
(1)	Land Preparation	34
(2)	Common Cultivation Management	35
3.	General Observation and Fact Findings	35
(1)	General Impression on Vegetable Growth in Bangladesh as viewed from the Climate	35
(2)	Impression on the Vegetable Varieties of Bangladesh Comparing with those in S-E Asia	36
Chapter 2.	RESULT OF THE TRIALS ON RADISH	38
1.	Purpose	38
2.	Materials, Method and Purpose of Each Trial	38
(1)	Outline of the Trials	38
(2)	General Cultivation Method	39
3.	General Observation on the Growth	39
(1)	On the 2nd Trial, Sown in September, 77	39
(2)	On the 3rd Trial, Sown in March, 78	39
(3)	On the 4th Trial, Sown in April, 78	39
(4)	On the 5th Trial, Sown in June, 78	39
(5)	On the 6th Trial, Sown in August, 78	40
(6)	On the 7th Trial, Sown in October, 78	40
4.	Results Obtained, Discussion and Conclusion	40
(1)	Performance of Chinese Radish in Cyclonic and Dense Rainy Seasons ..	40
(1.1)	General Progress	40
(1.2)	Outline of the Characteristics of Each Variety	46
(1.3)	Conclusion on Cultivation of Chinese Radish in Rainy Season	47
(2)	Performance of Japanese Radish in Cyclonic Season	48
(3)	Performance of Japanese Radish in Dry Season (7th Trial)	48

	Page
Chapter 3. RESULT OF THE TRIALS ON JAPANESE CABBAGE	51
1. The First Trial, in Dry Season	51
(1) Nursery Bed Preparation and Management	51
(2) Growing Bed Preparation and Management	51
(3) Varieties Tested	51
(4) Result Obtained	52
(5) Discussion	52
2. The Second Trial, in Rainy Season	52
(1) Materials and Method	52
(2) Growing Process	53
(3) Result Obtained	53
(4) Discussion	54
3. The Third Trial, in Rainy Season	54
(1) Materials and Method	54
(2) Growing Process	54
(3) Result Obtained	55
4. Discussion on the Two Time Trials in Rainy Season	56
(1) General Discussion	56
(2) Particulars	56
5. The Fourth Trial, in Dry Season	57
(1) Materials and Method	57
(2) Growing Process	57
(3) Result Obtained	59
6. General Discussion and Conclusion throughout the Four Trials	59
(1) Significance in This Series of Trials	59
(2) Cabbage Cultivation in Dry Season	60
(3) Prospect of Cabbage Production in Dense Rainy Season	61
Chapter 4. RESULTS OF TRIALS ON CAULIFLOWER, BROCCOLI AND KAILAAN	62
1. Purpose	62
2. On Cauliflower and Broccoli	62
2.1 Materials and Method	62
(1) Varieties Tested	62
(2) Cultivation Method	62
2.2 Results Obtained	62
2.3 Discussion and Conclusion	63
(1) On the Cauliflower	63
(2) On the Broccoli	64
3. Trials on Kailaan	65
3.1 Material, Method and Outline of Progress	65
(1) 1st Trial	65
(2) 2nd Trial	65
(3) 3rd Trial	66
(4) 4th Trial	66
(5) 5th Trial	66

	Page
3.2	Results Obtained and Discussion 66
(1)	On the 1st Trial 66
(2)	On the 5th Trial 67
3.3	Conclusion 68
(1)	On the Varieties and their Capacities 68
(2)	Standard Design of Cultivation 68
(3)	Notice on the Flower Formation 68
Chapter 5.	RESULT OF TRIALS ON CHINESE CABBAGE 70
1.	Purpose 70
2.	Materials and Method 70
(1)	Varieties Tested 70
(2)	Cultivation Method 70
3.	Result Obtained and Discussion 71
(1)	General Observation on 7-1-79, 69 Days after Sown 71
(2)	Result and Discussion 72
4.	Conclusion 73
Chapter 6.	RESULTS OF TRIALS ON JAPANESE LEAF ONION INCLUDING SPRING ONION OF S-E ASIA 74
1.	Purpose 74
2.	Materials and Method 74
(1)	Varieties Tested 74
(2)	Times of Trials 74
(3)	Design of Cultivation Method, Explaining Japanese Method in Detail 75
3.	Nature of Leaf Onion in Japan 77
(1)	Actual Situation of Cropping Pattern of Nebuka in Japan 77
(2)	Suggestions of Heat Tolerancy for Japanese Leaf Onion 78
(3)	Expectation of Leaf Onion Cultivation in Bangladesh before Execution 78
4.	Results Obtained and Discussion 78
(1)	On the 1st Trial, Preliminary Test of Cultivation 78
(1.1)	General Observation on the Performance in February 78
(1.2)	Extension of Cultivation Period up to the 1st Cyclonic Season 78
(1.3)	Result of the Extension 79
(1.4)	Flower Formation and Seeding 79
(2)	On the 2nd Trial, Grown in Rainy Season 79
(2.1)	Raising Seedlings 79
(2.2)	Growth in the Field 79
(2.3)	On the Varieties Tested 81
(2.4)	Performance 81
(3)	On the 3rd Trial, Grown in Dry Season 81
(3.1)	Raising Seedlings 81
(3.2)	Growth in the Field 82
(3.3)	Varietal Difference 82
(3.4)	Performance 83

	Page
5.	Trial on the Spring Onion 83
(1)	Purpose 83
(2)	Materials and Method 83
(3)	Performance at Gulshan Garden 83
(3.1)	Condition of Bulblets Tested 83
(3.2)	Sprouting 84
(3.3)	Growth and Performance 84
(3.4)	Dormancy of Bulblet 84
(4)	Performance in the other Fields 84
(4.1)	Thailand Cultivar 84
(4.2)	Other Cultivars 85
6.	Conclusion 85
(1)	On the Rainy Season Cropping 85
(1.1)	The Reason of Good Result 85
(1.2)	Japanese Leaf Onion to be a Rainy Season Vegetable 85
(1.3)	Cropping Pattern in Bangladesh 86
(2)	On the Spring Onion 86
(3)	On the Dry Season Cropping of Japanese Leaf Onion 86
(3.1)	Comparison with Cultivation in Japan 86
(3.2)	Yield Estimation 86
(3.3)	Prospect for Shipping Production and Exportation 87
(3.4)	Prospective Cropping Patterns in Bangladesh 87
Chapter 7.	RESULT OF TRIALS ON JAPANESE CARROT AND TRUNIP. 88
1.	Introduction and Purpose 88
(1)	Carrot with an Explanation of its Growing Habit 88
(2)	Turnip 88
2.	Progress of Trials of Carrot 89
(1)	Materials and Method 89
(2)	Progress 89
(2.1)	On the 1st Trial, Grown in 1st Cyclonic Season 89
(2.2)	On the 2nd Trial, Grown in Dry Season 89
3.	Progress of Trials on Turnip 90
(1)	Materials and Method 90
(1.1)	Varieties Tested 90
(1.2)	Times of Sowing and Management 90
(2)	Progress 91
(2.1)	Trial in Rainy Season 91
(2.2)	Trial in Dry Season 91
4.	Results and Conclusion 92
(1)	Carrot 92
(1.1)	On the Recommendable Varieties 92
(1.2)	Possibility to Deviate from Dry Season 92
(2)	Turnip 93
(2.1)	K. Kokabu Turnip 93
(2.2)	Shogoin Turnip 93

	Page
Chapter 8. RESULT OF TRIALS ON S-E ASIAN BRASSICA GREENS	94
1. Purpose	94
2. Outline of the Trials	94
2.1 Times of Sowing and Varieties Tested	95
2.2 Outline of Cultivation Method	95
2.3 General Progress	95
3. Fact Findings in the Trials through Examination and Observation	95
(1) Results Obtained in the 1st Trial, Sown in July, 77	95
(2) Observation in the 2nd Trial, Sown in March, 78	97
(3) Observation in the 3rd Trial, Sown in June, 78	98
(4) On the 4th and 5th Trials, Sown in July and August, 78	98
(5) On the 6th Trial, Sown in October, 78	99
(6) On the 8th Trial, Sown in February, 79	99
4. General Discussion and Conclusion	100
(1) On the Phenomenon of Premature Bolting and Flower Formation Physiology	100
(1.1) Theoretical Background	100
(1.2) Observation on Flower Formation of Each Group throughout 8 Trials .	100
(1.3) Discussion on the Phenomenon in Choisan, Petsi and Chinese Cabbage .	101
(1.4) Discussion on the Vernalization Physiology Accelerated by Long-Day Condition	102
(1.5) Conclusion on the Flower Formation Phenomenon	102
(2) General Conclusion or Summary	102
Chapter 9. RESULTS OF TRIALS ON AMARANTH, KANGKONG AND SPINACH	104
1. Introduction	104
2. Amaranth	104
(1) Purpose	104
(2) Material and Method	104
(3) Performance	105
(3.1) Growing Process in the 1st Trial, Sown in July, 77	105
(3.2) Growing Process in the 2nd Trial, Sown in June, 78	105
(4) Discussion and Conclusion	106
(4.1) Characteristics and Quality of the Cultivars Tested	106
(4.2) Conclusion	106
3. Kangkong	107
3.1 Purpose	107
3.2 Materials and Method	107
(1) Varieties or Cultivars Tested	107
(2) Time of Trial and Cultivation Method	107
A. 1st Trial, Sown on 24-7-77	107
B. 2nd Trial, Sown on 12-3-78	107
C. 3rd Trial at Pravari and Naojora Community Centers	107
D. 4th Trial, Sown on 14-8-78	107
E. 5th Trial, Sown on 24-8-78	108
F. 6th Trial, Sown on 23-9-78, at CERDI Field	108

	Page
3.3	Performance 108
(1)	Progress and Performance in the 1st Trial 108
(2)	Progress and Findings by Observation in Other Trials 109
(2.1)	Growth under Hot and Dry Condition 109
(2.2)	Growth in the Repeating Harvest Culture 109
(2.3)	Observation on the Vegetative Propagation 109
(2.4)	Possibility of Replant Failure 110
(2.5)	On the Quality of Cultivars 110
(2.6)	Genetical Notice for the Seed Production 110
(2.7)	On the Flowering and Fruiting Habit 111
(2.8)	Design of Seed Production 111
(2.9)	Prospective Cropping Patterns 111
4.	Spinach (<i>spinacia oleracea</i>) 112
4.1	Purpose 112
4.2	Materials and Methods 112
4.3	Performance and Discussion 112
(1)	Performance of the 3 Varieties 112
(2)	Flowering Habit of Japanese Varieties 113
(3)	Resistancy to Winter Aphid and Susceptibility to Higher Temperature . 114
4.4	Conclusion 114
(1)	On the Varieties 114
(2)	On the Adaptable Cropping Patterns in Bangladesh 114
(3)	Seed Production with Severe Notice for the Utilization of Hybrid Seeds 115
4.5	Summer Spinach (<i>Beta vulgaris var. flavescens</i>) 116
(1)	Evidences Observed 116
(2)	Role of Summer Spinach in Bangladesh 116
(2.1)	Evaluation of Its Nutritive Value 116
(2.2)	Evaluation of Its Capacity for Cyclonic Season Culture 116
Chapter 10.	RESULTS OF TRIALS ON SUPER SWEET CORN AND BEANS. . . 118
1.	Introduction 118
1.1	Super Sweet Corn, DMR 118
(1)	Background of Introduction from Thailand 118
(2)	Potentiality of Utilization of This Marvellous Corn. 118
1.2	Yard Long Bean and Other Beans 119
2.	Trials on Super Sweet Corn 119
(1)	Materials and Method 119
(1.1)	Times and Places of the Trials 119
(1.2)	Outline of Cultivation Method 120
(2)	Performance and Discussion 120
(2.1)	Preliminary Trial 120
(2.2)	Trials Sown in August 120
(2.3)	Trials Sown in 2nd Cyclonic Season 121
(2.4)	Trial Sown in December 122
(3)	Conclusion 123
(3.1)	General Aspect 123

	Page	
(3.2)	Prospective Cropping Patterns with Notice	123
(3.3)	Problem on the Flower Induction	123
(3.4)	Seed Production	124
(3.5)	Remarks	124
3.	Fact Findings on Yard Long Bean and Soy Bean	124
(1)	Outline of the Trials	124
(2)	Observation and Discussion on the Trials	125
(2.1)	Plant Growth in Autumn Sowing Cultures	125
(2.2)	Disorder of Flower Formation in March Sowing Culture.	125
(3)	Discussion and Conclusion	126
Chapter 11.	SOME OBSERVATION AND DISCUSSION ON FRUIT VEGETABLES	127
1.	On the Damage by Virus Infection	127
1.1	General Observation	127
1.2	Virus Observation in Tomato on the Trial	127
(1)	On the Tomato Trial Started in Dense Rainy Season	127
(1.1)	Materials and Method in the 1st Trial	127
(1.2)	General Growth Progress and Appearance of Virus	128
(2)	On the Tomato Trials in Dry Season	128
(2.1)	Materials and Method in the 2nd and 3rd Trials	128
(2.2)	General Progress and Observation in the Fields	129
(3)	Comparison between Two Types of Trials and Conclusion for Tomato Cultivation in Bangladesh	129
1.3	Virus Observation in Cucumber on the Trial	129
(1)	On the Cucumber Trial Started in Dense Rainy Season	129
(1.1)	Materials and Method	129
(1.2)	General Progress of the Growth	130
(1.3)	Appearance and Spread of Virus Disease	130
(2)	Discussion on the Particulars in Cucumber Virus	131
(3)	Some Observations on the Dry Season Growing Cucumber	131
1.4	Combined Discussion on Virus in Tomato and Cucumber	131
(1)	General Aspect	131
(2)	On the Transmission Insect	132
(3)	On the Hypothized Physiological Disorder	132
(4)	Conclusion	133
2.	Some Observation and Discussion on Fruit Borer, Stem Borer and Some Other Problems	134
2.1	General Observation	134
(1)	Vicissitude of Main Insects Appearance in Dacca	134
(2)	Special Appearance of Fruit Borer and Stem Borer	134
2.2	Observation on Brinjal (Egg Plant)	134
(1)	Outline of the Trial	134
(2)	Progress of Growth	135
(2.1)	In Rainy Season Culture	135
(2.2)	In Dry Season Culture	135
(2.3)	Observations on Stem Borer and Fruit Borer	136
(2.4)	Observation on Diseases	136

