hybrids more or less have a blood strain of tropical type Chinese cabbage widely spread in southern part of China involving Taiwan and Hainantao which have not only heat tolerancy and extra-earliness but also a big capacity of head formation even under somewhat adverse conditions. Head shape of these varieties is the most popular shape of Chinese cabbage in Japan or beer barrel shape which is suitable for solted pickling as well as others uses.

D. Michili: This variety from Thailand is a simple mass-selection variety but having enough uniformity and its speciality is suited to some extend of dense spacing, maybe 10 - 20% denser than the former 4, owing to its uplight growing style of leaves as wel as its capacity of easier forming head than typical Chifu type variety. Its long cylindrical head is specialized by long and wide mid-rib of leaves, maybe two times longer than other tropical Chinese cabbage variety, which is very important for aforesaid frying boiled dishes of Chinese cooking because mid-rib of Chinese cabbage is the most tasty part with crispness for enjoying this sort of dishes. Therefore, this type of Chinese cabbage is very popular in South East Asian countries where Chinese restaurants are popular as Dacca is getting.

4. CONCLUSION

Chinese cabbage could be a good leaf vegetable like ordinary cabbage not only with its heavy productivity within 2 - 2.5 months but also with its durability for long distant shipping for distant market, that is, a kind of shipping crops like cabbage, if it is grown during dry season. The fault of this vegetable is rather difficult to produce good heads needing some skill for its cultivation. If the leaf growth is checked, for example, by insufficient fertility, by dryness or by severe solidification of soil which causes no good development of roots, the leaf may spread out everlasting and never form head. In the other words, the key for successful cultivation is to keep quick growth throughout the growing period.

It can be generally said that the wrapping style head of the 4 Japanese variety is tolerant to the cultivation on the heavy soil as well as sandy soil owing to their strong capacity of head formation, while Michili is suited to sandy soil which the growth can be easily kept smooth but on the heavy soil Michili may fail its head formation or else produces only small heads. Anyhow, with these 5 varieties, if they failed to form head, they cannot be eaten since the spread green leaves are very tough and fiborus, no taste all all.

CHAPTER 6. RESULTS OF TRAILS ON JAPANESE LEAF ONION INCLUDING SPRING ONION OF S-E ASIA

1. PURPOSE

Leaf onion is not yet popular at present in Bangladesh but the expert guesses it would be not so difficult to popularize it there since Bengalee people has a custom to eat fresh leaves of local bulb onion before its bulb formation. The expert has interested in leaf onion cultivation in Bangladesh through his observation on his trial at Gulshan Garden which showed unexpectedly remarkably good performance not only in dry season but especially in rainy season. He concluded it can be added to rainy season vegetables despite its rather long growing period, if count its convenience of harvesting step by step with the demands.

Leaf onion said here is divided into two general groups, one is so-called Japanese leaf onion or Nebuka in Japanese which is grown by seed and another is so-called spring onion in Malaysia and Thailand or Wakagi in Japanese which is grown by bulblet or dividing. Both belong to *Allium fisturosum* but the later belongs to *A. fisturosam var. caespitosum* and different to *A. cepa* of ordinary onion and *A. porrum* of leek. Although the varieties tested in the trial taking data were Japanese leaf onion but some discussion of spring onion is added in the last paragraph taking its picture and observation. Present Bangladesh leaf onion seemed to be leaf of local onion, *A. cepa.*

2. MATERIALS AND METHOD

(1) Varieties Tested

Nebuka type or non tillering type: 91 Choju, 141 Kuronobori and 142 Shiro-Senbon. Hanegi or tillering type: 143 Kujo and 36 Pei-Sun. The former 4 are from Japan and the last one from Taiwan.

(2) Times of Trials

A. 1st Trial: 91 Choju was tested; Sown on 16-9-77, Planted around on 15-11-77. Only observation was done from February to May, 78.

B. 2nd Trial: 91 Choju and 36 Pei-Sun were tested; Sown on 11-3-78, Planted on 17-5. Observation was done from time to time with the growth but examination was done only once on 20-10-78 at the end of harvest.

C. 3rd Trial: With 4 varieties of above mentioned; Sown on 24-8-78, Planted on 4-11-78. Examination was done step by step observing their growth on 21-2-79 and 17-4-79.

D. Trials on the Spring Onions: Firstly Thailand cultivar was tested started in August, 78 then two cultivars collected in Cameron Highlands and Singapore were added in November, 78.

NOTE:

Leaf onion said here is a leaf vegetable which is cultivated for its long leaf stems and green leaf blades. So-called leaf stem here is not a real stem but exactly to be said leaf sheath. The real stem of onion is a compressed stem at the bottom of leaf sheath and all the leaves and

roots emerge from this compressed stem. "Leaf sheath" of leaf onion is corresponding to the bulb of normal onion, but since it shapes a compact long cylinder, it is popularly called "leaf stem" or simply "stem".

(3) Design of Cultivation Method, Explaining Japanese Method in Detail

A. Nursery bed: Linear sowing at 15 cm apart lines, widthwise on the bed. Raising seedlings for 2 - 2.5 months until the stem diameter became some 5 - 7 mm. Rate of basic fertilizers was more or less the same as other seed bed but one time top dressing was done with 100 g of urea and 200 g of crushed oil cake about one month after germination.

B. Preparation of planting bed: Planting rows were made by digging ditches with about 13 - 25 cm depth and 10 cm width at the bottom, keeping the level of ditch bottoms to be some centimeter above the bottom of main drainage ditches and also the height from the peak of earthed up soil to the bottom to be about 25 cm (Fig. 1). Put matured cowdung compost linearly at the bottom mixing with crushed oil cake which rate was more or less the same as basic fertilizer of cabbage.

C. Method of digging up the seedlings: In case of onion, it does not necessary to hold soil in the roots of seedlings because onion has hairy roots which spread straightly almost without branching. Therefore, it is better to dig up seedlings without ahead watering or under dry bed condition and after dig up deeply taking caution for cutting the roots as less as possible, crush the soil around the roots by gently pushing the clods by hand, then the roots can be safely cleaned with nearly 15 cm length.

D. Planting Method: Putting some soil between the roots and compost so that roots do not directly touch the fertilizers, arrange the seedling on the side of earthed up of the ditch keeping the base of seedlings to be the depth of bottom of ditch, then cover soil about 3 cm thickness, therefore, the general outlook is such as the seedlings are standing along the earthed up side of ditches but the planted ditches are still kept (not covering soil up to the leaf blade position of seedlings). In case of direction of ditch is E-W, the planting side is better to be northside of earthed up row, and in case of N-S direction, it is better to be the east side so that seedling can be protect from strong sunshine, from south in the former case and from west in the later case.

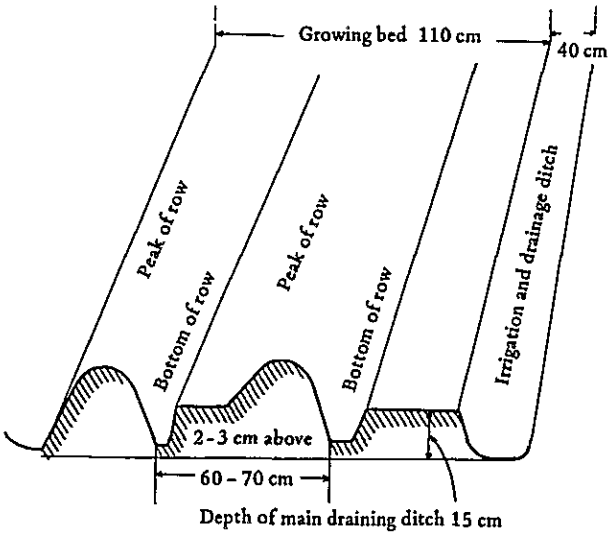
E. Spacing: So did the planting with the above manner but the spacing was 70 cm between ditches and 8 - 10 cm between plants.

In fact, in the first trial only one row was designed per one bed but it seemed to sparse spacing for leaf onion, then in the second trial 70 cm apart rows were designed on the flat field like Japan and it was not bad. The first was E-W direction and the second was N-S direction. In the third trial every two rows were designed on the growing bed of E-W direction, that is, 60 cm between rows but if the spacing is calculated involving 40 cm passage, the average row distance to be counted just 75 cm, $(110 + 40) \div 2$. This spacing was somewhat insufficient for the earthing up being unable to get enough soil from ditches at the last period of growing, but it was convenient to make furrow irrigation leading the water into the center ditch of the two rows after two month of planting.

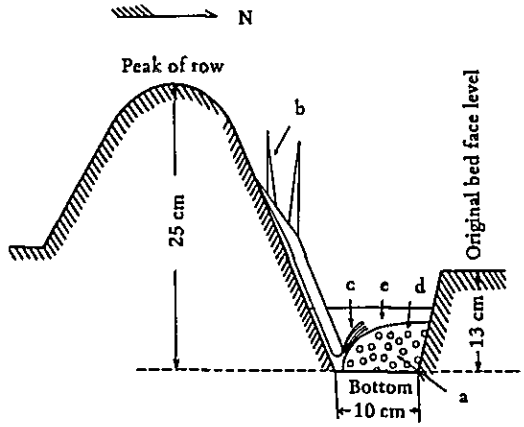
F. Method of Earthing up (Fig. 2): This practice is an important management in leaf onion cultivation especially for Nebuka type to make its stem (leaf sheath) blanching. This practice should be done in the following manner:

Fig. 1. Methods of Row Making and Seedling Setting

A. General Figure



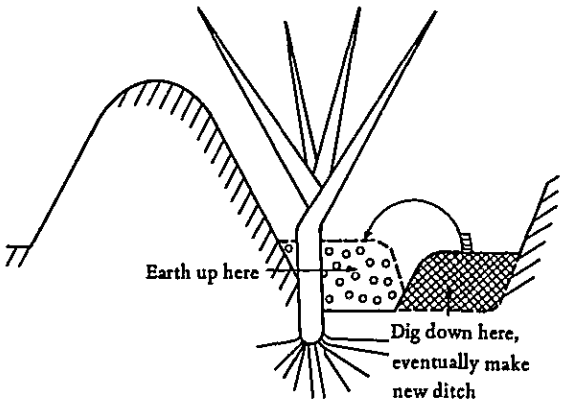
B. Vertical Section of A



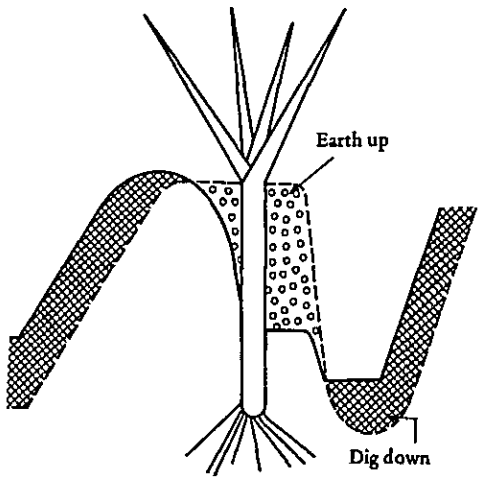
a. Compost mixed with fertilizer
b. Seedling
c. Roots of seedling
d. Intermediate soil (2 cm thickness)
e. Covering soil (3 cm thickness)

Fig. 2. Method of Earthing

A. First Earthing,
30 days after set



B. Second Earthing,
50 - 60 days after set



a. After set in the field, keep the plants growing as it is for about one month because this style is better to make good growth for leaf onion.

b. About one month after planting, when the stem length becomes some 10 cm, cover the ditches upto the ground level with soil from opposite side of the ditches so that the peak of rows can keep as it is.

c. Another one month after, when the onion stem comes up again about 10 cm or more than the level of peak of rows, earth up again the soil up to the level of bottom of the leaf blades so that the plants stand at the center of earthed rows. At this time, the stem diameter already becomes about 1 cm.

d. About 2 weeks after the second earthing, when the stem is blanched with 1.5 cm diameter, the leaf onion can be started harvest step by step, although the plants are still young and stems are yet soft and loose, only plant height reaches as if adult, but marketable.

e. Thereafter, the stem develops its thickness and compactness, that means improving quality and yield. Therefore, the more keep growing, leaf onion become the better quality and yield, and it can be kept 4 – 5 months after planted, when the stem become the quality of Table 17-B.