	Page
2.3	Observation on Fruit Borer Damage on Gourds 137
2.4	General Discussion and Conclusion 137
(1)	Susceptibility of Improved Varieties to the Borer 137
(2)	Discussion on the Hardiness of Fruit Skin for the Resistancy 137
(3)	Conclusion 138
ANNEX I	SOME DATA AND DISCUSSIONS ON SEED PRODUCTION OF CRUCIFEROUS VEGETABLES 139
1.	Introduction 139
2.	Discussion on Green Choisan and Canton Petsai 139
3.	On Kailaan 140
4.	On Chinese Radish 140
5.	Observation in Exhibition Garden of Comilla Academy 140
6.	Conclusion for Extermination of Aphid in Seed Production Field 141
7.	Recommendation of Foundation Stock Seeds Breeding in Cauliflower . 141
ANNEX II	LIST OF COLLECTED VEGETABLE SEEDS BY THE EXPERT ... 142
ANNEX III	REFERENCES 146

CHAPTER 1. GENERAL REMARKS

1. GENERAL PURPOSE AND MANAGEMENT OF THE TRIALS

(1) Purpose

The expert has carried out a series of trials on various kinds of vegetables of which seeds were introduced from Thailand and Taiwan as well as from Japan during his stay in Bangladesh from 1977 to 1979 as one of the main activities of extension resources development of CERDI. The purpose of these trials was firstly, to search out adequate kinds of vegetables for the countermeasure to increase vegetable production during the rainy season, which seemed to be the biggest problem of Bangladesh horticulture, utilizing S-E Asian tropical sorts of vegetables (a part of this concern was already reported in his previous paper in January, 1978) and secondly, to search out possible range of cultivation seasons in Bangladesh for each vegetable crop not only for the said tropical vegetables but also for various important temperate zone vegetables from Japan and some other places, in order to set up feasible cropping patterns in Bangladesh for each of foresaid introduced vegetables shown in the Tables of PART I.

(2) Relation between the Trials and the Cropping Patterns Designed in Part I

In this paper, actually more pages are allotted to such temperate zone vegetables as Japanese radish, cabbage, Chinese cabbage, cauliflower, Japanese leaf onion etc. than the S-E Asian tropical vegetables such as Choisan, Petsai, Kailaan, Kangkong etc. since the latter have been already referred to the previous paper in 1978. In order to clear up the fact how much extent the foresaid temperate zone vegetable varieties can be adaptable or can not be adaptable to grow under Bangladesh climate condition, a series of trials on them had to be also executed paralleling with the tropical varieties. Through this series of ecological studies, the expert could designed the series of cropping patterns of every vegetable shown in PART 1. This series of cropping patterns can be said the final conclusions of the expert's activities in Bangladesh arranging all his achievements of experiments and observations during his stay there.

(3) Executive Condition of the Trials

Since vegetable trial field of CERDI, even a temporary field, had not been settled until October of 1978, the expert had to carry out most of those trials at his home garden at Gulshan, Dacca and only a part of them was executed in the vegetable trial field of CERDI, Joydevpur after October, 1978. Some of the trials especially tentative seed production of introduced S-E Asian vegetables were performed at Kashimipur A.D.E. Field of Bangladesh Agriculture Development Corporation (BADC) in order to search out actual possibility of extension of said vegetables in Bangladesh.

Those expert's activities outside CERDI had been of course approved by Bangladesh Government Authorities such as CERDI and Planning Commission through the Committee concerned prior to start his action.

At the same time, he also made field observation of related institutions and farmers fields in leading Districts as well as market survey from time to time in order to get ideas on actual features of Bangladesh vegetable production and problems in the improvement.

(4) General Status of the Trials

The expert, however, has to notice here that this series of trials should be said but a preliminary experimentations without any replication of the testing plots and carried out following his voluntary sense with very limited area, budget and labour. It can be hardly said normal experiments lacking many essential processes needed for execution of normal experimentation. It can be said just a qualitative analysis of vegetable growings and never be taken as a quantitative analysis of vegetable production to determine their actual yields. Nevertheless the above, the expert believes that the results obtained in the trials can certainly help to realize the outline of performance of respective vegetable varieties under Bangladesh condition and enough to be applied into the design of their prospective cropping patterns because those show the facts in Bangladesh at all events and are not taken from books. That is, this report of the trials is to be taken as the ground of the design of the Prospective Adaptation of Various Imported Vegetable Varieties (Part I).

2. COMMON FIELD PREPARATION AND CULTIVATION PROCESS

(1) Land Preparation

A. Arrangement of Growing Bed and Irrigation Ditches cum Passages:

The field of Gulshan Garden measured nearly 400 m² was divided firstly into two sections of East and West preparing one main passage at the center then divided into each 9 growing beds measured 110 cm width with furrows of 40 cm width and about 15 cm depth for secondary passage and irrigation in the east-west direction. The length of beds were about 9.50 m and 10.50 m. Two supplemental beds were prepared at the east and west sides of the field the east bed was utilized an other purpose of cutting of ornamental plants because this side bed did not perform good growth for vegetable cultivation with shadows of other planted garden trees. The west side bed was utilized for a spare bed.

B. Land Reclamation and Cleaning of Grass Roots

At the beginning, the field was newly opened reclaiming a lawn land cleaning the grass roots by a tiller and hands. Supplemental cleaning was continued by hands several times during cultivation of vegetables but the grasses were almost finished about 6 months after by a few times of cultivations.

C. Common Fertilizer Supply

Generally 5 basketfuls of cowdung or compost made of cowdung mixed with hay produced by lawn cutting per one bed (30 - 50 kg per 15 m²) at the preparation of every cropping and nursery bed, that means cowdung or composed was supplied for every a few months of land utilization. The soil condition has been very much improved after several months softened very much.

300 to 500 g of crushed oil-cake and 100 g of urea were supplied for every time of planting. Some top dressing of urea and oil-cake were done from time to time for long period cropping of more than 2 months. The above is just a rough idea of fertilizer supply.

(2) Common Cultivation Management

A. Raising Seedlings

As the raising seedlings for cabbage, cauliflower, dailaan and leaf onion, the same planting beds were utilized covered with Kuremona Kanreisha net for about one week of every seed-sowing and transplanting. In the rainy season of 1978, polyethylene film covering was also utilized together with Kanreisha net to shelter inside seedlings from heavy rainfall and severe sunshine to improve their germination and growth of young stage. The film covering was very much improved the germination condition in general but taking care of ventilation was of course essential point for film covering to avoid rising up of temperature at daytime. Seed-sowing of tomato and other fruit vegetable have been generally done on the seed box or seed pot which were arranged in the veranda covered with iron net to avoid heavy rain, then transplanted in the field bed after 1 - 2 true leaf stage with the same manner of raising seedlings of cabbage.

B. Watering

Watering on the planting beds was done almost every day in the dry season as well as in the rainy season in case of more than 3 days of fine weather continued, by hands with plastic pipe and watering head. Furrow irrigation was also practiced at every a few days during a severe dryness, paralleling with top watering by pipe. Maintenance of moisture on the bed soil is the essential point for the vegetable culture in Bangladesh, in the other words, if the beds are left as it is for a few days in summer or for a week in winter, the beds may get dryness as severe as dried up almost 15 cm depth from the surface and it will cause certainly a severe checking of plant growth and may kill the plants in case of young stage. Severe withering can be often seen on the planting bed in case of the above mentioned as severe as if it might be caused not only by the evaporation from the whole leaves and stems but also caused by sacking back of water by dried soil from the plant roots.

C. Sanding

Sanding on the seed bed is also important practice for good germination in order to keep softness of surface soil. Frequent skilled hand tillering on the nursery bed is also essential in order to keep softness of surface soil which causes good growth of young seedlings.

D. Spraying

Fortunately ordinary diseases have not appeared severely may be due to newly reclaimed land except virus diseases, therefore, almost no spray of fungicides was done in the cultivation. It was curious but very less worms have appeared on the brassica greens during the dense rainy season, therefore, very less spraying of insecticide was done during this time, however, it was done almost every week during dry season.

3. GENERAL OBSERVATION AND FACT FINDINGS

(1) General Impression on Vegetable Growth in Bangladesh as Viewed from the Climate

A. Impression in a Short

Bangladesh could be said that a Paradise for vegetable in her dry season while she

acts them as a Hell during her rainy season. That is, every vegetable, not only leaf and root vegetables but also fruit vegetables, can be easily grown in her dry winter season while most of them can be hardly or nearly impossible grown during her rainy summer. This clear diametrical contrast has been never-seen phenomena for the expert in his working life visited and stay Europe, Middle East and several S-E Asian countries as well as whole Japan.

B. Status in the Dry Season

Of course it is caused by special climate condition of Bangladesh. As seen in the climate graphs of Bangladesh in Part 3, the climate from November to March is so mild as mean temperature ranges approximately from 27° - 17°C with difference of daily maximum and minimum being 15° - 20°C. This condition can embrace the growing of both summer and winter vegetables of temperate zone and make ideal growth or best physiological condition of those plants in general. Almost no rain of dryness delivers also good effect on plant growth with less diseases if irrigation facilities is available. That is a Paradise for plant. As explained here and there in the following Chapters, Bangladesh has a big potentiality to produce so excellent vegetables as to be exported in this season due to also her fertile alluvial soil of delta of world big River of Ganges and Brahmaputra.

C. Status in the Cyclonic and Dense Rainy Seasons

On the contrary, the climate from April through October is so severe as a hell of vegetables involving two special types of cyclonic and dense rainy seasons. The former is characterized by alternative commings of heavy windy showers and subsequent severe dryness by strong sunshine and remarkable high temperature which causes unbaranced growing physiology. The latter is characterized by extra-ordinary high humidity and so less difference of night and day time temperatures as less than 5°C in monthly average figures. Almost all the temperate zone vegetable cannot grow smoothly or even survive under those severe conditions. Only tropical type vegetable originated or acclimatized under tropical monsoon climate of S-E Asia can keep smooth growth under that condition.

(2) Impression on the Vegetable Varieties of Bangladesh Comparing with those in S-E Asia

A. Common Point in the Kinds

While the expert emphasizes to introduce a series of S-E Asian vegetables as fore-said, in fact, most of the said vegetables can be seen in Bangladesh as far as the kinds or species are concerned. For example, not only Danta (amaranth), tropical radish and Kalmishak (wild Kangkong) but also almost all cucurbits such as cucumber, squash, bitter gourd, lufa, wax gourd, bottle gourd etc. as well as bringal (tropical egg plant), chili pepper, long bean, and so forth. Only, Choisan, Petsai, Kailaan, Chinese cabbage, spring onion are scarce or not seen, on the contrary, snake gourd and Kakrol of cucurbits seem to be scarcely available in S-E Asia.

B. Different Point in the Superiority in the Varieties

As to the above mentioned common vegetable between Bangladesh and S-E Asia, however, the varieties or types are quite different each other. In general, S-E Asian varieties of those common vegetables have far better quality than Bangladesh local varieties have; that is to say, the formers are improved modern varieties and the latters are old undeveloped varieties. For example, bitter gourd, lufa (ribbed gourd) and long bean. Kalmishak is popular in Bangladesh

but it is only a wild type and Kangkong of Thailand and Taiwan has much better productivity and delicious quality than Kalmishak. Since local Danta belongs to stem type of amaranth, it needs long time for cultivation, but Taiwanese amaranth or Chinese spinach can be harvested with heavy yield within about one month due to its leaf type. The above is the reason why the expert emphasizes to introduce them into Bangladesh.

C. Discussion

It is curious for the expert why those excellent tropical vegetables have not yet been introduced into Bangladesh nevertheless S-E Asia is much closed countries than Europe, America and Japan. The expert wants here hesitatingly but frankly to point out the reason as follows:

a) In the recent historical era of these 2 - 3 Centuries, Bangladesh has been governed by European people and those colonistic people did not think of to improve local popular people's life or local vegetable cultivation only considered to bring and cultivate their own favorite European vegetables in Bangladesh, and they never thought to create exchange of vegetable civilization for the local people's happiness between Indian Subcontinent and S-E Asian countries although they were always keeping goings and comings between two places on their business.

b) Accordingly, the exchange of people's civilization for true people's happiness had to be done by the people themselves in those days, however, in this respect, the mountain strains between Bangladesh and Indo-China Peninsula had been an insuperable wall so that both people could not exchange their own civilization.

c) After the colonialism collapsed and local people achieved sovereign in their hands, the leaders looked for civilization mainly among the advanced nations so that the above isolation of vegetable exchange has been continued as a result.

d) Difference of eating customs between both people of Indian Subcontinent and S-E Asia, currie and Chinese style dishes, can be also counted as a certain-wall in this respect.