G. Irrigation: Somewhat differing to other vegetables, leaf onion is very tolerant to dryness, never killed by dryness after the seedlings come up 40 – 50 days old, while the roots are rather susceptible to excess moisture, that is, if the soil is saturated by water for long hours, the roots are easily rot and killed. But when the land is dry, leaf onion never die but stop its growth, so that irrigation is also necessary to make it good growth.

Accordingly, the fullow irrigation must be done frequently but caring of that the water should permiate into the ground within a few hours, especially at its early growing stage when the plants are standing at the bottom of ditches.

The above are outline of cultivation method of leaf onion in Japan which is explained here since it seemes to be not yet known in Bangladesh, and the leaf onion trials here have been managed by the above manner.

3. NATURE OF LEAF ONION IN JAPAN

Referring to its practical cultivation in Japan, the nature of Japanese leaf onion or Nebuka is regarded generally as follows:

(1) Actual Situation of Cropping Pattern of Nebuka in Japan

A. Planting Time: Sowing mostly in April, the planting time is generally in July in Japan and its mid-growing period is fallen into September to November when the temperature is as mild as in the range of 25° – 5°C (maximum to minimum) although actually it goes down gradually about 20° – 10°C in daily mean temperature.

B. Harvesting Time: Generally in winter from December to February when the temperature is as cold as about 8 – 12°C at day time and frost falls almost every night.

C. Production in Highlands: Production of adult size of Nebuka in summer is generally operated in the highland areas where the summer is as mild as autumn of lowlands.

From the above mentioned situation, the nature of Nebuka can be understood that it prefers mild climate for its growth just as Chinese cabbage, radish and carrot.

(2) Suggestions of Heat Tolerancy for Japanese Leaf Onion

A. Despite of the above, one point suggesting heat tolerancy in Nebuka is that it grows rather smoothly in young stage subsequent to planting in July, which shows rather tolerant to heat at the young stage but susceptible at the later growing stage or after grown up some extent, maybe, 2 - 2.5 cm of stem diameter when the stem grows to increase its compactness.

B. Another suggestion of heat tolerancy is with other type leaf onion than Nebuka. There is another type leaf onion in Japan called Hanegi or Natsunegi which habit is more similar to Spring Onion in S-E Asia but not belongs to *A. t. var. carespitosum* which is propagated mostly by dividing and sometimes by seeds. This type of Japanese leaf onion can harvest even in summer time in low-lands but the size and quality of products are inferior to Nebuka.

(3) Expectation of Leaf Onion Cultivation in Bangladesh before Execution

Accordingly, the expert never expected Japanese Nebuka could be grown under the severe condition of rainy season in Bangladesh before his execution of trial in Dacca. He expected simply Nebuka could be grown in some extent in Bangladesh only during dry season. So, he started the 1st Trial from September.

4. RESULTS OBTAINED AND DISCUSSION

(1) On the 1st Trial, Preliminary Test of Cultivation

(1.1) General Observation on the Performance in February

A. The first trial sown on 16-9-77 was but a preliminary cultivation test started when the expert had not yet had a definite idea whether Japanese leaf onion could be beneficially grown in Bangladesh or not. Moreover, he was absent for 3 months of its growing up period, therefore, he could make only general observation at the end of its growing period.

B. At the beginning of February, 78, when the expert came back Dacca, he noticed that the leaf onion was growing very smoothly in Gulshan Garden and at the same time he observed also a Japanese leaf onion was growing smoothly in Kashimipur BADC-ADE Field. The stem diameter was about 2 cm and its length was more than 20 cm which size could be marketable even in Japan.

(1.2) Extension of Cultivation Period up to the 1st Cyclone Season

Since the expert found the growth of Nebuka was unexpectedly good in February, therefore, he dicided to test how far extent the Nebuka can withstand the high temperature condition of Bangladesh, keeping it growing in the field up to it gets damage by heat and showery rains. From the end of February, the temperature of Dacca comes up corresponding to the beginning of July in Japan and that of March and April is much higher than Japan's mid-summer, mid-July to August.

(1.3) Result of the Extension

A. The fact was that the Nebuka at Gulshan continued its growth up to the end of March and withstood the severe condition of April and May.

B. From around on 20 - 5, however, it became reaching to the limit of standing in the field, getting some disease on the leaf blades and rotting at the bottom of stem which seemed to be caused by the frequent showery rains. Accordingly, the Nebuka was harvested wholly on 10-6-78.

C. Despite of ended at the beginning of June, it was an unexpected big fact finding that Nebuka could withstand to such a severe Cyclonic season of Bangladesh in April and May. Accordingly, the expect dicided to execute further precised trials of the 2nd and the 3rd.

(1.4) Flower Formation and Seeding

Another small observation on this trial was that since about 10% of them emerged flower heads, left them as it is to test their seed production, but eventually they could not produce sound seeds but did only abortive seeds, maybe caused by extraordinary hot temperature for Japanese leaf onion.

(2) On the 2nd Trial, Grown in Rainy Season

Sowing in March and planting in May, the second trial grown in the rainy season was executed. At the beginning of this trial, the expert had not yet a definite idea whether this trial could be successful or not.

(2.1) Raising Seedlings

A. The seed germination and seedling growth in March and April have been very smooth and seedlings have grown up to the size ready to be transplanted, 6 - 7 mm of stem diameter, about 60 days after seed sowing.

B. In fact, those seeds were sown twice in June and July but the germinations were very poor and cannot raise the seedlings further. At the end of August, however, the germination performed very good as explained in the third trial. Therefore, the poor germinations in June and July seemed to be not due to deterioration of the seeds themselves but due to worse weather condition and this condition seemed to be turned better from the end of August. Accordingly, the expert concluded that the period of May to early August would not be suitable to sow Nebuka seeds in Bangladesh.

(2.2) Growth in the Field

Although the seedlings were transplanted in the flat field just as in Japan, the plants grew smoothly in the field as seen in Photo Plate 21-C when the stem diameter of Choju became about 1.5 cm. At the end of August, some 100 days after planted, the stem size reached to about 1.5 cm in diameter and more than 20 cm in length and the leaf onion reached to be marketable although the stem compactness was yet rather loose and soft. Some leaf disease supposed to be Phytophthora blight or Alternalia leaf spot were appeared on the leaf blades during the dence rainy season but not so much severe. Kept growing in the field, the onion continued the growth

Table 16. Performance of Japanese Leaf Onion Grown in Rainy Season Sown on 11-3-78, Planted on 17-5 and Examined on 20-10-78

No.	Variety	Record taken	Weight of Whole plant	Length of Whole plant	Number of blades	Largest blade		Leaf stem	
						Length	Diameter	Length	Diameter
91	Choju	Average of 3	97.7 g	90.5	6.3	62.7	-	24.5	1.53
		Best plant	112	95.5	7	66	-	26	1.7

Note: Weight in gram and sizes in cm. 20 – 10 was the last harvest though it reached harvestable at the end of August.

Table 17. Performance of Japanese Leaf Onion Grown in Dry Season, Sown on 24-8-78, Planted on 4-11-78

A. Record of Detailed Examination on 21-2-79, 109 days after planted

No.	Variety	Weight (g)		No. of tillers	No. of blades	Height of plt. (A)	Width of spread	Largest blade		Size of Leaf stem			B/A
		Whole plt.	Root					Length	Dia-meter	Length 1 (B)	Length 2	Dia-meter	
91	Choju	252	6.6	1.0	8.8	80.2	26.6	57.0	2.84	33.6	16.9	2.52	0.42
	(Best plt.)	272	5.0	1	8	90.0	30.0	69.0	2.8	37.5	17.0	2.70	0.42
142	Shiro-Senbon	272	11.6	(2.0)	9.0	76.0	21.8	50.0	3.14	28.8	12.3	2.68	0.38
	(Best plt.)	329	18.0	2	8	79.0	26.0	50.0	4.0	33.0	15.0	2.80	0.42
143	Kujo	222	9.7	4.2+α	8.8	62.2	17.2	42.5	1.85	20.1	7.5	2.31	0.32
	(Best plt.)	310	18.0	6+α	11	67.5	18	49.0	1.5	18.5	10.0	2.0	0.27
		3 representative			8	69.0	21	40.0	1.8	19.5	9.5	1.8	0.28
		tillers of the plant			8	64.0	13	41.0	2.0	17.0	6.0	2.4	0.27

Note: (1) a. Root weight is included in whole plant weight. b. Width of spread is the width of two outermost blades spread. c. Length 1 is the length up to the growing point and Length 2 is that of up to the lowest living blade. d. Diameter of stem is at the thickest point at the bottom.

(2) All the plants examinated for Shiro-Senbon tillered into 2 but covered by outmost sheath.

(3) Total weight for 100 cm of row was: Choju - 10 plants, 2,410 g; Siro-Senbon - 10 plants, 2,310 g; and Kujo - 12 plants, 2,490 g.

B. Record of Examination on 17-4-79, 163 days after planted, recorded on 3 good plants

No.	Variety	Weight of plant	No. of tillers	Height of plt. (A)	No. of blades	Largest blade		Size of Leaf stem		B/A
						Length	Dia-meter	Length 1 (B)	Dia-meter	
91	Choju	440	1.0	85.0	12.3	50.7	3.03	34.2	3.37	0.40
	(Best plt.)	445	1	91.0	11	56.0	3.0	35.5	3.5	0.39
141	Kuronobori	247	1.0	71.7	10.3	43.3	2.50	28.6	2.42	0.40
	(Best plt.)	310	1	80.0	12	51.0	2.5	31.0	2.7	0.39
143	Kujo	225	9.3	69.7	6.0	51.0	2.0	22.7	1.43	0.33
	(Best plt.)	295	14	65.0	6	50.0	1.1	20.0	1.5	0.31

Note: The sizes of leaves and stems for Kujo were recorded only on the biggest tillers of the 3 plants.

and at the middle of October, some 150 days after planted, the stems became filled up with 1.5 - 2.0 diameter which could be marketable even in Japan, that is, reached maturity, therefore, examination was done.

(2.3) On the Varieties Tested

Two varieties, Choju and Pei-Sun were tested at this trial. As to the leaf colour, the former is dark green covered with full of bloom under high temperature condition while the later is light green with less bloom. As to the growth rate, Pei-Sun was clearly weaker than Choju and its performance was regarded as less than 70% of an other through field observation. The expert concluded that dark green type with much bloom covered may have much tolerancy and withstandable to severe condition of Bangladesh summer and rains, while light green type with less bloom has rather susceptible to that condition. Therefore, the examination was done only on Choju from the view point of practical interest.

(2.4) Performance

Result is shown in Table 16. From the data, the product can be evaluated to be marketable even in the markets in Japan, that is, although it is not evaluatable as normal class in Japanese market but having yet enough quality commercializable in Japan. Counting the fact produced under severe condition of Bangladesh rainy season, the performance can be said wonderful.

(3) On the 3rd Trial, Grown in Dry Season

The trial was a test of dry season cropping, sown at the end of August and the mid-growing period to be dry season, that is, supposed to be the best season of leaf onion culture in Bangladesh.

(3.1) Raising Seedlings

A. Although it was considered somewhat earlier than expected, sowing test on 24-8-78 was succeeded in its good germination, therefore, the trial was started with this raising seedlings. Seedlings of all the varieties went on very smoothly and at about 60 days after sown the seedlings became ready to be transplanted but practical transplantation was done on 4-11-78, at 71 days old. In fact, seedlings of leaf onion have some frexibility of time for transplantation, say for some two weeks, from 5 - 8 mm or 3/16 - 5/16 inch of stem-diameter.