Vegetables developed in the advanced nations or temperate zone vegetables, however, can not help to overcome the problem of rainy season as expalined in previous Division. Therefore, the expert expects urgently to create exchange of vegetable civilization between those tropical and subtropical nations as ASEAN Policy envisages.

CHAPTER 2. RESULT OF THE TRIALS ON RADISH

1. PURPOSE

The varieties of radish tested here are generally classified into two main types, S-E Asian type (tropical) and Japanese type (temperate zone). The former was tested mainly for its adaptability in the rainy season as well as for its possibility of local seed production in the dry season. The latter is tested mainly for its adaptability in the dry season as well as to confirm its performance in the rainy season.

2. MATERIALS, METHODS AND PURPOSES OF EACH TRIALS

Fig. 1. Series of Radish Trials and the Varieties Tested

Trial No.	Date of Sowing	Varieties Tested	Approximate Spacing	Date of Examination
1st	23-7-77	Chinese radish; 7. Fifty-Five Days (Chia Tai) 56. KU No. 1 (Kasetsart University), 51. Red Bombay (local)	linear sowing of 18 cm a part	29-8 and 19-9-77
2nd	16-9-77	7. 55 days, 93. Natsu-Mino (Mino-Early, summer type) (Kyowa S.)	10 x 18 cm and 40 x 18 cm	No record
3rd	12-3-78	Chin. rad.; 7. 55 days, 105. Tongkwa-Pei (Taiwan), 107. Kilah (Taiwan), Jap. rad.; 93. Natsu-Mino	Chin. rad.; 25 x 15 cm Jap. rad.; 30 x 20 cm	11-5-78
4th	14-4-78	Jap. rad.; 93. Natsu-Mino, 97. Omaru-Shogoin	30 x 20 cm	No record
5th	20-6-78	Chin. rad.; 7. 55 days, 105. Tongkwa-Pei, 108. Hybrid Early (Taiwan), 106. Tameihua (Taiwan), 107. Kilah (Taiwan), 127. Hybrid No. 150 (Takii) and Jap. rad.; 93. Natsu-Mino	Chin. rad.; 25 x 15 cm Jap. rad.; 30 x 20 cm	13-8-78
6th	14-8-78	Chin. rad.; 7. 55 days, 105. Tongkwa-Pei, 107. Kilah, 108. Hyb. Early, 127. Hyb. No. 150, 238. KU No. 1 (Kaset. Univ. foundation seed)	25 x 15 cm	4-10-78
7th	30-10-78	Jap. rad.; 93. Natsu-Mino, 92. Akizumari (Kyowa), 109. Heian Wase-Shogoin (Takii), 156. Japanese White Neck (Nepali Gov.), 167. Mino-Early (H.D.B.) and Chin. rad.; 106. Tameihua	60 x 30 cm	From 16-12-78 to 21-1-79

(1) Outline of Planning of the Trial

As seen in the Table, 7 times of trials were executed during two years. 1st, 5th and 6th were in the rainy season, and 3rd and 4th were in 1st Cyclonic season, both were subjected to test Chinese radish but Japanese varieties were also added to the latter two times to confirm their

ability. 7th trial was planned to test the productivity of Japanese radish but a Taiwanese variety of Tameihua was also added in this trial to confirm its productivity since this variety is the latest and biggest radish in Taiwan having lobation leaves like Japanese varieties.

(2) General Cultivation Method

Thinning has been practiced generally at three times, the first at the germination stage remaining 3 - 4 plants per spot, the second at 3 - 4 true leaf stage remaining 2 plants per spot and the third at about one month after sowing remaining single plant per spot. With linear sowing in the 1st trial, the thinning was done step by step with the growth but the plant density at the last thinning seemed to be somewhat too dense so that root thickness at the harvest was not enough. Therefore, the sowing method was changed to spot sowing from the 2nd trial.

Fertilizer dosage of 1st trial was also considered somewhat too short, that is, 3 basketfuls of cowdung and 300 g of oil cake for the basic and 200 g of urea for top dressing per one bed (about 15 m²). Therefore, from the second, it was increased 5 basketfuls of cowdung, 500 g of oil cake and 200 - 300 g of urea for the basic and one top dressing of 200 g of urea at the 3rd thinning time for Chinese radish, and 2 times of the same amount of urea and 300 g of oil cake for long period culture of Japanese radish (7th trial).

3. GENERAL OBSERVATION ON THE GROWTH

(1) On the 2nd Trial:

Since the expert came back Japan and had to absent from Dacca for nearly 3 months, the examination of 2nd trial could not be done but the growth has been rather smooth and the last thinning was executed on 19-10, 33 days after sowing, being somewhat delayed.

(2) On the 3rd Trial:

Germination and growth have been rather smooth but somewhat affected from severe dryness in April.

(3) On the 4th Trial:

Two Japanese radish did not grow smoothly affected by hot weather and severe dryness in April and May, and almost all the roots have got severe physiological disorder shown in the photograph and to be not marketable; that is, Mino Early (Natsu-Mino) got it at about 4 cm diameter stage and Shogoin got it at about 7 cm diameter stage, therefore, the trial was stopped on the half way recognizing that Japanese radishes, even with Mino Early summer type, the most heat tolerant variety among Japanese radish, cannot be adopted in cropping during summer season.

(4) On the 5th Trial:

Germination and early growth have been very smooth due to polyethylene film and Kanreisha net covering as seen in the photograph. Observation on 30-7-78: Hybrid No. 150; entire margin leaf showing the best growth and root diameter became about 3 cm at getting reached harvesting time. Hybrid Early; growth was quite good closed to the former but slightly infected by white spot on the leaves. 55 days; leaf growth was fairly good, root diameter became

nearly 3 cm. Tongkwa-Pei and Kilah; the growth was rather good but root growth delayed. Tameihua showed lobation leaves, an exception among Chinese radishes introduced this time, and late root growth. Natus-Mino; at least the leaf growth showed good but late root growth. Observation on 6-8-78, Natsu-Mino has died about 50% which means weak in this season.

(5) On the 6th Trial:

This trial was planned firstly in order to confirm the quality of the foundation seed of KU No. 1 (138, different stock seed to 56 obtained previously) which was presented in July, 1978 and planned to be the original seed of test seed production at ADE Field of BADC, Kashipur comparing with Hybrid No. 150 and 55 days.

Those mentioned three varieties showed fairly good growth while other three varieties, especially Kilah and Hybrid Early, did not show good growth as expected. Their worse growth was considered to be simply due to no good condition of the place they grown, that is, owing to the difference of previous crop to the former three; fertility of the soil had been worse or else the irrigation water could not permeate enough up to the roots by solidification of subsoil (no good preparation of the land), anyhow, it seemed to be not always showing the characters of those three varieties. The order of planting of six varieties was from 55 days, KU No. 1, Hybrid No. 150, Tongkwa-Pei, Hybrid Early to Kilah.

(6) On the 7th Trial:

Differed from other six trial, this trial was planned to test the adaptability of Japanese radish varieties to Bangladesh dry season condition since they are considered to be only adaptable in dry season and may show their excellent productivity and quality as a whole but the expert wanted to confirm what type of Japanese varieties would be really adaptable to Bangladesh soil condition.

Since all the Japanese varieties generally grow much bigger roots than Chinese radish and local Red Bombay, far wider spacing had been planned in this trial, that is, lengthwise two rows were prepared on the growing beds with 30 cm apart planting spots or hills, instead of always widthwise rows were prepared on the beds in other six rainy season trials.

Another purpose of this trial was to evaluate the seed of so-called Japanese White Neck produced by Vegetable Development Division of Department of Agriculture, Nepal, if it can be qualifiable to use in Bangladesh or not.

The germination and general plant growth in this trial showed fairly smooth and the three times of thinnings was done on right times. At the young stage, the seed of Mino Early bought at Gulshan Nursery of HDB was recognized as different variety and it was belonging to a sort of Chinese radish.

4. RESULTS OBTAINED, DISCUSSION AND CONCLUSION

(1) Performance of Chinese Radish in Cyclonic and Dense Rainy Seasons

(1.1) General Progress

**Table 2. Performance of 1st Trial in Mid-Rainy Season,
Sown on 23-7-77 and Examined on 9-9-77**

Variety	Weight (g)				No. of leaves	Size of largest leaf (cm)			Size of root (cm)	
	Whole plant	Root	Leaf	R/W		Whole length	Petiole	Width	Length	Dia-meter
Chinese radish, 7. 55 days	266 -	138 -	128 -	0.52 -	13 -	41 -	9.0 -	8.5 -	12.0 -	4.0 -
	366	188	178	0.51	14	44	12.0	10.5	17.0	4.5
Chinese radish, 56. KU No. 1	300 -	190 -	110 -	0.63 -	11 -	38 -	9.0 -	9.0 -	15.0 -	4.5 -
	376	226	150	0.62	15	40	10.0	10.5	18.0	4.5
Local radish, 51. Red Bombay	122 -	54 -	68 -	0.44 -	10 -	35 -	8.5 -	7.0 -	12.0 -	3.0 -
	226	120	106	0.53	14	40	11.0	9.0	21.0	3.0

Note: (1) The aboves are the minimum to maximum figures among 3 representative plants examined.

**Table 3. Performance of 3rd Trial in 1st Cyclonic Season,
Sown on 12-3-78 and Examined on 11-5**

Variety	Weight (g)				No. of leaves	Size of largest leaf (cm)		Size of root (cm)	
	Whole plant	Root	Leaf	R/W		Length	Width	Height	Dia-meter
Chinese radish, 7. 55 days	152 -	99 -	53 -	0.65 -	10 -	33.0 -	-	14.0 -	3.5 -
	234	166	68	0.71	10	39.0	-	16.0	5.0
Chinese radish, 107. Kilah	197 -	110 -	87 -	0.56 -	11 -	36.5 -	-	7.5 -	5.0 -
	312	152	160	0.49	16	40.5	-	8.5	6.5
Japanese radish 93. Mino Early, Summer	396 -	228 -	168 -	0.58 -	20 -	29.0 -	-	24.0 -	4.0 -
	488	360	128	0.74	23	31.5	-	30.5	4.5

Note: (1) The aboves are the minimum to maximum figures among 3 representative plants examined.

(2) Only 2 varieties of 55 days and Kilah were recorded out of 3 varieties of Chinese radish.

**Table 4A. Performance of 5th Trial, in Mid-Rainy Season,
Sown on 21-6 and Examined on 13-8**

No.	Variety	Weight (g)				No. of leaves	Size of largest leaf (cm)		Size of root (cm)		
		Whole plant	Root	Leaf	R/W		Length	Width	Length	Dia-meter	D/L
7.	Chin. rad., 55 days	204.3	127.7	76.7	0.63	14.3	31.0	8.8	15.3	3.9	0.25
105.	do., Tongkwa-Pei	229.7	124.0	105.7	0.54	12.7	32.8	9.2	10.3	4.7	0.46
127.	do., Hyb. No. 150	217.3	119.0	98.0	0.55	16.0	29.5	8.8	16.5	3.7	0.22
108.	do., Hybrid Early	214.0	94.7	119.0	0.44	17.3	33.3	8.5	12.7	4.0	0.31
107.	do., Kilah	224.0	76.0	148.0	0.34	14.0	36.5	10.5	7.4	4.5	0.61
106.	do., Ta-Meihua	221.7	98.7	123.0	0.45	12.7	38.3	11.3	11.0	4.0	0.36
93.	Jap. rad., Mino Early, Summer	161.7	68.3	93.3	0.42	17.7	30.3	8.7	16.7	2.5	0.15

Note: The above figures are average of records taken from 3 moderate plants out of 5 harvested ones.

**Table 4B. Performance of the Best Plants
among the Examined Plants in A**

No.	Variety	Weight (g)				No. of leaves	Size of largest leaf (cm)		Size of root (cm)		
		Whole plant	Root	Leaf	R/W		Length	Width	Length	Dia-meter	D/L
7.	Chin. rad., 55 days	206	141	65	0.68	13	30.5	8.5	15.0	3.9	0.26
105.	do., Tongkwa-Pei	222	126	96	0.57	11	34.5	10.0	10.5	4.5	0.43
127.	do., Hyb. No. 150	260	138	122	0.53	16	34.0	8.0	18.5	4.0	0.22
108.	do., Hybrid Early	208	97	111	0.47	16	34.0	7.5	16.0	3.4	0.21
107.	do., Kilah	228	114	114	0.50	12	33.5	10.0	7.2	5.8	0.81
106.	do., Ta-Meihua	278	118	160	0.42	14	37.5	12.5	13.0	3.9	0.30
93.	Jap. rad., Mino Early, Summer	204	82	122	0.40	20	31.5	7.5	20.0	2.5	0.13

Table 5A. Performance of 6th Trial in Late Rainy Season,
Sown on 14-8-78 and Examined on 4-10

No.	Variety	Weight (g)				No. of leaves	Size of largest leaf (cm)		Size of root (cm)		
		Whole plant	Root	Leaf	R/W		Length	Width	Length	Dia-meter	D/L
138.	KU No. 1	303.8	163.8	140.0	0.54	16.4	38.4	8.9	17.7	3.78	0.20
127.	Hybrid No. 150	278.8	147.4	131.4	0.53	16.6	36.9	9.7	15.6	3.88	0.25
7.	55 days	188.0	96.8	91.2	0.51	12.6	35.4	9.1	13.4	3.24	0.24
108.	Hybrid Early	131.0	56.2	74.8	0.43	13.4	31.9	8.8	13.9	2.82	0.20
105.	Tongkwa-Pei	128.4	50.8	77.6	0.40	10.8	34.8	10.5	11.4	2.92	0.26
107.	Kilah	73.0	15.8	57.2	0.22	11.0	33.3	8.5	6.0	2.24	0.37

Note: (1) The above figures are average of recorded 5 plant data.