B. On the germination, onion seeds seemed to need some extent of alternative temperature, that is, night temperature should drop down lower than 22-23°C and this is the reason why the seed germination was very poor when sown in June and July. Seed germination may be of course disturbed also by heavy rainfall, therefore, double coverings of plastic film and Kanreisha net were done on the seed bed to avoid it.

C. On the growth, the seedings grow very slowly in the first 30 days, up to 2 - 3 leaves stage, while the growth became suddenly active thereafter. Sometimes, the seedlings falled down the foliage by heavy rain drops so that a management of standing up the seedlings by means of earthing up at the bottom by hands was needed.

D. There was no remarkable difference on growth rate of the seedlings between the tested 4 varieties.

(3.2) Growth in the Field

A. Plant growth after set on the growing bed was very smooth without any disease and pest appearance. By means of improved furrow irrigation at the center of two rows, saving the irrigation labour, the plants were grown very smoothly after December. About 80 days after transplantation, the plants reached to marketable size or about 2 cm of stem-diameter although the compactness was yet somewhat loose. At this time, the three varieties of Nebuka showed complete one stemed onion while only Kujo showed 3 - 4 tillers already, it means the beginning of harvesting time for Kujo.

B. One more month after then, 3 Nebuka varieties became complete adult with compact stem, so, the first examination was done on 21-2-79. Continued the growth after the first examination, the plants were kept growing thereafter improving the stem length, thickness and compactness.

C. About 4 months after plantation, all the Nebuka varieties reached complete fulfilled stem stage (this stage will be discussed again later on), but the plants were further kept in the field in order to confirm the limit of field storing up to the April. At last, the second examination was done on 17-4-79, because the expert returned to Japan on 24-4.

(3.3) Varietal Difference

A. On the leaf colour, Choju and Kuronobori were almost the same dark green with bloom which bloom was much developed in summer time but became somewhat less in winter, Shiro-Senbon has lighter green than the former two but not yellowish like Pei-Sun. In fact, Japanese Nebuka or one stemed type leaf onion involves types of dark green, light green and intermediate and the former two belong to a typical dark green type and Shiro-Senbon belongs to a light green type. Kujo was dark green but somewhat lighter than Choju. In fact, Kujo in Japan involves more or less similar variation to Nebuka in leaf colour and the Kujo tested here was a dark green type having tolerancy to heat and less tillering among Kujo varieties.

B. On the growth and tillering, Choju showed the best growth rate, superior to Kuronobori and both showed complete one stemed type. Shiro-Senbon also showed good growth but at the time of first examination all the plants had made two tillers, though some of the plants showed complete two tillers but most of the plants were still covering with outer sheath but divided inside, and this means Siro-Senbon should be harvested earlier. Kujo showed also good performance but showed too much tillers at the last examination time, therefore, Kujo also be harvested within 4 months after plantation under the trial condition but when it is harvested about 100 days after transplantation, part of the tillers can be planted again in the field by dividing.

C. About 20% of Shiro-Senbon plants emerged flower heads, but no other 3 varieties had emerged their flower heads this year.

(3.4) Performance

A. The results of two time examinations are shown in Table 17-A and B. General speaking, the performance at the first examination can be evaluated as fairly good in Japanese level classifying it to be first class with its stem length and compactness, eating test was also excellent without fibour and toughness. The quality of onion at the second examination can be evaluated as scared quality even at Japanese market level with it stem thickness and compactness measuring more than 3 cm. One point the expert wants to notice is the onion produced here had 8 – 13 active leaf blades comparing with those in Japan usually have only 5 – 8 active leaf blades. Of course, this performance is an excellent character but this so much number of leaves made inconvenient to earth soil up to the top of the stem so that the blanching could not be done enough.

5. TRIAL ON THE SPRING ONION

(1) Purpose

Gaining his confidence that leaf onion could be added to the rainy season vegetables, the expert reminded straightly spring onion in S-E Asia of its substitute. That is, Japanese leaf onion is of course very promising vegetable in Bangladesh but its weak point is to have some extent of difficulty on its raising seedlings especially to have a delicate knowhow for the seed germination. Spring onion is very popular leaf onion in S-E Asian countries and much ressembles to Bangladesh local leaf onion which is utilized but very short period in winter. Moreover, spring onion is grown by it bulblets or dividing the green plants and it is much easier to cultivate than start from the seeds. Spring onion could be one of the very convenient and promising leaf vegetables if it could be grown during rainy season.

(2) Materials and Method

A. Thailand cultivator: A lot of bulblets of spring onion was got urgently from Bangkok at the beginning of August, 1978 in order to cultuvate it in the Community Centers of CERDI because it does not need any special technique. Of course, it was planted also at Gulshan Garden parallelling to the Community Center fields at the beginning of September, 78 and the vegetable trial field of CERDI, Joydevpur at the middle of October.

B. Malaysian and Singaporean cultivars: Getting dry bublets of those two cultivars, they were added to the trial of CERDI at the end of November, 1978.

(3) Performance at Gulshan Garden

(3.1) Condition of Bulblets Tested

More than one month has wasted from sending of Chia Tai Seed Co. to the planting time on 2-9-78 taking about 20 days for custom clearance in Dacca Airport and another two weeks for field preparation, the condition of bulblets was not always good; that is, (i) some of them have already sprouted, (ii) the construction of the bulblets was that several small bulblets were contained in the outside dried covering skin and those bulblets were divided individually into adequate size of bulblets by hands. Now, much black sooty dust was recognized at the bases of individual bulblets inside of general covering skin, which regarded as spores of a pathogent supposed to be a sort of Fusarium. In case of sprouted bulblets, this infected parts had grew

sticky. Accordingly, the expert worried very much if those bulblets might fail the sprouting and the plants sprouted might get rotting during its growing period.

(3.2) Sprouting

Nevertheless the above worry, almost all the planted bulblets had sprouted very well and simultaneously without any infection of the disease on their leaves, maybe, disinfected by the following dryness and strong sunshine and the worry became on imaginary fears in this case.

(3.3) Growth and Performance

The plant growth after sprout was quicker in the first 30 days than the seedlings germinated from seeds in the leaf onion trials, but due to several tillers came out from the individual bulblets (actually they contained several tiny bulblets instead of single divided bulblet) each tiller was as tiny as a string. About two months after plantation, the plant height came up about some 30 cm with some 8 cm length and 1 cm diameter stems which were ready to harvest but somewhat young to be used for dividing seedlings because only 3 - 4 tillers on each stock were adult size.

After foresaid stage, the size of individual tiller did not grow so larger but the number of adult sized tillers increased more and more. At the time of taken photo on 3-12-78, about 3 months after plantation, the number of adult tillers on the good stocks became 10-15, it was regarded as somewhat over maturity for simple marketing. Accordingly, it can be concluded that the harvesting time of spring onion is 60 - 90 days after bulblet plantation and when it is harvested later than some 75 days, a part of harvested onion, maybe, 1/3 or 1/4 of whole number of tillers, can be utilized for replanting by means of dividing.

(3.4) Dormancy of Bulblet

At the middle of February, 1979, all foliage of the spring onion had falled down just like the maturity of bulb onion. So, the bulblets was harvested and dried up. These bulblets were planted in the field again at the biginning of March but no bulblet had sprouted up to the end of March, therefore, it seemed to enter into dormancy. The expert does not know exactly how many months are needed for awaken from domarcy for this spring onion, but it may be 1 - 2 months. The digged up bulblets should be completely dried up and store at the dry place and after recognized a part of them emerge young leaves (maybe in April or May), it can be planted in the field. Furthermore, if the bulblets are stored in cold storage, the bulblets can be utilized any time in the year when needed to be planted.

(4) Performance in the Other Fields

(4.1) Thailand Cultivator

The progress of Thailand spring onion cultivations at two Community Centers and CERDI fields were more or less the same as those at Gulshan Garden.

In the Community Center fields, sprout was good because of watering at the planting time but due to dry weather was continued after the middle of September for nearly one month and no irrigation facilities was available, the plant height was only 20 – 25 cm and growth was so slow but they never died, and they grew up again after rain came. This character means that spring onion is very tolerant and convenient to a rough culture.

(4.2) Other Cultivars

On the other two cultivars from Cameron Highlands and Singapore, their growth and performance had been more or less the same as Thailand cultivars. One different point with those two cultivars they did not fall down their foliage up to April but they emerged flower heads as seen in the Photo, which was not seen with Thailand cultivar. It may be caused by belonging to different types.

6. CONCLUSION

(1) On the Rainy Season Cropping

(1.1) The Reason of Good Result

The expert was so surprised on the unexpected good result of the second trial as explained in (2.2) and (2.4). The expert cannot conclude it definitely now without any further research work but the reason why Japanese onion performed good under severe rainy season condition of Bangladesh can be counted as follows: (i) Some of th type of Japanese leaf onion, say dark green type varieties, has in fact a tolerancy to the severe conditon of the cyclonic season, that is, alternative appearance of severe wet and dry caused by the showers and subsequent strong sunshine, which causes severe physiological disorder on Japanese radish and other temperature zone vegetables, (ii) Generally onion group plants, *Allium* spp., prefer rather neutral to alkaline soil than acidity soil and most of soils in Bangladesh especially those of the basin of River Ganges and its influential areas are inclined to alkaline containing much lime. This condition seemed to be making that tolerancy for onion, in the other words, the alkaline tendency of Bangladesh soil is supposed to make leaf onion tolerant to such hot and severe weather condition than Japanese acidity soil does. In any case, it was a sole exception among the tested Japanese vegetables that leaf onion had showed a good performance under the rainy season condition.

(1.2) Japanese Leaf Onion to be a Rainy Season Vegetable

The expert concluded that Japanese leaf onion should be added to the member of countermeasure vegetables of Bangladesh rainy season. Although the expert emphasized to introduce short period leaf and root vegetables of S-E Asia for the countermeasure of vegetable shortage in rainy season of Bangladesh, but here he also recommend leaf onion instead of its habit of long growing season. The reason can be counted as follows:

a. Onion is one of the most important vegetables or spices for Bengallee people and leaf onion could be a sustitute of onion because of the same group of onion.

b. Leaf onion has a good capacity of productivity since it grows up to a vigorous plant which can be eaten almost wholly except its roots. Spacing at 75 cm x 10 cm, the member of plants standing in the field is counted as 12,500 per 10 acres that is, about 50,000 plants per acre. Counting if 80% of planted onion are grown up to average weight of 80 grams referring the data of Table 16, the yield of leaf onion in rainy season of harvest in September could be some 3,000 kg per acre. This figure can be wonderful productivity if counted of the fact of its taste and nutritive value as well as the production season.

c. Moreover, leaf onion cropping has a wide range of flexibility for its harvesting as discussed in (3.2)-C and this special habit of leaf onion is very convenient for the growers.

(1.3) Cropping Pattern in Bangladesh as shown

Accordingly, the expert has designed the cropping patterns of Japanese leaf onion in Bangladesh as shown in the Table of PART 1 of "Cropping Patterns." For the rainy season culture, actually in case of (1) the earliest sowing season, Kujo is recommended rather than Nebuka type due to its early maturity, but for the croppings of (2) both Nebuka and Kujo types are recommended.

(2) On the Spring Onion

As explained in 5-(3), spring onion is also recommended especially for novice farmers and Kitchen gardening due to its easier grownability but the yield may be 80 to 50% of Japanese leaf onion in rough estimation.

(3) On the Dry Season Cropping of Japanese Leaf Onion

(3.1) Comparison with Cultivation in Japan

The performance of Japanese leaf onion in the third trial can be evaluated as excellent comparing with its performance in Japan as follows:

a. The growing period of Nebuka in Japan is usually as follows: The nursery period is about 3 months sowing in the beginning of April up to the beginning of July, the growing period is 5 months to 8 months, setting in the field in July and harvesting from December up to February or March. That is nearly one year needed for leaf onion growing in Japan, although it must discount the period of cold winter from the middle of December to the middle of February when the growth of leaf onion is almost stopped, but at least it can count more than 150 days to reach the size of plant less than the data of Table 17-A, comparable to less than 100 days in the third trial.

b. Moreover, if such an excellent quality of leaf onion as the performance of Choju seen in Table 17-B with its thickness and compactness of the leaf stem in Japan, it can be produced only by another cropping pattern of autumn sowing culture. That is, sown at the end of September in the over wintering seed bed, one interim growing field culture, transplanted in April and grown up to the beginning of July, then set in the permanent growing field in July to the harvesting time of December to March, which is the special culture of famous Shimonita-Negi in Japan. This needs almost one year for growing period and about one and a half years from seed sowing. The quality of Choju at the beginning of April, 1979 has been really corresponded to this "Shimonita-Negi", but the growing period is only 160 days.

c. If counted the fact of difference of growing period between Dacca and Japan (Kanto Area), one can understand how excellent the performance of leaf onion is in Dacca, therefore, the expert can conclude with full of confidence that Bangladesh is an excellent land for cultivation of Nebuka, especially in dry season, maybe due to its alkaline soil with high content of lime.

(3.2) Yield Estimation

With the same cultivation design of the trials spacing at 75 x 10 cm, that is, about 13,000 plants per 10 acres, the yield of Nebuka can be roughly estimated that, in case of 80% of planted plants grown up average 200 g, the yield per 10 ares becomes 2,133 kg, or about 8,000

kg per 1 acre. It could be expected to produce this yield in about 100 days of growing period in dry season.

(3.3) Prospect for Shipping Production and Exportation

Since leaf onion is at present being rapidly popularized in everywhere in the world and it can be withstandable to a long distant shipment especially during dry season, the expert wants to recommend leaf onion to be an export vegetable counting its excellent adaptability in Bangladesh.

(3.4) Prospective Cropping Patterns in Bangladesh

Accordingly, the export designed the cropping patterns of leaf onion as shown in Table of Part 1. In case of aming at adult sized Nebuka, Pattern (3) is recommended. Since this cropping needs a long period for growing and it has a wide range of flexibility for harvesting time, it does not necessary to sow the seed more than once. Then the sowing time should be designed to be the best time avoiding the risk of failing germination, therefore, once in September is recommended in the Table. As to the Kujo cultivation, various manners of cultivation shown as (4), (5) and (6) are suggested due to counting its earlier harvest than Nebuka.

CHAPTER 7. RESULTS OF TRIALS ON JAPANESE CARROT AND TURNIP

1. INTRODUCTION AND PURPOSE

(1) Carrot with an explanation of its Growing Habit

A. Carrot is one of the important vegetables in Bangladesh counting its high nutritive value and feasibility to popularize it into Bengalee people with its adoptability for currie dishes. Carrot is, however, unfortunately not always adaptable to grow in Bangladesh especially during rainy season, that is why at present carrot is not yet sufficiently produced locally and large amount is now dependent on Indian production.

The reasons why carrot is not easily to grow in Bangladesh can be said as follows:

(i) It is susceptible to wetty condition of soil, its hairy absorbing roots is easily killed by water satulated condition of the soil.

(ii) It is susceptible to hot weather especially hot and moisty condition because carrot is originated in mild and dry climate area of Middle East.

(iii) Carrot prefers rather sandy light soil than clayey soil to develop good root with deep colour since good aeration condition of soil is essential for the development of root especially its colour, in the other words, heavy and solidified soil (worst condition of aeration) delivers tiny, fibrous, sometimes branchy, and yellowish coloured carrot with strong carrot smell.

B. Most of carrot varieties are very susceptible to hot weather due to originated in West Europe but Japan has developed high heat tolerant varieties because she had a heat tolerant local variety of chantenay type in Nagasaki, south west warm area of Japan, acclimatized from European sort since hundreds years ago, and utilizing this special type variety crossing with modern chantenay varieties, Japanese seed cos. have developed high heat tolerant improved varieties which can be never found among Europe and the United States varieties.

C. From the above point of view, there is almost no hope to grow carrot in Bangladesh during rainy season but big feasibility to produce it in dry season especially on sandy soil along rivers and Chittagong hilly area. Accordingly, a series of trials was done in order to confirm how far extent of season carrot can be grown in Bangladesh, utilizing the heat tolerant varieties of Japan.

(2) Turnip

Turnip is the second popular root vegetable to radish in Bangladesh but European Purple Top White Globe is a single variety growing there for the time being. The quality of Japanese turnip varieties have far better quality than the above mentioned variety with their tender and sweet leaves and complete fibreless root. So, the trials were done to confirm how far extent of season Japanese turnip can be adapted to grow in Bangladesh.

2. PROGRESS OF TRIALS ON CARROT

(1) Material and Method:

A. Varieties Tested: Two varieties of 89. Koizumi and 90. Kuroda were on test two times but unfortunately Kuroda did not germinate at the second trial due to its seed deterioration.

B. Times of Trials:

a. First trial was sown on 11-3-78 and examined taking photo on 18-6-78.
b. Second trial was sown on 30-10-78 and examined on 21-1-79.

The former is a test for tolerancy to spring to summer growing and the latter is to confirm the performance in dry season.

C. Cultivation Method: In the first trial, the seeds were sown in 4 lengthwise lines about 25 cm apart on the growing bed and covered with sand and lawn grass hay. In the second trial, the seeds were sown in 3 lengthwise lines about 40 cm apart on the bed and the same coverings were done as the former but furthermore Kanreisha tunnel cover was also done to protect from drying with strong sunshine.

(2) Progress

(2.1) On the First Trial

A. Seed germination and growth in early stage had been very smooth and the first thinning was done about 2 weeks after sowing at 1 - 2 true leaves stage when it was recognized as very thick standing and the second thinning was done after 10 days more. At the end of April, the palnts grew up nearly 20 cm height with 5-6 leaves and the biggest root diameter was more than 1 cm and the final thinning was done at the beginning of May when the plants seemed to be standing too crowded. The plant growth was generally very smooth up to this time and hay mulching was done all over the growing bed to protect from drying and heat on the roots. At this time, some difference was seen between two varieties, that is, Kuroda had dwarf and more spreading style leaves with a little darker colour than the leaves of Koizumi, while Koizumi had complete uplight leaf style and higher plant height.

B. At the end of May, some 70 - 75 days after sown, the root diameter became some 2 - 2.5 cm and getting marketable size for Dacca market but still somewhat young, therefore, only thinning harvests were done from time to time and most of plants were kept in the growing bed to confirm how far extend the roots can withstand to the hot climate in June. At the middle of June, a kind of leaf blight, may be *Cercospora carotae* or *Alternaria dauci*, was rapidly spread all over the field and the roots were getting rot, therefore, it showed the limit of carrot growing and examination was done on 18-6-78.

(2.2) On the Second Trial

A. Seed germination was sufficient with Koizumi but very poor with Kuroda, so, the trial was continued only on Koizumi. The plant growth in early stage was excellent and this time the thinnings were done in good times and earlier than previous trial making not to be

crowded standing.

Since the climate was much adapted to carrot growing this time, the biggest root diameter became about 2.5 cm, marketable in Dacca market, already at the end of December, some 60 days after sown, which is the time of starting thinning harvests.

B. Examination was done on 21-1-79, 82 days after sown, when the root size became completely adult or marketable even in International marketings as seen in Table 17 and Plate 25. No. remarkable problem happened in this trial and the remained carrots were kept up to the end of February.

3. PROGRESS OF TRIALS ON TURNIP

(1) Material and Method

(1.1) Varieties Tested

A. 94. Kanamachi Kokabu: The most popular small turnip in Japan, both leaf and root are utilized to be eaten by boiling, salted or vinegar picklings. The leaves are delicious with tenderness and special flavour of turnip, and the root is pure white and excellent quality with tender and flavour, absolutely without any fibrous. Early and harvstable about 45 - 50 days after sowing.

B. 96. Shogoin Turnip: The most popular large turnip in Japan. Its leaves can be utilized as a leaf vegetable up to 30 - 40 days after sowing just like Petsai and this variety is very often cultivated as a brassica green in the United States due to its uplight leaf style like Choisan by dense spacing culture. It is, however, cultivated in Japan as a root crop by sparse spacing like radish. Large turnip is cultivated as a substitute of radish esepcially on heavy or clayey soil where most of radishes cannot perform good root but turnip does well.

(1.2) Times of Sowing and Management

A. K. Kokabu: Sown 4 times on 19-7-78 (1st), 24-8-78 (2nd), 29-10-7 (3rd) and 16-2-79 (4th).

Spacings: Sown in widthwise lines of 20 cm apart on the growing bed. Cultivation management is more or less the same as other brassica greens.

Table 17 Performance of Japanese Carrot in Dry Season, Sown on 30-10-78, Examined 5 good plants on 21-1-79, 82 days after sown

No. Variety	Weight (g)				No. of	Size of largest leaf (cm)			Size of root (cm)		
	Whole Plant	Root	Leaf	R/W	leaves	Length	Width	No. of 2ndary	Length	Diameter	D/L
89. Koizumi Gosun	161	119	42	0.74	9.2	39.3	14.1	7.4	14.3	4.16	0.29
(Best plt.)	210	150	60	0.71	8	42.0	18.0	7	15.0	5.0	0.33

B. Shogoin Turnip: Sown 2 times on 24-8-78 (1st) and 16-2-79 (2nd)

Spacing: 1st trial; sown in widthwise lines of 20 cm apart as a leaf vegetable because no hope to perform good root in this season. 2nd trial; sown in 3 lengthwise lines on the growing bed, spot sowing at 40 x 30 cm. Cultivation management is more or less the same as radish and Chinese cabbage.

(2) Progress

(2.1) Trial in Rainy Season

A. K. Kokabu sown in 19-7-78 showed good germination and rather smooth growing up but a little bit inferior growth if compared with those of S-E Asian brassica greens sown on the same date. About 35 days after sown, the leaves grew up nearly 30 cm height and the good plants showed their roots having about 2 cm diameter but conic shape which was about 1/3 way for normal maturity, but most of leaves were getting tired with severe rainy season condition infected with leaf spot supposed to be *Cercosporella brassicae* and second to reach the limit of growing in the field. So, it was harvested taking photo on 25-8-78, 37 days after sown (Plate 26).

B. K. Kokabu sown on 24-8-78 performed comparably better than the former trial and about 1.5 months after sown it grew up nearly adult size having about 30 cm height of 7 - 8 leaves and about 3 cm of roundish root, but yet somewhat inferior performance to the normal Kokabu, that is, it showed that this sowing time is still hard for this K. Kokabu.

C. Shogoin Turnip sown on 24-8-78 performed almost normal leaf growth which seemed to be practiclaly approvable to grow this season as a leaf vegetable.

(2.2) Trial in Dry Season

A. K. Kokabu sown on 29-10-78 performed excellent as shown in Table 18 and Plate 26 which can be evaluated excellent even if at Tokyo market just as that of autumn culture in Japan.

K. Kokabu sown on 18-2-79 showed also a normal performance just as spring culture in Japan and it was matured at the beginning of April, some 45 days after sown, but from out-appearance it was regarded as the limit of field growing, cannot be kept in the field any more.

B. Shogoin sown on 16-2-79 showed a normal growth up to the beginning of April when the growth rate of root was about 1/3 way of normal maturity, having approximately 6 cm diameter and conic shape if compared with normal size of 10 -12 cm diameter of flattened round shape. Since its quality was somewhat too solid, the expert felt that this quality seemed to be the beginning of physicological disorder explained in the Chapter of radish and actually this physiological disorder had already appeared on the Shogoin radish sown on the same date as shown in Plate 4. Therefore, this time, at the beginning of April is the limit of field growth for Shogoin turnip.

C. Really, it was regretful that Shogoin Turnip was not sown in October or November comparing with Purple Top but if it was done the expert is quite sure the result may be excellent.