(2) The place planted 108, 105 and 107 seemed to be not fertile due to the previous crop.

Table 5B. Performance of the Best Plant
among 5 Examined Plants in A

No.	Variety	Weight (g)				No. of leaves	Size of largest leaf (cm)		Size of root (cm)		
		Whole plant	Root	Leaf	R/W		Length	Width	Length	Dia-meter	D/L
138.	KU No. 1	384	201	183	0.52	18	40.2	8.8	20.5	3.9	0.19
127.	Hybrid No. 150	482	306	176	0.63	19	37.5	10.9	21.0	5.2	0.25
7.	55 days	252	140	112	0.56	14	36.5	9.3	14.0	3.1	0.22
108.	Hybrid Early	189	90	99	0.48	15	31.5	9.0	19.0	2.9	0.15
105.	Tongkwa-Pei	174	60	114	0.34	10	39.0	12.5	7.0	3.9	0.56
107.	Kilah	129	20	109	0.16	16	36.0	10.0	7.5	2.1	0.28

Table 6A. Performance of 7th Trial in Dry Season,
Swon on 30-10-78, Examined on 16-12-78 to 21-1-79,
on the Respective Maturities of Each Variety

No.	Variety	Date of exam.	No. of plant exam.	Weight (g)			No. of leaves	Size of largest leaf (cm)		Size of root (cm)		
				Whole plant	Root	R/W		Length	Width	Length	Dia-meter	D/L
167.	So-called Mino Early ⁽¹⁾	16-12	2	447.5	182.5	0.41	16.0	42.0	15.0	21.0	4.0	0.19
93.	Mino Early, summer ⁽²⁾	do	2	589.5	320.0	0.54	22.0	41.5	15.0	33.5	4.4	0.13
93.	do.	25-12	3	1,054.3	641.3	0.61	22.3	48.0	17.5	35.5	5.5	0.15
106.	Chin. rad., Tameihua	do	4	893.7	653.3	0.71	11.5	47.0	16.9	20.3	7.8	0.38
156.	Japanese White Neck	29-12	4	1,229.3	540.8	0.44	29.8	53.4	22.0	30.0	5.5	0.18
92.	Akizumari	do	3	918.7	604.0	0.66	26.3	40.7	13.8	25.2	6.0	0.24
109.	Heian Wase Shogoin ⁽³⁾	25-12	1	990.0	530.0	0.54	30	51.5	19.0	10.0	9.5	0.95
109.	do. ⁽³⁾	7-1-79	2	1,390.5	756.5	0.54	38.0	51.0	19.8	12.3	11.3	0.92
109.	do.	21-1-79	5	1,917.0	998.0	0.52	52.8	57.6	20.1	11.5	13.4	1.17

Note: (1) This seed was bought at the Gulshan Nursery with the name of "Mino Early" but under trial it was recognized as a topical type variety and not Mino Early.

(2), (3) These harvest times were somewhat immature stage as the respective varieties.

(4) All the figures in the above are averages of respective numbers of plants examined.

Table 6B. Performance of the Best Plant
among the Examined Plants in A

No.	Variety	Weight (g)				No. of leaves	Size of largest leaf (cm)		Size of root (cm)		
		Whole plant	Root	Leaf	R/W		Length	Width	Length	Dia-meter	D/L
167.	So-called Mino Early	522	186	336	0.36	19	46.0	14.0	19.0	4.0	0.21
93.	Natsu-Mino	1,311	864	447	0.66	25	47.0	17.0	41.5	6.0	0.14
106.	Tameihua	984	684	300	0.70	12	52.0	17.0	19.5	8.0	0.41
156.	Japanese White Neck	1,565	716	849	0.46	30	51.0	21.5	33.0	6.0	0.18
92.	Akizumari	1,142	764	378	0.67	25	44.0	15.5	27.5	6.5	0.24
109.	Heian Wase Shogoin	2,905	1,430	1,475	0.49	77	62.5	23.0	13.5	15.0	1.11

A. Germination

Tables 2, 3, 4, 5 and 7 show the results of a series of trials executed in the siad season. Only the 3rd trial (Table 3) was a cultivation in the hottest season of April to May and others were more or less in the dense rainy season of July to September. The former condition is characterized by hottest in daytime but nighttime is not always highest in year and the difference of maximum and minimum is still wide. Seed germination in March sowing seemed to be rather smooth due to less risk of exposed in heavy rain and general growth seemed to be also smooth for Chinese radish varieties if watering is adequate. Seed sowing after mid-April, however, has realized that the germination may frequently be disturbed very much by the cyclonic showers, really a trial sown in late April of 78 was completely failed in its germination due to heavy shower came in the next day although the bed was covered by Kanreisha net, which means a net-covering was not enough against such a heavy shower to protect from solidification of surface soil under subsequent severe dryness by strong sunshine of April to Mid-June, sometimes even July through September. Accordingly, a double covering with Kanreisha net and polyethylene film was practiced thereafter until October.

B. Thinning

Cultivation of the 1st trial (Table 2) was executed with linear sowing, the same as other brassica greens but this method realized to be liable to dense standing at late growing period, that is, hard to decide to switch off from leaf vegetable to root vegetable. Therefore, sowing method thereafter was changed to spot-sowing, sowing 4 - 6 seeds per plot. Nevertheless the above, if the thinning times of the first and second delayed and hypocotyles of seedlings are much elongated, it seems to cause producing much elongated neck roots for most of Chinese radish varieties, that is, most of Chinese radishes have a habit of very easy and quick elongation of their hypocotyle at the earliest stage, so thinning must be done without a day's delay. The last thinning making one plant per plot be not also delayed. If the last two plants are standing within 3 cm or 1 inch, it should be thin up to single at about 6 true leaf stage. After the 2nd thinning, it is better to earthen up at the bottom by hand in order to stabilize the base of plants. The above phenomenon is what the expert realized through those several times of trials and decided to be a skill of cultivation.

C. Bolting

Generally Chinese radish bolts its flower stalk at about 50 - 55 days after sowing and the radish should be harvested before its bolting. Looking over those six times of trials, the expert realized that the bolting time is earlier in earlier sowing, that is, a few plants bolted as early as before 50 days in the 3rd trial sown in March while the earliest bolting was usually seen after 50 - 55 days in July sowing. No bolted plant was seen in the 6th trial until harvesting time, and when some of the sample plants from this trial was transplanted for the test of seed production, they bolted in December and started flowering in late December.

From the above observation, the expert recognized that the flower formation of Chinese radish is accelerated under long day condition in Bangladesh. Really from many facts of vernalization experiments in the past, it was recognized that, in the case of cruciferous plants contrary to wheat, long day condition or light can act supplementary effect to low temperature in vernalization. Accordingly, the expert guesses the above explanation has enough background.

In this case, the long day condition means including the time of extending day-length

from the end of March up to the end of July. Day-length condition in the 6th trial acted minus effect for the flower formation due to day length is shortening after August. Anyhow, this observation is very important and interesting thing, and the expert hopes some further investigation or experiment in this respect would be performed by researchers in Bangladesh, since ecological research on tropical type of cruciferous crops is not yet performed in tropical or sub-tropical area and it could be a subject of PH. D thesis.

Returning back the main subject, it can be concluded that the harvest of Chinese radish can be designed at 50 days as the maximum when sown in March and April (rather young stage of root), 50 - 55 days for June and July sowing, and it can be kept more than 60 days in the sowing after late August (fully matured root) in Bangladesh, around 25°N, or northmore places.

(1.2) Outline of the Characteristics of Each Variety

A. Leaf Shape

As explained formerly, the Chinese radish varieties discussed here have upright style of entire margin leaves with almost no pubescences and the leaf quality is tenderer and less harshness than local Red Bombay leaf. There was some diversity in leaf shape, some were wider and roundish while others were narrower and long. There was a tendency that earlier varieties of 55 days and KU No. 1 has longer, narrower and lighter green leaves than latter varieties of Kilah and Tongkwa-Pei, but it was very vague because each variety also involves some diversity in their leaf shape. Only Ta-Meihua had lobation leaves and somewhat spreading style than complete upright style of other varieties, but the lobation of Ta-Meihua is not so severe as Japanese varieties having less number and larger and roundish lobes with less pubescence and not so much spread as Japanese varieties do.

B. Root Shape

Since most of varieties tested this time were mass selection varieties, they involved some diversity in their root shape; long to short, slender to thick, pointed to fat tips, long slender to fat necks and so forth, therefore, it could not determine clearly the shape of respective varieties. Only Hybrid No. 150 of Takii Seed showed rather good uniformity, may be due to an F₁-hybrid variety, having fat necked cylindrical root with fairly fat tip.

It can be said, however, roughly as follows: 55 days, KU No. 1 and Hybrid Early are long slender and in case of getting elongate hypocotyles at very young stage they seemed to be bent roots but when they grew smoothly, they produced rather thick necked roots. Since Hybrid No. 150 has good vigour in its growth, it produced stout cylindrical roots with fat neck. KU No. 1 was considered as belonging same category of 55 days. KU No. 1 of 138 stock seed performed similar result to No. 150 although it had still some range of diversity. Therefore, it was qualified to be original seed for local seed production and this seed was really used for the test seed production at ADE Kashimipur Field in 1978 with mother plant selection and resulted in a good yield of the seed.

Though it has a wide range of diversity, Kilah can be said a short and fat ovary shape. It was liable to be elongate neck when its hypocotyle elongated at young stage. As for Hybrid Early, it can be said only long type because it involved wide diversity in shape. As for Ta-Meihua,

although it did not produce true matured root in this series of trials due to having late maturity, it produced rather long ovary root in dry season which is explained later.

C. Maturity

To determine real maturity of a variety is not easy work. Since maturity of radish may be affected by several factors of the growth such as not only by growth rate affected by land fertility and spacing but also, especially cropping in rainy season as these trials, affected severely by time of flower induction (bolting) and rate of development of heart rot (physiological disorder) as well as development of pithy tissue and so forth.

It can be said, however, roughly as follows: 55 days, KU No. 1, Hybrid No. 150 are early variety and after all to be most popular and promising varieties in Bangladesh like Thailand. Ta-Meihua is the latest variety among these Chinese radishes and not suitable to grow during rainy season. It would be suited to grow aiming at harvesting in November and December as explained in the next Division. Tongkwa-Pei seems to be intermediate type of the formers and Tameihua.

(1.3) Conclusion on Chinese Radish Cultivation in Rainy Season

As explained in the previous paper of January, 1978, Chinese radish tested here was confirmed to be a promising crop in the seasons from March up to October in order to fulfill the vegetable shortage in Bangladesh markets. KU No. 1, a strain of 55 days, and Hybrid No. 150 were the most promising varieties for this purpose.

Since Chinese radish as a whole except Ta-Meihua have upright standing leaf style with entire margin blade, they can be grown under rather dense stand spacing, but too thick standing results in small root. In fact, the sample plants produced at Kashimipur seemed to be generally larger than the same produced at Gulshan Garden, that may be caused by sparser spacing than the latter trials (Table 7).

The spacing density is a function for the growth rate of leaf and root, sparse means less leaf and bigger root. Since Chinese radish can be utilized both purpose of leaf and root even at the final harvest, an adequate spacing can be eventually decided counting the market favourite.

From the results obtained in this series of trials, the following cropping patterns and their background of design and management notices can be concluded.

A. Earliest cropping from March to April: The limiting factors of this crop is earlier bolting than thereafter, and hot temperature and severe dryness during growing season which may cause the heart rot if the harvest is delayed, therefore, it would be better to harvest earlier in somewhat dense spacing. Spacing be designed at about 25 x 15 cm by spot-sowing with 5 - 6 seeds. Harvest be about 50 days with two times of thinning harvests for leaf vegetable.

B. Mid-Season of rainy season cropping from June and July: The limiting factor in this season may be heavy rainfall which disturbs the germination and young stage. Very quick growth in July and August, exact take care of thinning practice is necessary. Bolting time will start usually after 55 days of sowing. Less leaf worms. Spacing be designed at 30 x 15 cm by the same spot sowing. Harvest be around 55 days after sowing.

C. Late Cropping after Mid August

No risk for premature bolting. Growth condition is getting better in later period, but some risk should be counted for the heart rot in the Second Cyclonic season. Spacing be 30 – 35 x 20 – 25 cm to produce bigger root production, more than 200 g of roots can be expected at harvesting about 60 – 65 days after sowing.

(2) Performance of Japanese Radish in Cyclonic Season

As mentioned here and there in the previous Division, the performance of root in this season can be said completely failed owing to the appearance of heart rot, a physiological disorder supposed to be a boron deficiency. As for Natsu-Mino, summer type of Mino Early and the most heat tolerant variety among Japanese radishes, its growth rate was sometimes better than Chinese radishes. From many observation a common idea on the appearance of boron deficiency in vegetables in Japan is that it is liable to appear on the vigorous growing varieties at the most quick growing part when their growth is severely checked, in most case, caused by dryness.

This idea is just met the said condition; that is, Mino Early can be said the most vigorous growing variety, severe dryness frequently happened by strong sunshine under hot temperature in April and May. The soil solution in the soil is very much concentrated at that time. Then it makes threshold of boron deficiency.

Anyhow, it can be concluded that Japanese radish, even Mino Early, cannot be recommended to grow in Bangladesh sowing from March up to August. Japanese radish cannot be recommended for leaf use due to their spreading leaf style and harshness in taste.