Table 18 Performance of Kokabu, Japanese Small Turnip in Dry Season
Sown on 29-10-78, Examined 4 good plants on 16-12, 49 days after sown

No. Varieties	Weight (g)				No. of	Largest leaf (cm)		Root (cm)		
	Whole plant	Root	Leaf	R/W	Leaves	Length	Width	Height	Diameter	D/H
94 Someya Kanamachi	156.3	92.3	64.2	0.59	11.5	33.3	11.3	4.95	5.75	1.16
(Best plant)	186	136	50	0.73	12	29.0	11.5	6.5	6.5	1.00

4. RESULTS AND CONCLUSION

(1) Carrot

(1.1) On the Recommendable Varieties

As seen in the Table 17, the performance of Koizumi carrot can be evalauted as excellent at international level. In fact, in order to achieve this growth rate of root in the temperate zone like Japan, carrot needs 100 - 120 days for growing period about one month more than it did in Bangladesh. It can be therefore understood how much adopted Bangladesh is for carrot culture as far as dry season is concerned.

Carrot could be one of the exporting vegetables if more suitable soil condition areas are found out, which may be found along River Ganges and Chittagong hilly area providing good irrigation facilities. In this case Japanese heat resistant varieties such as Koizumi, Kuroda, Shin-Kuroda and related varieties are highly recommended.

(1.2) Possibility to Deviate from Dry Season

About the possibility to extend the growing time from the dry season, it can be sound out through the first trial and some references of other crop trials.

(a) The end of carrot production at general places of Bangladesh may be at the end of May when the heavy rainfall becomes frequent. The quality of carrot, however, can be said that the later the growing season will result in the more inferior. The quality of carrot produced in the first trial can be said the limit of marketability, much inferior to that of second trial. It means that carrot can be grown sowing in March but its growth is much bad affected by hot temperature in April and May. Carrot produced in this season could be only for local use but not suitable for exportation.

(b) The beginning of seed sowing may be at the middle of September avoiding frequent rainfall and high humidity by the beginning of September which may cause worse germination and growing up at early stage.

After all, the cropping pattern shown in the Table of PART 1 is designed, concentrating the best season to be sowing in October and November focussed its mid-growing period to be December to February.

(2) Turnip

(2.1) K. Kokabu: As explained in 3-(2)-(B) and Table 18, Kokabu showed excellent result. Due to its early maturity Kokabu can be produced rather wide range from end of October to the end of March, needing only 45-50 days of growing just like Chinese radish. Seed sowing can be started from the middle of September, the best season be sowing from end of October to the beginning of December, and last sowing to be the end of February. Since Choisan, petsai and Chinese radish are liable to make premature bolting when sown in December through February, Kokabu may be more suited to grow this period due to having no risk of premature bolting in Bangladesh. Only one thing must be pointed out here is that there is much risk of severe damage by sudden appearance of aphids in December and January, therefore, much taking caution is necessary during this period for insecticide spray, other wise, very frequently all the young plants are killed by aphid damage. In fact, K. Kokabu and Shogoin sown on 19-12-78 were wholly killed by aphids at the beginning of January.

(2.2) Shogoin: As explained in 3-(2)-A, Shogoin turnip can be grown only as a brassica green at the end of rainy season, sowing from the end of August through September. After September sowing, Shogoin turnip can be grown as a root crop, maturing 60-70 days after sown, as a substitute vegetable of radish. Since turnip prefers rather heavy soil where radish does not perform well, turnip is recommended on heavy soil instead of radish, especially where long radish varieties produce branchy roots or difficult to pull out from the ground. Shogoin turnip, however, growth also well even on sandy soil if irrigation facilities is available. Shogoin is recommended rather than Pusple Top Turnip due to its fine quality and heavy productivity with its tender leaves.

CHAPTER 8. RESULTS OF TRIALS ON S-E ASIAN BRASSICA GREENS

1. PURPOSE

Brassica greens mentioned here are S-E Asian tropical type bassicas such as Choisan, Petsai, Tropical Chinese cabbage and Bread leaf mustard other than *B. oleracea* group, which are very popular in all South-East Asian countries but not yet much popularized in Bangladesh. The feasibility of those leaf vegetables for the countermeasure of shortage of vegetable in Bangladesh rainy season has been already discussed in detail in the expert's previous paper, "Production Prospect of Short Period Leaf Vegetables . . . ", 1978.

Several times of trials were excecuted continuously in 1978 to 1979 but actual data were not always taken from every trial taking only photoes and observations since the expert did not have enough time and labour to manage so many examination for taking data every time. The report of results of those trials were mainly touched on general observation of the expert and explanation on the photoes, outlining the previous data and a few new data.

2. OUTLINE OF TRIALS

Table 19 Outline of Trial on the Brassica Greens

Trial	Time of sown	Varieties tested	Spacing	Observation
1st Trial	22-7-77	3. Green Choisan, 4. Canton Petsai, (Thailand) 30. Pusan Petsai, 31. Yutsai (Taiwan)	Linear sowing, 12 cm apart	Examination on 25-8-77
	23-7-77	6. Chin, cab. 55 days, 5. Broad leaf mustard, 32. Paohsin Mus. 57. Edible mustard	Linear sowing 18 cm apart	29-8-77
2nd Trial	12-3-78	3. Choisan (Taiwan), 101. Choisan (Malaysia) 86. Surugana (Japan), 6. Ch. cab. 55 days, 30. Pusan	Linear sowing 15 cm apart	Observation on 27/29-4-78
3rd Trial	23-6-78	Choisan: 3, 31, 101; Petsai: 4, 117 (Sakata) and 126 (Takii); Pusan Petsai: 30	Linear sowing 12 cm apart	Ended on 20-8-78
4th Trial	5/19-7-78	Mustard: 5 (Thailand), 32 (Taiwan) Pusan Petsai: 30 (Transplanted)	Linear sowing 18 cm apart	Examination on 12-8-78
5th Trial	24-8-78	Choisan: 31, 101; Petsai: 4, 126; Pusan P.:30; Chin. cab.: 6, 134, 40 days; 32. Paohsin mustard	15 cm apart lines 20 cm apart lines	–
6th Trial	30-10-78	3. Green Choisan, 4. Canton Petsai, 86. Surugana	Insert culture between Ch.Cabbage	Photo on 3-12-78
7th Trial	19-12-78	Mustard; 5 and 153, Khumal (Nepal) (Wholly Killed by aphid within 2 weeks)	3 lines on the bed 25 cm apart hills	–
8th Trial	18-2-78	Tropical Chin. cab.: 6. 55 days, 134. 40 days, and 135. Early, 136. Michili (4 vars. from Thailand), 115. Tropical Pride, 131. Saladeer (Japan) Mustard: 32. Paohsin, 153. Khumal	3 lines on the bed, 30 cm between hills, spot sowing	Photo and observation on 6-4-79

(2.1) Times of Sowing and Varieties Tested

Total 8 times of trials had been operated during 2 years excluding heading Chinese cabbage as reported in Chapter 5, as shown in Table 19.

(2.2) Outline of Cultivation Method

A. With the rainy season trials from 1st to 5th rather dense spacing of linear sowings were done at 12 - 15 cm apart for Choisan, Petsai and Pusan Petsai which were expected to harvest 30 - 40 days after sown and at 18 - 20 cm apart for Tropical Chinese Cabbage and broad leaf mustard which were expected to harvest 50 - 60 days after sown. While with the dry season trials from 6th to 8th, sparse spacings were designed expecting longer plant growing during dry season.

B. First thinnings were done commonly at the germinating time or by one true leaf stage spacing to be 1.5 - 2.0 cm between seedlings. Second thinnings were done about 2 weeks after the first or at 3 - 4 true leaves stage spacing to be 3 - 5 cm between plants. The third thinnings were done operating thinning harvest usually after 30 days of sown. Some top dressings of urea or/and crushed oil cake were also done refering the leaf colour from time to time at need usually after 2nd or 3rd thinning especially on Chinese Cabbage and broad leaf mustard.

(2.3) General Progress

A. Since the first trial was the first experience for the expert to cultivate tropical varieties under tropical condition, the thinning practice had been always delayed than needed due to too quick their growth than his expectation under the dense rainy condition. Chinese cabbage (6) and broad leaf mustard (5, 32 and 57), therefore, had get big damage of sunscald by a sudden heavy thinning practice at 30 days after sown, and their grown up was not smoothly getting white leaf spot subsequently.

B. Another failure was on 7th trial, that is, they were got so severe damage by sudden and terrible appearance of aphids as all the seedlings had been killed within 10 days of germination, therefore this trial was completely stopped.

C. The 6th trial of Choisan and Petsai was operated to utilize the space of heading Chinese cabbage culture inserting one line at the center of two growing rows of the latter for about one month, sowing at the same time.

D. The 8th trial was designed to confirm whether if those tropical Chinese cabbage and heading mustard could form head in March to April or not. The cultivation spacing was therefore designed following to that of heading Chinese cabbage culture in dry season.

3. FACT FINDINGS IN THE TRIALS THROUGH EXAMINATION AND OBSERVATION

(1) Results Obtained in the 1st Trial, Sown in July, 77 (See Plate 27)

Results obtained in this trial are shown in Table 20.

A. Green Choisan and Yutsai belong to the same type of Brassica green and to be harvest-

ed at its bolting time of about 5 - 10 cm stem length but before the flower bud mass becomes visible. Its stem is tender, no fibrous and delicious if easten with its leaves by Chinese style fried and boiled cooking if harvested at the suggested time.

B. Canton Petsai is harvested usually before bolted. Its leaves is somewhat different to Choisan having wide, long and thick white petiole at adult stage.

C. Pusan Petsai is another type than the above two and belongs to Chinese cabbage but non-head type. Its yellowish green leaves are roundish and flat blade. All of the three grew very smoothly and rapidly under dense rain condition and was harvestable from 30 days to 40 days after sown.

D. Broad Leaf Mustard did not become big since they were harvested by thinning at about 35 days after sowing, just a half way to the adult, as explained in (2.3)-A.

Table 20 Character and Performance of Choisan, Petsai and Bread Leaf Mustard in 1st Trial, sown on 22/23-7 and examined on 25/29-8-77

Variety name and Scientific name	Observed Character (color, shape etc.)	Weight of plant (Average of 5 plants)			Size of largest leaf (Average of 5 plants)			
					Leaf blade			Petiol
		Top	Root	T/R ratio	L	W	L/W	Length
3. Green Choisan *Brassica camp estris* (n = 10)	Deep green oval leaf blade with a little lobation and whitish green petiol	g 28	g 1.6	17.5	cm 30.0	cm 8.6	3.4	cm 12
31. Yutsai *B. campestris* (n = 10)	Deep green leaf blade with long petiol, white rib	23.6	1.0	23.6	32.6	9.2	3.5	13.6
4. Canton Petsai *B. chinensis* (n = 10)	Light green leaf blade with long white petiol	32.6	1.4	23.3	25.0	10.4	2.4	11.6
30. Pusan Petsai *B. pekinensis* (n = 10)	Yellowish green, broad and thin leaf blade with whitish petiol, smooth surface	38.0	1.8	21.1	24.8	12.2	2.0	8.2
6. Chinese cabbage *B. pekinensis* (n = 10)	Very light green, broad and thin, fringed leaf blade with long white petiol	38.0	1.0	38.0	22.6	9.0	2.5	8.2
5. Broad leaf mustard *B. juncea* (n = 18)	Light green dentate marginate leaf blade with short petiol	19.0	1.0	19.0	20.2	11.0	1.8	3.6
32. Paohsin Mustard *B. juncea* (n = 18)	Yellowish green and light hairy leaf blade, short petiol	14.0	0.6	23.3	19.2	7.8	2.5	4.2
57. Edible Mustard *B. juncea* (N = 18)	Light green much dentate leaf blade with short petiol	20.8	1.0	20.8	21.8	10.0	2.2	3.8

Table 21 Record of Bread Leaf Mustard in 4th Trial and Another Trial

No., Variety	Weight (g)		No. of	Size of biggest leaf			Its Petiole (cm)	
	Whole plant	Root	Spread leaves	Length	Width	L/W	Length	Width
32. Paohsin Mustard (Taiwan) sown on 5-7-78 and recorded on 12-8, half way for maturity								
Average of 3 plants	94	2.7	7.7	28.1	15.8	1.83	nil	2.53
The biggest plant	112	3	7	29	16.5	1.76	nil	2.5
153. Khumal Mustard (Nepal) sown in October and recorded on 11-1-79, grown at Kashimipur BADC-ADE Field								
Average of 3 plants	443	-	12.3	48.7	24.2	2.01	37.5	3.7
The biggest plant	555	-	12	50	28	1.79	41	4.0

Note: Only 32 Paohsin Mustard was taken record since it showed smooth growing.