(3) Performance of Japanese Radish in Day Season (7th Trial)

Since November to January is the best season for all cruciferous crop cultivations, in a glance of Table 6A and B, one can understand the growth data of this trial is far better than those of any other trials during rainy season. Although no Chinese radish variety in the previous trial except Ta-Meihua were tested in this trial, it can be easily supposed that if those Chinese radish varieties were grown in this season, they can perform much better result than former trial season.

Only one unknown variety but certainly belonging to tropical Chinese radish (167) has been mixed in this trial. It was identified as Chinese radish from its leaf characters, that is, less number, semi-upright style, more upright than Ta-Meihua, less number of lobes of large roundish shape, lighter green coloured blades with almost no pubescences, whitish mid-rib or petiole and juicy soft root. It was much earlier and smaller than other Japanese varieties. This variety, may be closer varieties to so-called Chinese radish here.

All the Japanese varieties performed good roots which were far larger than so-called Chinese radishes as a whole but one must presume to select better variety and better cropping pattern from the result.

A. Natsu-Mino or Mino Early, summer type:

This variety can be concluded the best variety among Japanese varieties tested here,

with its productivity in early maturity. Even at 47 days after sowing, it showed much bigger root than the earliest 167 and its 56 days old stage already performed the largest productivity among Japanese type radishes and its root shape was good cylindrical with complete neck and somewhat pointed tip. In Japan, this variety is the most popular in summer culture having wide range of adaptability for various type of soil and best tolerancy to virus disease. Usually, it is harvested at 50 – 55 days after sowing, therefore, the performance in this trial can be said to show the same growth rate as in Japan. In Japan, there is two type strains in Mino-Wase, summer type and spring type. The former has more tolerancy to heat and virus than the latter, therefore, it is no doubt to select the former in case of Bangladesh. The latter should be said a special charactered varieties in case of sowing spring when the temperature comes down lower than about 5°C like in Japan and has a big risk of premature bolting with normal Japanese varieties, therefore, this characteristics of spring type Mino-Wase is no valuable in Bangladesh where the temperature never goes down to such low degree even in the coolest December and January.

B. Akizumari

Data of root weight of this variety is not bad and the ratio of R/W shows good too, but the length is not enough for this variety if compared with its normal performance in Japan which length is at least more than 40 cm. Really this variety is usually grown on volcanic ash soil or light soil in Japan since it had originated in Kanto District. The short length of the root grown in Dacca was really caused by grown on heavy soil. Accordingly, this variety cannot be recommended widely in Bangladesh. On the sandy soil such as along Ganges River in Rajshahi and Pabna and those of coastal and hilly areas in Chittagong District, this variety may perform beautiful complete cylindrical long root with good stump tip, and if so, this variety will be better than Mino-Wase.

C. Japanese White Neck

This seed stock has been developed in Nepal originated from a Japanese radish variety and produced the seed by Vegetable Development Division of Department of Agriculture of Nepal in Kathmandu and the expert has added it in this trial in order to evaluate whether this seed can be qualified to use in Bangladesh or not. Through this trial it was evaluated utilizable to cultivate in Bangladesh during dry season since this seed can be got by Bangladesh people with much cheaper price than if got it from Japanese Seed Cos., and since it performed fairly uniform roots as seen in its photograph. It was identified as Shirokubi-Miyashige. This variety is, though it is an old variety spread rather widely in Japan, having wide range of soil adaptability, therefore, even on the heavy soil of Gulsham it performed fairly long good shaped roots. Accordingly, the expert wants to recommend this stock seeds for a creation of friendship between the people of Bangladesh and Nepal.

D. Shogoin

The stock seed of this variety tested here was Takii's Heian Wase Shogoin. Although this variety showed the latest habit among the varieties tested here, this variety performed eventually very heavy yield and good shaped round roots at some 80 days after sowing.

This variety was originated on the very heavy soil in Kyoto very similar condition of heavy soil of Bangladesh and its root is fairly solid and fibreless having tasty sweetness when boiled, moreover its root has an excellent characteristics of long standing ability in the field due to very late development of pithy tissue. This radish root may be very suitable to currie cooking

certainly better than Kohlrabi and Purple Top Turnip counting its yield in the field, not soluble in the heavy boiling of carrie and its tender and sweetness.

Accordingly, the expert wants to recommend urgently this variety in Bangladesh by such cropping pattern. Sowing from the end of October to the end of November, with sparse spacing of 60 x 45 cm of spot-sowing, and harvest 70 - 90 days after sowing, or any time from 2 months to 3 months after sowing providing good management of furrow irrigation. It can cover the radish marketing from the end of December through February and it could be a new vegetable for Bangladesh people as its novel large turnip shape of radish.

E. Ta-Meihua

This variety performed also good yield of roots with good rate of R/W = 0.71 and beautiful smooth pure white skin of good overy shape. It can be also recommendable in Bangladesh during dry season. This variety is the best variety of eating and long standing ability in the field in Taiwan. It can be corresponding to Shogoin in Japan and a noted product in Taipei during winter. The expert is, however, afraid if the seed may difficult to get in Bangladesh because this seed is specialized in Taiwan.

Table 7. Record of Sample Plants Grown at ADE Field of Kashipur, Sown on 8-8-78 and Harvested on 19-9-78

No.	Variety	Weight (g)				Size of root (cm)		
		Whole plant	Root	Leaf	R/W	Length	Dia-meter	D/L
107.	Kilah	343	210	133	0.61	11.3	5.6	
105.	Tongkwa-Pei	499	347	152	0.70	15.5	5.9	
103.	Hybrid Early	410	225	185	0.55	21.3	4.2	
106.	Tameihua	338	138	200	0.41	13.0	4.6	

Note: The above data are the average of 2 sample plants examined.

CHAPTER 3. RESULT OF THE TRAILS ON JAPANESE CABBAGE

1. THE FIRST TRIAL, IN DRY SEASON

(1) Nursery Bed Preparation and Management

- a. 110 cm width and 10 m length bed with 40 cm width 12 cm depth ditch.
- b. 5 baskets full of matured cowdung and 500 g of crushed oil cake per one bed were mixed with bed soil being crushed and leveled.
- c. Seed bed has been no top dressing but the transplanted bed was supplied 100 g of urea per bed as a top dressing one week after the transplantation.
- d. The bed soil was intertilled by small hand weeder from time to time after heavy rain in order to keep soften the soil surface.
- e. The bed was kept covered with Kanreisha net for a week after seed sowing and transplanting to shelter young seedlings against heavy rain and severe sunshine.
- f. Top watering was done every day by watering tube.
- g. Pregoramme: 20-9-77, linear sowing 12 cm apart line to line. One thinning at cotyledon stage only at the crowded places. Transplanting in the nursery bed on 4 and 5-10 at 1-2 true leaf stage for 15 x 12 cm spacing.

(2) Growing Bed Preparation and Management

- a. Set in the growing bed on 26-10-77, at the spacing of 2 lines on the bed, 70 cm apart, and 35 cm apart plant by plant.
- b. Field preparation and the dosage of cowdung and oil cake were the same as the nursery bed.
- c. Top dressings were done two times at the side of planting lines, 600 g of oil cake and 200 g of urea per bed each time.
- d. Top watering were done every day when rain did not come for a week, during November and December furrow irrigations were also done every other days filling water in the ditches.
- e. Once in a few weeks, soil was digged up from the ditch and earthened up at both shoulders of the bed.

(3) Varieties Tested

Kagayaki, Shogun and Shimpoo from Kyowa Seed Co. New October, Ogosho and Toyodawase Shin-1, from Ishii Seed Co. About 30 plants were tested per each variety, or ½ bed area.

(4) Result Obtained

Table 8 Results of the 1st Trial in Dry Season Sown in 20-9-77.

A. Record of Head Diameter Examined on 20-12-77 (Examined per 10 plants)

Variety	Kagayaki	Shogun	Shimpoo	New October	Ogoshō	Shin-Toyodawase
Average	12.6 cm	11.9 cm	8.5 cm	16.6 cm	9.9 cm	11.7 cm
Maximum	15	15	11	18	12	14
Minimum	11	11	7	15	8	11

B. Record of head performance taken at respective mature time.

Variety		Kagayaki	Shogun	Shimpoo	New October	Ogoshō	Toyoda
Weight	Average	1,040 g	831 g	1,260 g	975 g	1,208 g	721 g
	Maximum	1,250	1,400	1,700	1,150	1,800	800
	Minimum	700	500	850	600	900	600
Diameter	Average	16.5 cm	14.8 cm	17.4 cm	17.5 cm	17.9 cm	14.7 cm
	Maximum	18	-	20	-	22	-
	Minimum	15	-	15	-	15	-
Depth	Average	10.2 cm	9.7 cm	10.3 cm	12.3 cm	9.9 cm	10.4 cm
	Maximum	11	-	12	-	11	-
	Minimum	9	-	9	-	9	-
Recorded on		12-1-78	6-1-78	20-1-78	30-12-77	27-1-78	31-12-77
No. of heads examined		20	21	23	-	21	7

(5) Discussion

Although the expert could not attend to the harvest examination, from those data it can be said that Kagayaki, Shogun and New October are promising due to their early maturity, Shimpoo and Ogoshō are not bad but somewhat late. Toyodawase Shin-1 is not recommendable due to its quite different character to others, it is a special fall-sowing type in Japan.

2. THE SECOND TRIAL IN RAINY SEASON

(1) Materials and Method

A. Raising Seedlings

a. Seed sowing on 12-5-78 in the large seed pots. Thin up once at the cotyledon stage at crowded places.

b. Transplanted in the nursery bed at 1.5 true leaf stage at the same spacing as the first trial. Bed preparation and management were also the same as previous.

B. Growing Bed

a. Field preparation was the same way but top watering and furrow irrigation were done more carefully if no rain for several days. Dosages of cowdung and oil cake were about 1.5 times more than former, top dressing was done two times at 2 weeks and 45 days after transplanted in the growing beds, then total rate were 200 g of urea and 600 g of crushed cowdung. More careful earthening was done digging up the soil from the ditches, approximately once in a few weeks due to eroding by frequent heavy rain.

b. Set in the growing bed on 18-7, 37 days after sowing, at 6-7 true leaf stage at the spacing of 70 x 40 cm (2 lines per bed) for cabbage and of 40 x 25 cm (3 lines per bed) for Kailaan.

C. Variety Tested

Cabbage: Kagayaki, Shogun (Kyowa) and New October, Ogosho (Ishii)

(2) Growing Process

This cultivation was planned aiming at the growth period of head formation to be July and August or under dense rainy condition. Unexpectedly, however, the weather condition of July to early half of August has been less rain and predominated with fine and hot weather which caused worse growth on the cabbage than expected, although Kailaans showed rather tolerant to this hot temperature condition. All the varieties were examined in the same day.

(3) Results Obtained

Table 9. Performance of 2nd Trial in Early Rainy Season,
Sown on 12-5-78, Set on 18-7 and Examined
on 16-9-78

A. Performance of Frame Leaves and Other Observation

Variety	No. of plants examined	No. of Frame leaves	Size of the largest leaf			Rate of head formation and other observation
			Length	Width	L/W	
Kagayaki	4 plts.	14.8	20.8 cm	19.1 cm	1.08	15 headed out of 16 plants.
Shogun	4	15.5	21.4	20.6	1.04	16 per 20; black spot with <i>alternaria</i> appeared 25 per 30.
New October	4	12.5	21.6	20.1	1.07	
Ogosho	4	20.0	23.7	20.9	1.13	16 per 26, leaves developed petiole & delayed maturity.

Note: Sizes of leaves were recorded only on the largest leaf of each plant.

B. Performance of Head

Variety	No. of heads examined	Average of heads examined			The largest head		
		Weight	Diameter	Depth	Weight	Diameter	Width
Kagayaki	4 plts.	222.0 g	10.4 cm	9.3 cm	280 g	12.5 cm	9.5 cm
Shogun	4	409.0	11.4	9.1	552	13.5	10.0
New October	4	502.5	13.0	12.0	666	13.0	12.0
Ogoshi	4	199.0	8.8	10.2	466	Only one head good but others were immatured.	

Note: Only typical or good heads were examined.

(4) Discussion

Since the weather during head developing period has been predominating fine and hot temperature over dense rains, the condition was hard for cabbage growth, therefore, the head performance was in general only 1/3 to 1/6 of the performance shown in dry season of the first trial. Discussion is done together with the next trial.

3. THE THIRD TRIAL IN RAINY SEASON

(1) Materials and Method

A. Planning

This trial was planned with the same idea as the second trial, that is, the head development be adjusted in last-July to mid-September expecting to be under dense rain condition with lower temperature than April and May. The two trials were planned to compare which is better.

B. Cultivation

a. The manners of raising seedlings and cultivation on the growing beds are the same as the second trial, the same spacing and rate of fertilizer supply as well as the management.

b. Sown on 21-6-78 in the seed pots and transplanted in the nursery bed on 2-7.

c. Set in the growing bed on 30-7-78.

C. Varieties Tested

Leo and Titan of Sakata Seed, Kagayaki and Shogun of Kyowa Seed, and New October and Ogoshi of Ishii Seed, Total 6 varieties.

(2) Growing Process

A. Growing condition of this trial seemed to be better than the second trial due to dense rains came after the end of August to the middle of September, that is, dense rain condition came some 1-2 months after the average year.

B. Nevertheless the above, the growing condition was much worse than dry season, some of the later varieties like Ogocho and Titan showed much later head-formation and eventually Titan could not form normal head, spreading all the leaves to form head.ad.

(3) Result Obtained

Earlier 3 varieties of Leo, Kagayaki and Shogun were examined on 4 October, 66 days after setting, medium variety of New October is examined two times, on 4 and 10 October due to see better performance on 10th, and Ogocho and Titan were examined on 10 October when the condition seemed to come to the limit of growing, 72 days of setting.

Table 10. Performance of the 3rd Trial in Late Rainy Season,
Sown on 21-6-78 and Set on 30-7-78

A. Performance of Plant Frame

Variety	No. of plants examined	No. of Frame leave	Size of the largest leaves			General observation
			Length	Width	L/W	
Record on 4 October						
Leo	3 plts.	8.0	21.0 cm	19.7 cm	1.07	Over matured and head surface became decaying.
Kagayaki	2	13.0	26.3	23.3	1.13	To mature after 1 week.
Shogun	3	11.0	24.3	23.2	1.05	Good growth, just matured good head.
New October	3	11.0	25.5	24.3	1.05	Best growth and head, somewhat immature.
Record on 10 October						
New October	2	12.5	27.0	26.8	1.01	Just maturity but could be kept 1 week more.
Ogocho	2	18.0	28.0	23.3	1.20	Internodes of heading stem elongated.
Titan	2	18.0	21.3	18.5	1.15	Still spreading leaves at the heart, no hope of heading.

B. Performance of Head

Variety	Weight			Size of head		The biggest head	
	Whole plant	Head	H/W	Diameter	Depth	Weight	Diameter
Record on 4 October							
Leo	403.7 g	292.3	0.73	10.7 cm	10.2 cm	331 g	11.0 cm
Kagayaki	490.5	177.0	0.36	11.0	7.8	203	12.0
Shogun	623.7	368.0	0.59	11.0	9.0	436	12.0
New October	785.0	469.7	0.60	13.0	11.7	485	13.5
Record on 10 October							
New October	818.0	504.0	0.62	14.8	12.8	612	16.0
Ogocho	445.0	103.5	0.23	11.0	9.8	138	12.0
Taitan	256.0	15.5	0.06	-	-	17	-

4. DISCUSSION ON THE TWO TIME TRIALS IN RAINY SEASON

(1) General Discussion

A. Those two trials were carried out in order to search the possibility of cabbage production in the rainy season. The expert saw a cabbage growing field in Kashimipur BADC field in May, it was so poor growth, only 20 - 30% of plants formed very small head, therefore, the expert concluded that head-formation of cabbage may be almost no hope due to extraordinary high-temperature condition in April and May in Bangladesh. Then, he hypothesized that cabbage could be grown during rainy season providing to choose the most heat tolerant varieties and if its head-formation stage is focused at the dense rainy season from the end of June to the middle of September when the temperature is lower and severe dryness of soil is less than April and May. The stage of head-formation from the appearance of small head at the center of frame leaves to the head maturity, usually for about one month, is the most rapid and delicate growing stage for cabbage and if the growth in this stage is checked by hot temperature and severe dryness of soil, cabbage cannot form head spreading rapidly its center-leaves which are going to form the head. Therefore, this stage must be adjusted to the milder weather condition than April and May.

B. As seen in the results of the second and third trials, the majority of plants have formed their heads at any rate, therefore, it has proved that the expert hypothesis mentioned the above is realized.

C. General speaking, however, it was realized also that the head size of cabbage produced in the rainy season may be less than 1/3 of those produced in the dry season, which means the price of cabbage in August to early October should be more than 3 - 4 times as high as cabbage in December through February.

D. The economic evaluation of cabbage production in the rainy season should be concluded in more precised repeated trials at several different places but these two time experiments may show a basic reality of the matter in question. "Cabbage can be produced in the rainy season but the production may be much costly than dry season, and the essential point is to select the most heat tolerant varieties and to keep the soil wet caring of irrigation when fine weather continues for more than 3 - 4 days even in the rainy season.

(2) Particulars

A. The reason why the performance of the third trial was better than that of the second trial can be concluded caused by predomination of fine days from middle of July to middle of August this year. This condition may change from year to year by fluctuation of weather condition.

B. The late maturing varieties like Taitan and Ogosho cannot be recommended to grow in this season. They could not form good head due to their habit of rapid spreading of heading leaves when grown under severe condition of rainy season.

C. Among the varieties tested in these trials, Shogun and New October were proved as promising varieties in this season. Shogun is a variety which is being very popular in Taiwan due to its tolerancy to heat and the black rot raging under hot and rainy condition. New October is a heat resistant succession type variety with strong growing habit and this variety has thinner leaves

which suited to be eaten raw or as salad.

D. Leo also a promising varieties as it earliness but it produces smaller head and needs rapid harvesting when matures.

E. Princess and Harvester Queen from Sakata were also added in the trial but they were died raising seedling stage due to susceptible to heat because they are suited to cooler places.

5. THE FOURTH TRIAL IN DRY SEASON

(1) Materials and Method

A. Manner of Cultivation

a. Raising seedlings: Manner of raising seedlings was the same as the first trial, that is, the seeds were sown in the bed by linear sowing and transplanted in the nursery bed with the spacing of 15 x 12 cm.

b. Set in the growing bed at the 32 day old stage with the spacing of 70 x 35 cm, or 2 line planting on the bed. Rate of fertilizers was approximately the same as the second and third trials.

B. Varieties Tested and Rate of Planting

a. Varieties tested were Leo, Kagayaki and Shogun. Really some other varieties were also raised the seedlings but they were planted in CERDI's vegetable trial field, Joydevpur and did not plant here. They were New October of Ishii, Harvester Queen, Princess and Titan of Sakata Seed and Late Drunhead of Nepali Government.

b. Sown on 1-10-78, transplanted in the nursery bed on 15-10, set in the growing bed on 2-11-78.

(2) Growing Process

A. Raising seedlings have gone rather smoothly except some of the varieties suited to the cooler places like Harvester Queen and Princess which performed very poor raising and large part of seedlings were died on the way of raising.

B. Grown in the growing bed was very smooth. It was the first time the expert could see the growth of vegetables in November through January, and he realized that it was extraordinary good performance not only with cabbage but also common to all the vegetables, providing good management of irrigation is carried out.

Table 11. Performance of the 4th Trial in Dry Season
Sown on 1-10-78 and Set on 2-11

A. Performance of Plant Frame

Variety	Examined		No. of frame leaves	Size of the largest leaf			General observation
	Date	No. pnts.		Length	Width	L/W	
Leo	15	5	9.5	26.0 cm	27.0 cm	0.96	Maturity was 10 days before. Overmatured and outer leaves of head became drying.
	24	5	7.2	23.4	25.2	0.93	
Average			-	-	-	0.95	
Kagayaki	15	5	12.4	33.2	29.5	1.13	
	24	5	11.2	27.8	26.6	1.05	
Average			-	-	-	1.09	
Shogun	15	5	15.0	33.2	31.9	1.04	Matured but freshy. Withstand very well.
	24	5	10.4	33.7	32.4	1.04	
Average			-	-	-	1.04	

Note: (1) Examination was done 2 times on 15 and 24-1-79.

(2) During 15 to 24, the frame leaves were much fallen therefore the averages were not taken, because it seems to be nonsense.

B. Performance of Head

Variety		Weight			Size of head		The largest head	
		Whole plant	Head	H/W	Diameter	Dpeth	Weight	Diameter
Leo	15	1,468 g	1,109 g	0.76	16.7 cm	10.5 cm	1,300 g	18 cm
	24	1,163	960	0.83	16.8	10.3	1,020	17
Average		1,316	1,035	0.80	16.8	10.4	-	-
Kagayaki	15	1,750	1,143	0.65	16.0	11.2	1,365	17
	24	1,562	1,120	0.72	16.2	11.2	1,255	17
Average		1,656	1,132	0.69	16.1	11.2	-	-
Shogun	15	2,600	1,758	0.68	19.5	11.2	1,925	20
	24	2,512	1,942	0.77	20.5	11.7	2,060	20
Average		2,556	1,850	0.73	20.0	11.5	-	-

Character of the frame leaves:

- a. Leo: Lighter green than the other two, a little fringed margin with smooth surface.
- b. Shogun: Medium green with much bloom, almost smooth margin and surface. Good growth with no injury upto the end of January.
- c. Kagayaki: Almost the same character but the growth is somewhat weaker than Shogun.

(3) Result Obtained

A. Better performing plants were examined selecting each 5 plants per variety two times on 15 and 24-1-79, that is, 75 and 84 days after setting.

B. Leo was the earliest among 3 varieties and became harvestable at the beginning of January, that is, somewhat over-matured on 15th but some increase of head weight seemed to go on during these 10 days, this variety showed some tired growth on 15th, appearing yellow turning on the lower frame leaves, and completely over matured on 24th, showing the development of ansciss layer at the basis of several outer leaves of head, that is, still marketable but decrease weight and quality.

C. Kagayaki was just the harvesting time on 15th. This variety showed a little worse growth than Shogun. No more increase of head weight was go on after 15th but showed capable of keeping in the field a few weeks more.

D. Although its maturity was somewhat later than Leo, Shogun showed the best and vigorous growth. On 15th, it reached its maturity but its frame leaves showed still young and active. It has increased the weight of heads after 15th. Really, it has been kept in the field harvesting from time to time until the end of February when the temperature went up rapidly.

E. The yeilds were in order of Shogun, Kagayaki, and Leo as seen in the Table. Common results of this trial showed bigger performance of heads than the first trial. The reason why Shogun and New October performed smaller heads than Kagayaki and Ogocho in 1st trial could be the former two were latter maturing than the latter, for example, the largest head of Shogun was 1,400 kg, may be this plant reached already its maturity.

6. GENERAL DISCUSSION AND CONCLUSION THROUGHOUT THE FOUR TRIALS

(1) Significance in This Series of Trials

This series of trials was carried out aiming at to sound the fact how far extent cabbage could be grown under Bangladesh condition as a whole with least area and least labour at the given home garden condition, with very limited area of some 400 m² for all kinds of vegetables having to be on trial and with only one Marie for the labour. The expert also designed to test several varieties in order to search out some of them may adaptable and other may not adaptable for the given condition, in the other words, in the extreme case, if only one variety was tested and it was unadaptable one, the experimenter might conclude wrong result.

With the help of his comprehensive knowledge and experience of cabbage cultivation, the expert could get some extent of general idea of possibility of cabbage cultivation under Bangladesh condition through this series of trials. But the quantities of yields themselves seen in the result Tables cannot be definit strictly in this series of trials and it must be understood that all the result figures shows but a trend of possibility, that is, for example, in case, variety A performed 10% more yield than variety B in the Table it can conclude that variety A may have more productivity trend than variety B. However, it can be concluded that variety A is earlier than variety B or variety A is tolerant and B is susceptible to the rainy season condition in Bangladesh since the expert has carefully observed daily on the growth of plants and noticed appreance of diseases and pests or physiological disorder and natural habit of the varieties.

(2) Cabbage Cultivation in Dry Season

A. As seen in the results of the first and fourth trials, cabbage can produce 1 – 2 kg of heads at the spacing of two lines per 110 + 40 cm bed and 35 cm apart plant to plant, that is 0.26 m² per plant, about 3,800 plants per 10 a or about 15,000 plants per 1 acre.

B. This performance is almost the same level of cabbage cultivation at the marketing production areas in Japan, that is, it bears comparison with cabbage cultivation in Japan, providing a good irrigation facilities.

C. On the Varieties

Cabbage varieties can be roughly classified into a few types:

a. Early groups such as Leo, K-Y Cross and K-K Cross. General speaking, cultivation of early variety is easier than medium one. As seen with Leo in the results of 4th Trial, early variety cannot be kept in the field for long time since its growth is quickly tired stopping the growth and becoming susceptible to disease and physiological disorders after its maturity. Therefore, this type maybe better to grow in early marketing purpose, for example, sowing late September to early October, set in the field 30 - 35 days after and harvest in December or earlier, but the harvesting should be completed within a week or 10 days.

b. Medium group such as Kagayaki, Ogosho and O-S Cross.

c. Medium late group such as Shogun, New October, Titan.

Those medium group are generally heavy yielders than early group, forming 1.5 – 2.0 kg of heads. Moreover, superior character of those varieties are good ability for keeping in the field for a long time, in the other words, have a good flexibility in their harvesting time. Really, the expert could keep Shogun in the 4th trial up to the beginning of March, some 1.5 months after its maturity, harvesting step by step according to the needs of products. This character is very convenient from practical point of view, that is, it can harvest watching the market condition of price. For example, in Bangladesh market, most of the leaf and root vegetables like Cauliflower, cabbage and radish grown in dry season rush to send to makets from middle December to early January, therefore the prices are frequently dropping down. Such a time, in case of growing this type of cabbage variety, the producers can wait the harvest up to market price rises up.

d. Late group such as Nepali Late Drunhead. This variety has performed eventually not bad but due to segregating not only various types of head but also various maturity it cannot be recommendable. This variety was grown in the CERDI trial field as seen in the Photo Plates.

e. There are two types of head qualities in medium groups, that is, one is thick leaved and another is thin leaved. Leo, Shogun and Kagayaki belong to the former and New October, Ogosho and O-S Cross belong to the latter. The former is suited to heavy boiled or fried eaten due to their tough taste, if utilized for currie, this type seems to be better due to no dissolving even boiled for long time. This type is more tolerant to storage and long distant shipping. The latter is suited for salad use or light frying dish with their soft and brittle taste.

D. Prospect for Exporting

Examining those dry season trial of cabbage, the expert can say that Bangladesh dry season is very much suited to cabbage production by its good weather condition, fertile alluvial soil and Bengalee farmers having good potentiality of skillness for farming.