As explained in detail in the previous paper, 1978, Choisan and Petsai are regarded as very promising leaf vegetable in the rainy season since they can harvest in a very short period of 30 days growing. These two are the most popular leaf vegetable in S-E Asian countries especially at suburban vegetable growing areas.

(2) Observation in the 2nd Trial, Sown in March, 1978 (See Plate 28)

A. Choisan: Thailand cultivar (3) showed a few % of flowering plants at 35 days while Malaysian cultivar (101) showed a few % at 25 days and more than 10% at 35 days, therefore, it can be concluded that Malaysian cultivar is earlier type than Thailand, and the former should be grown at dense spacing harvesting within 30 days in smaller style (about 25 cm height) than the latter, in the other words, Thailand cartivar has more flexibility in harvest time than the latter.

B. Petsai: Canton Petsai began bolting at 45 days while Pusan Petsai did at 40 days. Those 4 varieties of Choisan and Petsai ended their marketable harvest around on 28-4, about 47 days after sown due to their flower development.

C. Chinese cabbage: the cultivar (6) seemed to be 55 Days, a loose head light green leaf with fringed margin variety and very popular in Bangkok market. Although it showed a few % of bolting at about 40 days, most of its plants continued vegetative growth up to 50 days. It seemed to be grown up much larger if more sparse spacing is given, but in this trial the spacing was really too dense and the lower leaves were getting rot by humitiy and high temperature under this condition in April and came to the limit of harvest around at 50 days. The quality of products, however, had the character of Chinese cabbage, nice for salted pickling, since this variety has tender outer leaves, much tenderer than ordinary heading Chinese cabbage, therefore, it could be marketable despite of small style using also outer leaves.

D. Surugana: This variety was bred at Shizuoka-ken Agr. Exp. Sta., Japan crossing Canton Petsai with Komatsuna (most popular brassica green in Japan). Due to its slow or no bolting habit keeping a hybrid vigour, it showed very bigorous good growth continuing its growing after 50 days without any bolting. This variety was proved having high tolerancy to the high temperature of April in Dacca and very promising variety counting its non-bolting habit in the spring sowing culture as discuss in detail later on.

(3) Observation in 3rd Trial, Sown in June, 78

A. General growth condition was good in the trial. At the time of operating this trial, Agricultural Exhibition was held by the Government at Dacca for a month.

And as an atraction, a series of sample plants from this trial had to be arranged in this Exhibition changing a few plants per every few days for 2 - 3 weeks from every plot of the varieties, therefore, the examination could not executed due to shortage of representative sample of plants. The exhibition was a good oppotunity to show the said varieties for popular people as well as leaders to understand and extend them in Bangladesh for rainy season culture.

B. There were no remarkable premature bolting happened in this trial. The bolting time of all tested varieties were after 40 - 45 days even in the earliest Choisan group when the practical harvesting time had over, as discussed with 1st trial in the previous paper, 1977.

C. As for Choisan group, no remarkable difference among 3 cultivars are seen.

D. As for Petsai group, 126. Pakchoi (Takii) was very similar to 4. Canton Petsai (Chia Tai) while 117. Tsai Shim (Sakata) was more similar to 3. Green Choisan. Really, Petsai and Pak Choi are the same writing letter in Chinese but only different pronountiations and the former is Mandarin and the latter is Cantonese. Similarly, Choisan is Cantonese and Tsai Shim is more closed to Mandarin.

(4) On the 4th and 5th Trial, Sown in July and August, 78 (See Plate 29)

A. In the 4th trial, germination was rather no good may be due to no good management of watering during the expert's absent of home for a week after sowing. Resowing was done on 19 - 7 for Thailand mustard (5) but Taiwan mustard showed rather good germination and continued the cultivation by sowing of 5 - 7. As for Pusan Petsai, the cultivation of sowing of 5 - 7 was continued by means of transplantation to the new growing bed. After all, Paohsin mustard (32) grew up rather well, so record was made on 12 - 8, 38 days after sown as seen in Table 21 and Photo but regretefully second recording could not be made. Anyhow, through this trial, it was proved that broad leaf mustard can be grown in dense rainy season up to semi-heading stage being some 300 - 400 weight by 60 - 70 days in Bangladesh, if adequate spacing and adequate cultivation management are given. Pusan Petsai grew up the plant having 4 - 5 spread large leaves sizing 20 x 15 cm which qulaity is so tender and nice as can be substitute of butter cup type lettice.

B. The similar series of brassica greens trial to 3rd Trial was operated again sowing on 24 - 8 - 79 as 5th Trial, using double shelters of polyethylene film and Kanreisha net. The germination and first growth of seedlings were very much stabilized and smooth. Characteristic of Chinese cabbage of (6) 55 days and (134) 40 days were identified in this trial, that is, the former had light green from the first while the latter had dark green on outer leaves. Both had fringed margin but the latter was more finely fringed. The latter formed small but rather solid head and at this stage out-look of the plant become whitish center (head) with dark green outer leaves but both outer leaves and head were almost equally tender. The former performed loose head but the whole plant is generally larger than the latter.

As to the Paohsin mustard, at least it formed head sizing about 10 cm across, therefore, it was proved that heading mustard can be grown in dense rainy season in Bangladesh.

(5) On the 6th Trial, Sown in October, 78

As seen in the photo, the growth of Choisan and Petsai is really much better in this season than rainy season. Therefore, it must be understand that even tropical brassica grows better in dry season than rainy season, however, they are recommended for rainy season culture because they can withstand to that severe condition when temperate zone brassica cannot withstand.

Another point from this trial, it can be clearly understood from the photoes that Surugana performs more vigorous and nice than Choisan and Petsai.

Surugana is really very interesting brassica green even in tropical areas, maybe due to its hybrid vigour between tropical and temperate zone caltivers.

(6) On the 8th Trial, Sown in February, 79 (See Plate 30)

Although the trial of February sown Tropical Chinese cabbage and mustard had been on a half way of their maturity, the record by camera had to taken on 6-4-79 at 47 days after sown due to ending of the expert's duty term in Bangladesh. His observation record were as follows:

A. Thailand cultivar of Chinese cabbage 55 days (6), Broad leaf mustard (5) and Taiwanese Paohsin mustard (32) showed very poor germination and subsequent plant growth owing to the seeds had already deteriorated during those two years, while other verieties had grown up rather smoothly.

B. No visible bolting was seen among the varieties by that date.

C. Being smooth growing with those three varieties, Saladeer (131) was showing 20 - 30% of its head-formation, Tropical Pride (115) did just the beginning of head-formation while Michili showed not yet enter into head-formation at all, they were supposed to be able to produce their head despite of more or less smaller and looser than did in December, maybe, Saladeer ten days after, Tropical Pride 3 weeks after and Michili at the beginning of May with some extent of difficulty by the severe heat in April and May. It can be at least concluded that this cropping could be acceptable but this sowing time is certainly the last moment of Chinese cabbage cultivation expecting their complete head.

D. Thailand cultivar of Extra Early 40 days (134) and Early (135), growing smoothly, had reached already 40 - 50% of head-formation but seen some extent of stem elongation. They seemed to be harvestable after 7 - 10 days. It can be concluded for those two varieties that this cropping pattern is suited to them but it may involve some risk of premature bolting if sown earlier than this sowing time of middle of February, regarding the fact of physiological trend of flower formation seen among other tropical brassica green and radish. Since outer leaves of those varieties are tender and eatable, they can be on market in such style as, removing a half of lower leaves, head with some outer leaves during the season being scared Chinese cabbage in the market.

E. Although Thailand and Taiwanese cultivars of mustard (5 and 32) did not show smooth growth owing to the seed deterioration, Nepali cultivar of Khumal had grown up in good out appearance as seen in the photo. This means that broad leaf mustard can be grown very smoothly in this cropping pattern. Generally, broad leaf mustard is regarded as much tolerant to high temperature than Chinese cabbage does. Therefore, mustard could be very promising leaf vegetable to cultivate harvesting in April and May. And this cultivar of Nepali mustard can be acceptable for Bangladesh farmers.

4. GENERAL DISCUSSION AND CONCLUSION

(1) The Phenomenon of Premature Bolting and Flower Formation Physiology

(1.1) Theoretical Background

A. Viewed with the sight of researchers in the temperate zone, in a short, tropical types of brassica and radish have been regarded as having no or almost no requirement of low temperature for their flower formation (vernalization), or tropical type varieties can flower and fruit without cold condition of winter, because they had been confirmed to flower and fruit sowing in summer there through numbers of experiments. No significant varietal difference was seen among them since they flowered almost simultaneously under the said condition.

B. The above has been clearly compared with the idea that those varieties originated or developed in the temperate zone require more or less certain low temperature for their flower and fruit formation, or need to be wintered over for their flowering and fruitng, that is, vernalization is an essential factor for their reproductive development, moreover, a wide range of varietal difference had been confirmed among them, that is, a wide range of difference for the grade of requirement of low temperature among the varieties of temperate zone.

Note: the low temperature conditon in actual seed vernalization tests had been 0 - 5°C and general idea of the low temperature affectable to flower induction of cruciferous plants was lower temperature than 15°C in Japan.

C. SHINOHARA, however, reserved some extent of flexibility for the above clear cutting idea on the tropical type varieties in his paper (SHINOHARA, S, 1959) but he could not explain clearly his reserved flexibility at that time since he did not yet perform experiments in tropical or subtropical areas.

D. Evidences seen in the series of trials with tropical types of brassica greens and radish this time seemed to show something upon the above mentioned flexibility on the requirement of low temperature and the varietal difference on the requirement.

(1.2) Observation on Flower Formation of Each Group throughout 8 Trials

A. Bolting time of Chinese radish has been accelerated in early sowing of the 3rd trial sown in March, medium in medium sowing of June and July, 1st and 5th Trials, while no-bolting happened in late sowing of after August as explained in the discussion in 4-(1.1)-C. Among the varieties, 55 days and Red Bombay were eariest, Kilah was late and Ta-Meihna was the latest.

B. Similar trend was seen among brassica varieties, that is, the bolting and flowering times were accelerated in early sowing in March (2nd Trial),medium in June and July sowing but no-bolting or very delayed flowering in late August and October sowing (5th and 6th). Some

acceleration was seen in the tropical Chinese cabbage varieties in the February sowing (8th Trial).

C. It was generally seen that Choisan group was earliest bolting, Petsai was second earliest, Chinese cabbage of 40 days and 55 days were medium, Saladeer was medium late, Surugana and Chihili were the latest among the tropical type varieties tested.

Although they could be classified among tropical type, Saladeer and Surugana were somewhat later than corresponding varieties due to hybrids between pure tropical type and Japanese varieties.

D. All the broad leaf mustard varieties tested here showed always no bolting up to their maturity for 60 - 70 days after sown. This seemed to be caused by somewhat different condition for their flower induction to other foresaid varieties, that is, mustard (n = 18) is controlled only by long-day condition (Non-vernalization type) while other foresaid brassicas (n = 10) and radish are controlled by low-temperature and long-day length conditions (Seed-vernalization type) according to the paper, SHINOHARA, 1959. Since trials on the mustard this time are lacking the sowing under typical long day condition of March to June, the expert cannot discuss the problem further more, however, it can be concluded that Bread leaf mustard tested this time had no problem on premature bolting for market cultivation as far as sowing in July thorugh February.