The expert saw wonderful performance of cabbage cultivation in the farmer's field nearby Comilla Academy, that is, variety so-called Nagaoka No. 1 (maybe O-S Cross) has produced uniform heads of more than 25 cm diameter estimating about 5 kg and this performance is really the second time of the expert met with during his 40 year life involving numerous time of his experimentations and investigations of farmer's fields, and the first time was in a suburban of Kushiro City of east part of Hokkaido in 1944, one of the world suited production area of cabbage. Accordingly, the expert can conclude that dry season cabbage harvesting December through February of Bangladesh has a good possibility to export to foreign countries due to its lower cost of the production.

(3) Prospect of Cabbage Production in Dense Rainy Season

A. As much discussed in the Section 4, Cabbage can be produced also in the rainy season providing harvest in the period of late August through early October. The performance, however, may be rather instable from year to year according to the fluctuation of weather condition especially dense rain condition and yield may be less than 1/3 of dry season.

B. Cabbage production maturing in April and May seems to be almost impossible to be economical since the alternation of extreme high temperature causing quick dryness and heavy rain makes so bad effect on the growth which causes physiological disorder in the heart of stem resembled to boron deficiency, and as the result, large part of plants dies before head formation.

C. Condition in October also causes more or less similar growing condition to April and May. The expert noticed some of the stems of plants of the third trial showed the symptom of physiological disorder mentioned the above. But the symptom appeared were not so severe that their head was formed, only this fact could be a risk for cabbage production in October in case of violence (see also Photo Plate 10-C).

REMARK:

Refer also Tables of Part 1 of Cultivation types of various vegetables in Bangladesh.

CHAPTER 4. RESULTS OF TRIALS ON CAULIFLOWER, BROCCOLI AND KAILAAN

1. PURPOSE

Cauliflower is a popular and important vegetable in Bangladesh and broccoli is a recently introduced one but extendable following to cauliflower. Both can produce their seeds on practise but the system is not yet established due to no qualified stock seed is available. Kailaan is a newly introduced one from S-E Asia, one of the very promising vegetable for the countermeasure of rainy season and its seed production is very easy in Bangladesh.

The former two are hard to grow in rainy season of Bangladesh while Kailaan can easily grow throughout the year with its ever flowering capacity and mature for vegetable in a short period of two months from sowing, therefore, the latter can take the place of the former two in rainy season harvesting from May through October.

This series of trials has been executed, firstly to realize the real capacity of Japanese F₁-hybrid varieties of cauliflower and broccoli as well as a Nepali cauliflower in dry season and secondly to confirm the real capacity of Kailaan during rainy season using a few types of seed stocks.

2. ON CAULIFLOWER AND BROCCOLI

2.1 Materials and Method

(1) Varieties Tested

Cauliflower: 127. Snow Queen, 128. Snow Queen (Takii Seed) and 152. Nepali, Veg. Dev. Div. Dep. Agr., Nepal Gov.; each 10 plants. Broccoli: Green 18 (Sakata Seed); 31 plants.

(2) Cultivation Method

Sown on 1-10-78 in open seed bed at linear sowing 12 cm apart; Transplanted in the nursery bed on 15-10 at some 15 x 12 cm; Set in the growing bed on 2-11 at 75 x 35 cm spacing or two lines on the bed. Rate of fertilizer and other management were the same as the 4th trial of cabbage.

2.2 Results Obtained

Progressive growth has been very smooth without appearance of any disease. Examination was done progressively at the maturity of each variety. Records are as seen in Table 12.

**Table 12. Performance of Cauliflower and Broccoli at Gulshan Garden,
Sown on 1-10 and Set in the Field on 2-11-78**

No.	Variety	Date and No. of plants Examined	Weight of (g)			No. of leaves		Size of the biggest leaf (cm)		Size of Head (cm)	
			Whole plant	Head	Ratio of H/W	on the Head	on the Frame	Length	Width	Width	Depth
128 Ca., Snow Queen	Average	25-12-78 5 plants	910	307	0.34	7.2	13.2	41.0	17.4	14.7, 12.4	6.8
	Best plant		1,040	332	0.32	6	14	43.0	19.5	15.5, 12.5	7
129 Ca., Snow King	Average	4-1-79 3 plants	879	427	0.49	9.0	13.3	40.7	18.2	13.5, 12.3	7.7
	Average	7-1-79 3 plants	-	448	-	11.0	-	-	-	12.0, 11.3	6.8
	Best plant		878	468	0.53	9	12	40.5	19.0	14, 13	8.0
147 Br., Green 18	Average	3-1-79 3 plants	991	249	0.25	5.3	13.3	46.3	18.5	13.1, 11.8	12.0
	Average	7-1-79 4 plants	-	291	-	5.0	-	-	-	15.0, 12.4	11.3
	Best plant		1,352	358	0.26	4	15	50.0	19.0	17.0, 13.0	12
152 Ca., Nepali	Average	22-1-79 3 plants	1,591	475	0.30	8.7	19.3	56.0	22.8	15.5	9.2
	Best plant		1,448	555	0.38	7	18	48.0	19.0	17.5	11.5

- Note: (1) Harvest was done step by step on the maturity of each plant.
(2) Snow Queen and Snow King showed good uniformity while Nepali produced only 3 good head and 1 poor head and remainder did not form head.

2.3 Discussion and Conclusion

(1) On the Cauliflower

A. Performance

As seen in Table 12, the maturity of Snow Queen can be evaluated about one week earlier than Snow King and both F₁-hybrid varieties showed excellent uniformity in quality and size of their heads maturing all the plants within one week per respective varieties. Nepali was quite late, about 4 weeks later than Snow King and produced only 3 marketable size heads and one inferior head out of 10 plants and the remained plants found tiny irregular elongated tops which is hardly recognized as cauliflower curd. As for the leaf character, the formes two have lighter green, less bloom and roundish tip which is a character of Early Snow Ball while Nepali has darker green much bloom and somewhat pointed tip which is a character of late variety.

While the former two can be evaluated excellent for growing in Bangladesh, Nepali seed cannot be evaluated approval, maybe, because of insufficient selection or else does not adaptable to subtropical condition due to developed at high altitude place of Nepal.

B. Discussion

The problem is risen from the fact that head formation of cauliflower is deeply affected by temperature condition and each variety, if not mixed type, has its own range of temperature condition (usually around 17°C), therefore, the heading time is rather limited in the season for every type of variety. In the other words, with one variety, cauliflower does not have so much flexibility for changing its harvesting time by means of changing its sowing time. For example, theoretically, even if a variety is so sown as at the beginning of September and at the end of October (50 days different), its harvesting time may be fallen down in the range of only 10 days or 2 weeks and never makes the original difference of 50 days. This tendency becomes clearer and sharper with F_1 -hybrid variety than simple variety of mass selection.

Therefore, the expert's worry is that although Snow Queen and Snow King have excellent quality and uniformity, they have to be harvested within short period and have very less flexibility to change the harvesting time by change of sowing time. This is a special phenomenon of cauliflower and broccoli and can be said their pitty.

C. Conclusion

a. Accordingly, in case of design to produce cauliflower from November to February, this plan cannot be realized only with Snow Queen and Snow King. For the production of November to early December, special variety of tropical extra early type has to be provided. At the same time, for the purpose of producing late January through March, a late variety other than Snow Ball type has to be provided.

b. Another point is physiological disorder. A part of heads of Snow Queen and Snow King showed brown discolour on the part of head and this discolouration was recognized extending down into the pith of stem, therefore, it was considered to be the same physiological disorder appeared on the Japanese radish in May and June.

This disorder was recognized to be not so big problem in this cropping pattern that it can be avoidable if the head is harvested on right time before over maturity since it seemed to appear at the later stage. It is quite possible that the disorder may appear earlier and severer in case of early cropping. Accordingly, such a vigorous growing of early varieties as Snow Queen and Snow King may not be suitable to start sowing as early as in August or early September due to the appearance of this discolouration with the same reason as explained on Mino-Wase radish.

(2) On the Broccoli

A. Performance

Although general performance of the broccoli was fairly good, the same as Snow Queen and Snow King, comparing with performance in Japan, the size and productivity of its main head was smaller than cauliflower as seen in Table 12 comparing its weight and H/W ratio with those of cauliflower.

As seen in the photograph, however, the broccoli had sprouted several secondary small heads from the auxiliary buds of the stumps 10-15 days after the main head harvested. Regretfully, the yield of those secondary heads has not been recorded but they could be estimated a pretty amount which can supplement the inferior yield of main head.

B. Discussion and Conclusion

The secondary small head can be utilized for some special uses, namely not only home use and local market but also could be utilized for processing of pickles or even special use for a garnishings of meat dishes with whole style.

Since broccoli has the same habit of flower induction as cauliflower but it has rather narrow range of varietal difference than cauliflower does, broccoli's harvesting time may be limited in December to February in Bangladesh due to the same ecological reason as cauliflower but less flexibility. Accordingly, the cropping pattern of broccoli in Bangladesh may be limited in the sowing in late September through October, setting in the field about one month after sowing, and harvest main heads in late December to January with additional harvest of secondary heads in January and February. Although the harvesting time may not accelerate so early than earlier time of sowing, the plant sown earlier will be bigger than the late sown and it will result in producing the bigger main head and more number of marketable secondary heads.

3. TRIALS ON KAILAAN

Kailaan is the vegetable which could be substitutable to broccoli during rainy season, moreover, it is one of the easiest growing vegetables in the rainy season and seems to be the most easily acceptable to Bangladesh people to eat. Several varieties of Kailaan was accordingly tested during rainy season.

3.1 Material, Method and Outline of Progress

The following series of trials were executed from 1977 to 1979. Regretfully, actual records were taken at only two times since all the performances in the different trials seemed to be more or less the same and they could be understand in the photos.

(1) 1st Trial

Varieties tested: 1 Narrow leaf, 2 Bread leaf (both from Chia Tai Seed) and 33 Yellow leaf from Taiwan. Method: Sown on 26-7-77; Transplanted in the nursery bed on 11-8 and Set in the growing bed on 6 and 7-9-77. Spacings were 3 lines on the bed for the 33, 3 and 4 lines for the 2 and 4-5 lines for the 1 with all planted 15 cm apart. Progress: Progress of growth was smooth. Result is recorded in Table 13.

(2) 2nd Trial

3 varieties tested in previous trial were tested again sowing on 28-9-77 and set in the growing bed on 27-10-77 at 3 lines and 20 cm apart, but the results was not recorded due to the same reason for the radish trial in that autumn, only the seed production test of 1 Narrow leaf Kailaan was continued up to March 1978 as explained later in Annex 1 of Test Seed Production.

(3) 3rd Trial

Varieties tested: Sp. 2 Narrow Leaf (Locally produced seed at Gulshan Garden from 1 Narrow Leaf), 102 Pointed Leaf and 103 Savoy Leaf (both from Malaysia). Method: Sown on 12-3-78; Transplanted into the nursery bed on 26-3 at the spacing of 12 x 10 cm, and Set in the growing bed on 9-4-78 planting 3 lines with 20 cm apart between plants on the growing bed. Picking up the seedlings for transplantation thinning every other ones, the remaind seedling of Sp. 2 were left as it is on the nursery bed for harvesting the earlier stage. Progress: Growth was generally smooth. The plants grown continuously on the nursery bed were harvested step by step from the beginning of April and ended arround on 10-5. The plants grown transplanting on the growing bed were starting harvest arround 30 days after setting and the first flowering plants were seen around in 15-5 (64 days) which means the end of harvesting.

(4) 4th Trial

Varieties tested: Sp. 5 Narrow Leaf (local produced seed at Gulashan from 1 Narrow Leaf) and 103 Savoy Leaf (Malaysia). Method: Sown on 12-5-78; Transplanted into nursery bed on 25-5 and Set in the growing bed on 18-6-78 with almost the same manner as previous trial. Progress: The growth can be said generally smooth but the growth rate seemed to be somewhat inferior to those of the same time trial of cabbage (2nd trial).

Some whitish brown spot disease which supposed to be Alternaria leaf spot appeared on the leaves but not so violent. On 30-7-78, both varieties became harvesting time around that time and one flowering plant was seen in the Sp. 2 Narrow leaf (just 80 days after sowing) and this means the end of harvesting time for this variety.

(5) 5th Trial

Varieties tested: Sp. 2 Narrow Leaf, 2 Broad Leaf, 118 Green Lance (Sakata Seed) and 128 Tinhao (Takii Seed). Method: Sown on 21-6-78 by linear sowing on the seed bed; Transplanted into the nursery bed on 2-7 at the spacing of 12 x 10 cm and Set in the growing bed on 30-7-78 in 4 lines and 20 cm apart between plants on the bed. Progress: The growth can be said generally smooth and the result is seen in Table 14.

3.2 Results Obtained and Discussion

(1) On the 1st Trial

Table 13. Performance of Kailaan Varieties in the 1st Trial
Sown on 26-7-77, Planted on 7-9 and Examined on 10-10-77

No.	Variety	Weight (g)		Characteristics of leaf and stem
		Whole plant	Root	
1.	Narrow Leaf, stem type	214 - 300	20	Narrow and pointed leaf blade, stem swells early, earlier maturing, white flower
2.	Bread Leaf, leaf type	290 - 316	20	Broad and roundish leaf blade, stem swells late, suited to harvest young tops a few times
33.	Yellow Leaf, leaf type	226	20	Similar type to 2. but light yellowish blade with yellow flower.

Note: Number of plants examined was 3.

Examination was done at 74 days after sown or 33 days after planted. The growth rate seemed to be somewhat over-matured especially on 1 Narrow Leaf since the stem diameter became about 2.5 cm and the skin became so fibrous as to be peeled off for eating. 60 - 65 days after sown may be adequate.

1 and 2 were conformed to belong to *Brassica alboglabra* but 33 seemed to belong to *B. acephala* or ordinary Kale because of having yellow flower. 1 showed rather uniformity although involving some diversity on the rate of stem swelling. 2 showed much mixed types ranging from almost the same types as 1 to very broad and roundish blade with somewhat savoyed face. Anyhow, the latter two were considered to be suited to grow such manner as firstly pick the main stem top with 3 - 4 leaves then a few time harvest secondly shoots from the stump.

(2) On the 5th Trial

Table 14. Performance of 4 Varieties of Kailaan in the 5th Trial,
Sown on 21-6-78, Planted on 30-7 and Examined on 16-9-78

No.	Variety	Weight of Whole plant (g)	Number of leaves	Size of the largest leaf			Remark
				Length (cm)	Width (cm)	L/W	
Sp. 2.	Narrow Leaf (Best plant)	161.0	8.5	23.3	12.5	1.86	Early flowering type; 10% of plants were flowering
		200	9	24	13	1.85	
2.	Broad Leaf (Best plant)	86.0	7.7	23.2	16.0	1.45	Worst performance but caused by aged seed and subsequent worse growth
		92	8	25.5	18	1.42	
118.	Green Lanse (Best plant)	211.7	9.3	29.0	14.3	1.03	Fairly good but early flowering; 60% of plants are already flowering
		240	8	30	16	1.88	
128.	Tinhao (Best plant)	185.3	8.3	27.7	18.8	1.47	Best performance; Large leaves on very thick stem
		246	9	28	23	1.22	

Note: Number of plant examined was 3 except 2 plants for Sp. 2.

Japanese two F_1 -hybrid varieties of 118 and 128 showed excellent performances with complete uniformity compared with other two varieties of mass-selection.

Sp. 2 showed good germination and good growth due to newly produced seed of March, 1979 at Gulshan Garden but 2 showed very bad germination and worst growing up, consequently which seemed to cause the worst performance, accordingly, the worst performance can not be said the capacity of Broad Leaf variety itself. This result is one of the examples if no good germinative seed were used, the result may be no good especially in case of rainy season culture.

The date of examination of this trial was at 88 days after sowing and 49 days after planted in the growing bed, later setting than normal counting 40 days for raising seedlings. This is rather late time for the harvest of Kailaan which standard is normally 30 - 35 day after planting 30 days old seedlings. Therefore, early flowering stem type of Green Lanse and Sp. 2 have been over-matured or flowered and even Tinhao which did not yet flowered but its stem has already over-matured having diameter of 3 - 4 cm and the skin became fibrous.

3.3 Conclusion

(1) On the Varieties and Their Capacity

From the data of leaf size (L/W ratio) and flowering time or percentage in Table 14, Narrow Leaf is early flowering type and Broad Leaf is late flowering type. It can be said that Green Lanse belongs to the former and Tinhao belongs to the later.

Regulatefully the record was not taken but as for the Malaysian varieties in the third trial, 102 Pointed Leaf belonged to the former type and 103 Savoy Leaf belonged to the latter from observation. As seen in the photograph of seed production, a few maternal lines selected from 2 Broad Leaf were identified to be called Savoy Leaf Kailaan; that is to say, the population of Broad Leaf Kailaan of Thailand involves also the same type plants as Savoy Leaf Kailaan of Malaysia and this type can be said the best plant character of Broad Leaf or Leaf type Kailaan.

Actually, in the vegetable market of Bangkok, Kuala Lumpur, Penang and Singapore, one can find two types of Kailaan in marketing styles, that is, one is usually bundled young plants and another is large cut plants with a few large leaves and usually piled in bulk, the former is Narrow or Pointed Leaf variety and the latter is Broad or Savoy Leaf type. In the practical production fields of those areas, the former is cultivated in the intensive culture areas by dense spacing and quick growing, sometimes transplanting and sometimes even direct sowing or transplanted at very young stage of 1 - 2 true leaves. The latter can be found in somewhat extensive culture of upland area with sparse spacing growing rather long period up to large plants.

(2) Standard Design of Cultivation

Summarizing the results of a series of the trials and other observation, Kailaan can be concluded as a very promising vegetable to grow during rainy season in Bangladesh, when cabbage, cauliflower and broccoli are hard or impossible to produce.

As understandable from the above, two types of stem type and leaf type of Kailaan varieties may be also needed in Bangladesh. The standard of cultivation of the two types would be as follows:

a. Stem type: Raising seedlings for 25 - 30 days on the nursery bed, transplant in the growing bed of about 100 cm width spacing 20 - 25 x 15 - 20 cm, with much N-fertilizer and every day watering on the bed together with furrow irrigation aiming quick growing, and harvest about 30 days after planting. Or else, with broad casting sowing on the seed bed, one time thinning at the germination stage, transplanting seedlings at 2 - 3 true leaf stage, or 15 - 20 days after sowing, with spacing of 20 x 15 - 20 cm, and harvest at 35 - 40 days after transplanted.

b. Leaf type: Raising seedlings for 30 days, transplanted on the growing bed with spacing of 25 - 30 x 25 cm, first harvest at about 30 days after transplanted and continue a few harvests from axils.

(3) Notice on the Flower Formation

Kailaan, even with stem type, should be harvested before the flower buds appear clearly on the top, since when a mass of flower buds appears, stem skin becomes fibrous and

needed to be peeled off for eat. Therefore, the flower appearance means the limit of harvesting time.

As understandable from the 3rd trial, March to April sowing makes early flowering so that harvesting should be done earlier. As to the sowing after June, harvesting time can be designed just as the above standard. In the autumn, the flowering time is delayed and this produces thicker stems but care of not to be overmatured with fibourous skin, if the cultivation management is good, the development of fibour may be much delayed.

The seed production problem is explained in Annex 1 of Seed Production.

CHAPTER 5. RESULT OF TRIAL ON CHINESE CABBAGE

1. PURPOSE

Chinese cabbage is still strange vegetable in Bangladesh, furthermore so in all westmore part of the world than Indian Subcontinent, the expert is yet keep his thought that it could become an important vegetable either in Bangladesh as well as in the westmore zone in the near future. The reason is as follows:

a. Chinese cabbage has a wonderful capacity to perform the biggest yield of excellent quality product in the shortest period, maybe the biggest among all kinds of leaf vegetables if counted its quality and growing period.

b. Chinese cabbage is the most important and delicious vegetable for Chinese dishes, especially for frying boiled dishes. In fact, many substitute vegetable are used in such sort of dishes under the pressure of necessity in the unavailable places, for example, cos-lettuce in European and Mediterranean countries and cut bottle gourd in Bangladesh and neighbouring countries. Moreover, Chinese cooking is rapidly spreading now in the world as well as in Bangladesh because this sort of dishes can be acceptable for all the sorts of people in the world.

c. The biggest difficulty in extension of Chinese cabbage has been in fact the difficulty of its head formation, which key point is to achieve keeping its quick and smooth growth throughout the growing period, as well as to get the good seed. This point is, however, almost going to be solved at present since Japan has developed many F_1 -hybrid varieties having complete uniformity and the earliest varieties forming 1 - 2 kg of heads so early as 60 - 70 days, even with unexperienced growers outside Japan, have developed recently.

The expert, therefore, executed this trial but planned only in dry season because he thought the rainy season of Bangladesh is so severe for Japanese Chinese cabbage that it can hardly produce marketable heads or no head at all.

2. MATERIALS AND METHOD

(1) Varieties Tested

115 Tropical Pride, 116 Tropical Delight (Sakata Seed), 130 Tropicana, 131 Saladeer, 132 39-B (Takii Seed) and 136 Michili (Chia Tai Seed).

(2) Cultivation Method

Sown on 30-10-78 directly at 2 lines of 60 cm apart on the bed and 30 cm between plant. At the center of the lines each one line of short period brassicas such as Green Choisan, Cantan Petsai and Surugana were intercropped for 45 days to utilize the space during young stage of Chinese cabbage but no remarkable bad effect was seen.

Thinning practice was done following the manner in radish. Rate of fertilizers and watering were almost the same as cabbage after set, only a sufficient top dressing was done at the time of removing intercrop, that is, the beginning of head formation.

3. RESULT OBTAINED AND DISCUSSION

(1) General Observation on 7-1-79 (69 days after sown)

A. Tropicana

Characteristics of frame leaves; light green, roughly savoyed face and slightly fringed margin, in some respects resembles to 134 Chia Tai's 40 days, a green leaved typical tropical Chinese cabbage, therefore, it seemed to be an improved variety of tropical type but it did not produce flower in the later observation. All the plants grown formed heads maturing at the beginning of January, some 65 days after sowing. Some extent of white spot (*Cereosporella brassicae*) appeared on the leaves at the end of growth but seemed to be no remarkable effect on the yield.

B. Saladeer

Frame leaves; Outer most large leaves are rather dark but turns the lighter and yellowish green on the inner leaves and becomes whitish on the covering leaves of head, the characteristics very much resemble to 6 Chia Tai's 55 days and this variety was regarded as a tropical type since it flowered and produced seed in Jaydevpur in the later observation. It was very much susceptible to ring spot mosaic or turnip mosaic virus as well as white spot whereby 7 plants out of 20 was eventually died and only 7 plants produced good heads. One plant bolted on 7-1-79.

C. 39-B

Frame leaves; dark green, slightly savoyed and no fringe. Head shape and characteristics seemed to belong to Chifu but the outer-leaves are somewhat wrapping, and dwarf thick but slightly inverted triangle shape. Growth was vigorous.

D. Tropical Pride

Frame leaves; Clear green, deeply savoyed face and slightly fringed margin. Head; Typical tropical type of inverted triangle shape and very compact. Better than Saladeer but appeared 3 ring spot virus infected plants out of 22.

E. Tropical Delight

Frame leaves; Dark green, roughly savoyed and roughly fringed margin, showing much vigorous growth. Head; Inverted triangle shape and very compact.

F. Michili

Very different to the above 5 varieties, this variety produces long cylindrical but pointed head, a typical Tienchin type. Frame leaves; Dark green, no savoyed but all the veins are running uprightly, long narrow blade with finely fringed margin. Although this is not an F₁ hybrid but showed fairly uniformity. Vigorous growth without leaf disease but this phenomenon may be caused by its later maturity, that is, on that day this variety did not reach maturity while all other varieties have already reached their maturity and Saladeer and Tropicana were already overmatured.

Table 15. Performance of Heading Chinese Cabbage in Dry Season Sown on 30-10-78 and Examined on 15-1-79*

No.	Variety	Weight (cm)				No. of leaves	Largest leaf (cm)		Size of head (cm)		
		Whole plant	Frame	Head	H/W		Length	Width	Height	Diameter	D/H
131	Saladeer* (Aver.)	1,090	356	734	0.67	9.4	31.8	20.5	18.0	14.1	0.78
	(Best plant)	1,374	414	960	0.70	10	33.0	20.5	18.0	15.0	0.83
130	Tropicana (Aver.)	1,927	421	1,506	0.78	6.8	34.4	22.4	22.6	12.8	0.57
	(Best plant)	2,275	450	1,825	0.80	6	39.0	24.0	24.0	12.0	0.50
132	39-B (Aver.)	1,756	398	1,358	0.77	8.2	34.7	23.0	22.4	13.6	0.61
	(Best plant)	1,950	395	1,555	0.80	6	36.0	26.0	23.0	15.0	0.65
115	Tropical Pride	1,862	486	1,376	0.74	7.2	25.7	23.2	19.8	14.8	0.75
	(Best plant)	2,055	555	1,500	0.73	9	34.0	25.0	21.0	15.0	0.71
116	Tropical Delight	1,911	466	1,445	0.76	7.8	28.6	22.0	20.6	14.2	0.69
	(Best plant)	1,970	470	1,500	0.76	8	27.0	20.5	22.0	14.0	0.64
136	Michili (Aver.)	1,377	393	984	0.71	7.4	45.0	21.0	36.0	9.0	0.25
	(Best plant)	1,830	595	1,235	0.67	9	44.0	24.0	35.0	11.0	0.31

- Note: (1) * Saladeer alone was tested on 7-1-79 because of early maturity and getting disease.
(2) The above data were expressed both average figures of 5 plants examined and the figures of the best plants per respective varieties.
(3) Frame leaves means excluding fallen leaves; maybe, several leaves were already fallen.

(2) Result and Discussion

Result obtained by the examination on 15-1-79 (77 days after sowing) except with Saladeer on 7-1-79. It is difficult to make a sharp conclusion from this trial owing to no duplication of plot, however, a rough conclusion can be said as follows:

A. The Maturities of 6 varieties were estimated as Saladeer the earliest maturing earlier than 60 days, Tropicana and Tropical Pride are early maturing about 65 - 70 days, 39-B and Tropical Delight are medium maturing about 70 - 75 days, and Michili is late maturing 75 - 85 days, in the condition of this trial.

B. Saladeer has a peculiar characteristics of typical tropical type among Japanese seeds, and has very tender leaves and even frame leaves can be usable. However, it cannot be recommendable for ordinary culture in dry season owing to its susceptibility of virus disease. It might be good for rainy season culture with harvesting at semi-heading stage which is discussed later on in Chapter 8.

C. Other 4 varieties of Japanese F₁-hybrid are more or less similar and all seem to be very promising for the cultivation in dry season. The expert guesses that all of these F₁ -