(1.3) Discussion on the Phenomenon in Choisan, Petsai and Chinese Cabbage

The biggest fact findings on the flower formation or premature bolting in the Trials was:

A. Choisan group involves at least two types of cultivars (varieties), early and late, and Malaysian cultivar of Choisan and Yutsai belonged to the former and Thailand cultivar of Green Choisan belonged to the latter. In the earlier sowing, therefore, the latter is recommended to avoid premature bolting or earlier development of fiber in the stem.

B. In Petsai group, the similar difference was seen, that is, Canton Petsai was early and Surugana was the latest, therefore, the latter is more recommendable than the former in March sowing. In the further researches on Petsai collecting more cultivars from various places, the wider range of difference on the bolting may be found out, and if so, the later bolting cultivar should be chosen in the earlier sowing.

C. The same trend was reflected also in the tropical Chinese cabbage and Chinese radish as explained in the above.

D. Anyhow, such delicate differences in flowering habits among tropical varieties in different sowing time as well as different cultivars can never confirm exactly under temperate zone condition but should be tested in the tropical area, more strictly in the very places of every tropical countries as roughly done by the expert in this occasion. The expert wants therefore to recommend to operate further research works with this concern to obtain more exact and clear evidences and more over to operate breeding works based on those varietal ecological studies just as we, Japanese did on Japanese varietal development and eventually achieved all year round culture on every crops.

(1.4) Discussion on the Vernalization Physiology Accelerated by Long-Day Condition

Another important fact findings in this concern is that::

A. The flower induction of tropical varieties in the subtropical area like Bangladesh (21° - 27°N.; Dacca at 23°50' has range of daylength of 10.20 - 13.40 hrs.) seemed to be affected firstly by low temperature around 20° - 25°C but secondly by long-day condition refering the fact that light condition has been generally supplementing the low temperature condition in many experiments on the seed vernalization of *brassica* and *raphanus* (SHINOHARA, S., 1959) which is diametrically contrastable with the general belief of dark condition supplements low temperature exposure in the vernalization of *graminacae* plants like wheat, barley and rye (LYSENKO, T.D., 1932 and WHYTE, R.O., 1938).

B. The low temperature condition of around 20° - 25°C for the vernalization of tropical cruciferous plants is but a hypothesized suggestion of the expert this time, refering the condition exposed on the series of Trials and, of course, it should be cleared by the future experiments. It could be at least suggestable here that even tropical varieties do certainly have a function of vernalization but their requiring low temperature condition may be much higehr than the idea on temperate zone varieties, and the temperature could be fallen into a certain point from 20° - 25°C.

C. Moreover, a long day condition is supposed to be supplementing the low temperature in this case referring that growing under the same temperature condition, the plants sown in March and April showed earlier bolting but those sown in August did not show bolting up to December or very late bolting in October, with the earliest type of Choisan and narrow leaf Kailaan, a diametrical contrast. The former is the time of extending long daylength and the latter is that of shortening the day length, that is, extending time act to long-day effect and shortening does short day effect as explain in the later Chapter with tropical beans and sweet corn.

(1.5) Conclusion on the Flower Formation Phenomenon

As the conclusion, it can be summarized on the flower formation that caution for premature bolting must be hold in case of sowing in February to April selecting a slow-bolting variety while there is almost no risk of bolting or capable to keep longer time in the field expecting bigger products in case of sowing after late August without selection of the variety.

(2) General Conclusion or Summary

Summarizing the aforesaid discussion, it can be generally concluded as follows:

A. The prospective cropping patterns of Choisan, Petsai and Broad leaf mustard are designed as shown in respective Tables in Part 1.

B. As for Choisan group, it is better to select later bolting cultivar or variety in order to avoid risk of premature bolting, if sown in spring. In case of fertile field with enough watering capacity, however, premature bolting doesn't matter so much if designed dense spacing and early harvesting within 35 days.

C. As for Petsai group, Surugana can be recommended as a heavy yield or especially in

early sowing, counting its vigorous growth and slow bolting capacity.

D. As for Tropical Chinese cabbage, the role of this type is cropping in summer and dense rainy season when Japanese F_1-hybrid varieties cannot be grown.

E. In case of sowing in June and July, denser spaced spot sowing at 20 - 25 x 15 - 20 cm providing exact thinnings on time is recommended in order to harvest at somewhat young stage head with a half number of outer-leaves as seen in Plates 29 and 33.

F. In case of sowing August and September which expects harvest Chinese cabbage before excellent Japanese Chinese cabbage comes in the market and to produce the quality as good as possible, sparser spacing by spot sowing at 50 - 60 x 30 - 35 cm or more is recommended. Although such spacing had not been designed in the trials this time but the expert is quite sure the above sparse spacing will result in producing big head of tropical Chinese cabbage which are seen in Bangkok market.

G. Tropical Chinese cabbage can be produced sowing in February to early March as shown in the 8th Trial. In this case, Japanese earliest varieties such as Tropicana and Tropical Pride as well as Saladeer can be approval in February sowing with the same sparse spacing of cultivation in tropical dry season.

H. In case of March sowing, the spacing may be better to follow the case of E using true tropical varieties of Thailand cultivars. In this case, since its mid growing period falles into April to May, diseases by high humidity may be much less than E, growing in July and August, but much causion on premature bolting and growth check with the highest temperature should be held, eventually the result may be similar to E, that is, harvest somewhat young head with a half of outer-leaves.

I. On the seed production of those brassicas, it is reported in Annex 1.

CHAPTER 9. RESULTS OF TRIALS ON AMARANTH, KANGKONG AND SPINACH

1. INTRODUCTION

These leafy greens can be called spinach group since they have commonly tender leaves of nutritious value with high content of chlorophyle and minerals and are called by popular names of "spinach", for example, Chinese spinach for amaranth, water spinaph for KangKong, Indian Spinach for Basella, summer spinach for chard (leafy beet), but all of them belong to quite different species and families each other, that is, spinach belongs to *Spinacia oleracea* of Chenopodiaceae, amaranth to Amaranthaceae, KangKong to Convolvulaceae, Basella to *Basella rubra* of Basellaceae and Chard to *Beta vulgaris* of Chenopodiaceae.

Although all mutritionists in the world recommend spinach (*Spinacia oleracea*) for improvement of people's diet, it is a great pitty that spinach can grow only under mild weather and cannot be grown in tropical lowland like Bangladesh rainy season as explained in the later part of this Chapter. Accordingly, the introduction of good varieties of amaranth and KangKong into Bangladesh horticulture is very important in order to be supplements of spinach but having equally good quality and good taste. So, those trials were done.

2. AMARANTH *(Amaranthus mangostanus)*

(1) Purpose

Amaranth, Danta or Larshak, is very popular leaf vegetable in Bangladesh but most of them are stem type and usually being harvested at so large style as some 80 cm height and more than 2 cm of stem diameter, grown for more than 2 months. Leaf amaranth or Chinese spinach, however, is one of a few essential vegetables in the suburban vegetable growing areas of S-E Asian countries like Bangkok and Singapore but all of them are leaf type and harvested at young stage of about 20 cm height with several large leaves, growing only for 30 days.

The expert noticed the above mentioned difference between both areas and considered that, as a countermeasure of increase vegetable production during rainy season, those short period cropping pattern in S-E Asia should be introduced in Bangladesh, introducing good leaf type varieties from there. This is the purpose to operate trials on Amaranth.

(2) Materials and Method

A. Varieties Tested

34. Hsientsai, Green (Taiwan), 71. Chinese spinach, Green (Thailand), 52. Larshak, Red, 53. Local white, 54. Danta, Bengalee, latter three are local varieties.

B. Times of Trial

1st Trial: Sown on 26-7-77 and examined on 26-8-77.
2nd Trial: Sown on 23-6-78 and examined on 6-8-78.

C. Outline of Cultivation Method

In both trials, the seeds were sown by broad casting method directly on the growing bed, thinning was done two times following the manner for brassica greens, and other cultivation managements were more or less the same as brassica greens.

(3) Performance

(3.1) Growing Progress in the 1st Trial

Seed germination was somewhat disturbed by heavy rain-fall happened on the next day of sowing but actually no problem on the trial.

Table 22. Performance of Amaranch in 1st Trial Examined on 26-8, 32 days after Sown

No. Variety	Character	Weight (g)			Size of harvest leaf (cm)			
		Top	Root	T/R	Blade			Len. of petiole
					Len.	Wid.	L/W	
34. Chinese spinach (Leaf type amaranth) Taiwan	Light green heart shaped leaf blade, branch shoot sprout from every node	15.0	1.4	10.7	11.6	9.4	1.2	3.5
52. Local red Amaranth (Stem type)	Reddish green oblong heart leaf blade on juicy red long stem no sprout of branch	8.0	0.8	10.0	10.0	4.4	2.3	4.1
53. Local white Amaranth (Stem type)	Deep green oblong heart leaf blade on long green stem	12.4	1.6	7.8	11.0	5.6	2.0	3.3
54. Danta Bengalee (Leaf type)	Very similar to # 34 but leaf blades are darker and harshy than # 34	13.2	2.0	6.6	14.0	6.4	2.2	2.9

(3.2) Growing Progress in the 2nd Trial

Seed germination and plant growth were generally not bad but unfortunately the subjected Taiwanese cultivar, 34. Hsientsai had been situated no good place owing to under shadow of big tree, therefore, the record did not adopted in the Table because clearly inferior to if grown normally. The examination was somewhat delayed.

Table 23 Performance of Amaranth in 2nd Trial Examined on 6-8, 45 Days After Sown

No.	Variety	Whole plant weight (g)	Plant height (cm)	Diameter of stem (cm)	Number of leaves	Size of largest leaf				Flower develop-ment
						Blade (cm)			Petiole length (cm)	
						Length	Width	L/W		
52.	Larshak, red	109	76.5	1.35	22	11.5	7.7	1.49	8.75	5
54.	Danta, Bengalee	49	67.0	0.85	17	11.7	8.0	1.46	7.20	4
71.	Chinese spinach, green	33	67.5	0.70	18	8.6	6.1	1.41	5.45	4

Note: (i) Data are average of 2 representative plants.

(ii) Grades of flower development: 5. Inflorescence is flowering on the top, also visible on the branches. 4. Infloresence is visible on the top of main stem.

(4) *Discussion and Conclusion*

(4.1) Characteristics and Quality of the Caltivars Tested

A. 52. Larshak Red was a purified red stem type with red leaves and seemed to be the best cultivar having tender stem if harvested at early stage. 53. Local white was really green coloured stem type but mixing some red or red blotched leaves. These two are pure stem type which grows elongate stem quickly, develops its branch slowly and the leaves are oblonged, pointed shape and somewhat harshy.

B. 34. Hsientsai was complete leaf type, slow elongation of stem but developed branches quickly after 4 weeks of growing but its leaves were large, roundish and very tender and seemed to have best quality of leaves which should be harvested around 30 days after sown.

C. 54. Danta Bengalee seemed to belong to leaf type developing branches quickly although it grow up to large branchy plants in Bangladesh, maybe, harvesting from time to time picking its young shoots, but its quality of leaves is harshier than Taiwanese caltivar.

D. 71. Thailand cultivar was intermediate type of Taiwanese Hsientsai and Danta Bengalee.

E. The flower development in the June sown culture was that Larshak was earliest, Danta Bengalee and Thailand Chinese spinach were medium and Taiwanese Hsientsai was the latest in the field observation.

F. Eventually, to fufill the above mention purpose of short period growing, Hsientsai is the best cultivar having best quality large leaves and heavy yield at the time of 30 days. Thailand cultivars may be acceptable but the quality is second to the Taiwanese. Danta green may be also acceptable.

(4.2) Conclusion

A. Habit of amaranth plant is generally regarded as having high tolerancy to hot temperature but more prefers dry condition than humid and its flower induction is accelerated under long day condition.

B. Referring the above, present predominant cultivation of amaranth in Bangladesh, (i) sowing at early March harvest in May to June and (ii) sowing in early September harvest in November is just fit to its plant habit.

C. Although the expert suggested its cropping patterns in a year as a short period leaf vegetable production as seen in the Table of Part 1 but practically the following notice must be held.

D. Since more suitable better quality crops such as Kangkong and tropical brassia greens are available from July through September, amaranth maybe better to share its harvesting time in March to early June and October to November in a short, in hot dry weather, when the other crops are somewhat hard for their growth.

3. KANGKONG (*Ipomoea aquatica*)

3.1 Purpose

A wild type of this plant called Kalmishak is growing naturally in ponds everywhere in Bangladesh and its young shoots are seen in the markets picking up in the water as a substitute vegetable during dense rainy season, therefore, Bengalee people have a custom to eat this plant. Moreover, similar wild plant is seen also in Thailand and Siamese people had been utilizing its young shorts just the same manner as Bengalee but at present they eat only cultivated Kangkong since they introduced garden variety from South China, not so far ago. Accordingly, Kangkong, though it is not yet popular in Bangladesh, can be easily introduced and on market here. So, the export operate the trial as one of the short period leafy greens in rainy season.

Note: Kangkong is Malayan name, Wengtsai in Chinese and water spinach or water convolvul in English.

3.2 Materials and Method

(1) Varieties or Cultivars tested:

10. Water spinach (Thailand) and 137. Kangkong (Kasetsart Univ., Thailand), 35. Wengtsai (Taiwan), 103. Wengtsai, other cultivar than 35 but from Taiwan.

(2) Time of Trial and Cultivation Method:

A. 1st Trial:

Sown on 24-7-77 and examined on 25-8-77. Using two cultivars of 35 and 10, seeds were sown in lengthwise three lines on the glowing bed, one time thinning was done at one true leaf stage with supplemental transplantation at the missing place with the thinned seedlings. Irrigation was specially cared because this plant prefers moisty condition of the soil.

B. 2nd Trial:

Sown on 12-3-78 and observation on 29-4-79 using the same two cultivars and same cultivation manners as 1st trial. First harvest was done around at the end of April and the plants were kept growing up to early August picking young shoots from time to time.

C. 3rd Trial at Pravari and Naojora Community Centers:

A. Grown plants in the 2nd Trial field were digged up, utilizing both cut vines and divided roots, and planted in the said trial fields on 3-8-78.

B. Seed of Kasetsert University cultivar was sown in the same fields on 8-8-78.

D. 4th Trial:

Sown on 14-8-78 tested 3 cultivars of 35, 104 and 137 in order to compare 137. Foundation seed of Kasetsart University with the Taiwanese cultivars.

E. 5th Trial:

Sown on 24-8-78 tested only one cultivar of 137 because seed germination of 4th trial was not good and also thinking to prdouce seed from this foundation seed.

F. 6th Trial:

Sown on 23-8-79 in the vegetable trial field of CERDI, Joydevpur, using Kasetsart Univ. Cultivar (137).

3.3 Performance

(1) Progress and Performance in the 1st Trial

A. As explained in detail in the previous paper, SHINOHARA (1978), the growth of Kangkong in the first trial seemed to be really enjoying the moisty high temperature condition in dense rainy season, that is, after germinated simultaneously it grew up very quickly and reached 25 cm of height only in 25 days, moreover, the quality of stem and leaves was excellent, tender and sweet, no fibrous and harshness at all which was far better than wild type Kalmishak.

B. Record taken on 25-8-77, 32 days after sown, are as shown in Table 23.

Table 23 Performance of Kangkong in 1st Trial Examined on 25-8-77

No. No., Variety	Character	Weight (g)			Size of largest leaf (cm)			
					Blade			Petiole
		Top	Root	T/R	Len.	Wid.	L/W	length
10. Kangkong Thailand *Ipomea aquatica*	Green long slender oval leaf blade, less branches at cotyledon node, roots sprout at the bottom of stem	7.0	1.0	7.0	14.2	3.4	4.2	4.0
35. Kangkong Taiwan *Ipomea aquatica*	Green but narrower leaf blade than the former and most of plants emerged 2 side shoots from cotyledon node	10.2	1.4	5.7	16.2	1.9	8.5	4.4

Note: Data are average of 3 representative plants.

C. At the time of first harvest by thinning, no practical quality difference was seen between two cultivars, only slight difference was seen as mentioned in the Table 23 and Taiwanese cultivar showed heavier yield, maybe due to emergence of side shoots. This quicker branching habit of Taiwanese cultivar is very important for the convenience of cut-harvesting of vines several times. Thailand cultivar also mixed those typed plant but very few, maybe, only 10 - 20%.

D. A few week after the first harvest, many running vines appears from Thailand cultivar but almost no in Taiwanese cultivar, as shown in the photo of Plate 32.

E. The running vines grew as quick as extending a few centimeter or more per day. This vine developed fiber also quickly, therefore, it is not good character as leaf vegetable.

F. Both cultivars, however, segregated no red color, anthocyanin shading, neither on leaves nor stems, that is complete light green and bore pure white flowers.

G. Leaf shape changed gradually from long narrow to oblonged conversed heart shape with pointed tip and this shape change was more remarkable on the vined plants.

(2) Progress and Findings by Observation in Other Trials

Although trial was done several times including different places, the varieties tested and the cultivation manners were almost the same, therefore, further discussions are made in overall the trials.

(2.1) Growth under Hot and Dry Condition

Growth in the 2nd Trial sown on 12-3-78 was rather slow in March despite of every-day watering comparing with the same time sown brassica greens and that of 1st Trial, but recovered in normal pace in April when good showers came frequently, therefore, first harvest was done only on 27-4, about 45 days after sown. It seemed to show how much Kangkong is fond of moisty condition of soil.

(2.2) Growth in the Repeating Harvest Culture

Kept in the field picking young shoots for nearly 5 months, the plant stock of March sown grew up so large as nearly 15 cm diameter at the base having 20 - 30 main stems. At this time, several shoots can be harvested every day but the shoot quality was not excellent as the first few harvestings having roundish darker green leaves.

(2.3) Observation on the Vegetative Propagation

A. The above mentioned plant stocks were digged up cutting all the vines sprouted. At this time such off-type stocks as having less number of vines and other vines spreading long on the ground bearing roundish darker green leaves were ommitted from the propagation.

B. The harvested vines were cut into some 20 cm of length and planted lengthwisely on the planting line 5 - 8 cm apart.

C. The harvested stocks were divided as keeping 1 - 3 stem stumps per one division and planted on the planting line about 15 cm apart.

D. All the planted cut-vines and divided stocks were easily set in the field within a few days, of course, by means of watered at the planting time, and new shoots sprouted to be harvested within a few weeks. Some difference was seen among the sprouted shoots as follows:

E. The new shoots sprouted from the divided stocks showed such a trend as (a) some-what slower sprout, (b) but more number sprouted simultaneously and (c) the leaves on new shoots showed long, narrow and sharply pointed shape much similar to those on the first shoots from seeds.

F. On the contrally, those come up from the cut-vines showed more similar to those shoots from aged plants bearing more roundish short leaves.

G. Any way, the quality and productivity of shoots of both plots became similar after a few harvests of shoots.

(2.4) Possibility of Replant Failure:

A. The seed germination of the 4th Trial had been partially no good despite of good watering management and, discussing various factors on it, it seemed to be most likely a kind of replant failure since this place was used for cultivation of Kangkong last year for 3 - 4 months then left as it is until March this year when soybean was planted.

b. The expert therefore felt there may be a kind of replant failure on Kangkong although he doesn't yet know much about the nature of Kangkong. He wants to suggest here better to make an experimentation for replant failure problem on Kangkong.

(2.5) On the Quality of Cultivars

A. From the foresaid observation on Taiwanese and Siamese cultivars, it can be conclude as follows:

(a) Cultivated type of *Ipomea aquatica* should have firstly light green leaf, stem and pure white flower secondly long narrow leaf shape at least at the beginning of shoots sprout from seed. These two means to have excellent quality of products.

B. There are two types of plant habit: one is dwarf type and produces much number of branch shoots but not spreads long vines which can be identified at very young stage of about 20 cm height by means of sprouting two side shoots already from the cotyledon node. Another is creeping type and spreads long creeping vine with long internodes and leaf shape changes rapidly from long narrow to roundish oblonged conversed heart-shape, and emerges less branch shoots if not pick the top, which can be identified at the beginning by means of not sprouting side shoots at the cotyledon node.

C. The caltivar from Taiwan (35) belongs to the former type segregating very few percentage of the latter, while Siamese cultivar (10) belongs generally to the latter mixing some percents of the former, that is, the former is more improved cultivar than the latter.

D. The foundation seed of Kasetsart University (137) showed intermediate between 10 and 35, that is, not yet complete the selection of the former type.

(2.6) Genetical Notice for the Seed Production

A. At the seed production of Kangkong, caution for the above point is essential, that is, seed plants must be selected the dwarf type omitting the creeping type at the foresaid young stage.

B. Another caution for seed production is natural pollination with wild type Kalmishak. Kangkong is considered to be an out-pollinative plant because its closed species of sweet potato has a habit of self-incompartibility or produce its seeds accepting other plant's

pollen. Accordingly, at the planning of seed production of Kangkong, the field should be isolated from the growing place of wild Kalmishak.

C. Even if Kangkong seeds are partially disturbed by crossing with Kalmishak, it can be easily identified by means of that the hybridized plants certainly show the darker green leaves and stem, anthocyanin flash appears somewhere on leaves, on stem or both and lastly bears bluish or purplish flashed flower. If such plants found in the cultivation, those plants should be taken out from the field.

(2.7) On the Flowering and Fruiting Habit

A. Since Kangkong belongs to short day plant, it requires more or less short day length condition for its flowering and fruiting. That is why no flower is seen in the cultivation from April through August.

B. In the progress of the series of Trials this time, (a) Only vegetative growth was flourished during April to August, (b) some flower appearance were seen from mid-September, (c) mid-flowering season was October lasting to November, (d) fruit capsules were step by step seen on the plants from late October up to December, (e) even some aged capsules did not fall down up to the end of November or beginning of December when number of flowers was reduced (f) in December the flowering were almost gone and only capsules were seen on the vines, (g) aftter the middle of December, the capsules did not mature for considerably long time keeping freshy. (See Plate 32-D)

(2.8) Design of Seed Production

From the above observation, the seed production can be designed as follows:

A. No need of frequent picking of matured capsules every time at their maturity, but it can be harvested simultaneous one or two times from late November to early December with fruited vines as seen in Plate 32-D.

B. Harvested capsules in middle of December did not dry up for long time despite of exposing to sunshine and capusules on the plant did not matured for long time, these two phenomena seemed to show that the temperature condition from mid-December came down to be not enough Kangkong's seed development or maturing.

C. The first observation shows that even though out-look of capsules seems to be already matured, if the seeds inside are yet immatured, the capsule cover does not dehydrate so easily.

(2.9) Prospective Cropping Patterns:

A. There are two manner of harvesting and two manner of propagations as explained in the above.

B. From the observation in the markets of Bangkok and Singapore etc., the Kangkong products in the market is bundled young plants with roots, that is, harvested wholly about 30 days after sown. In this case, it doesn't be so much problems whether caltivar belongs to dwarf type or creeping type (see Plate 33).

C. But in another cultivation manner of picking young shoots several times from the plant stock maybe more adoptable for Bangladesh farmers and at least for Kitchen gardening. In this case, the dwarf typed cultivar is absolutely superior to the creeping type.

D. After all, the prospective cropping patterns were designed as shown in the Table of Part 1.

4. SPINACH (*spinacia oleracea*)

4.1 Purpose

As mentioned at the beginning of this Chapter, spinach (*Spinacia oleraceaa*) is one of cherished desiring vegetables for Bengalee leaders to produce in Bangladesh. This trial was operated to confirm how far extent spinach could be adaptable deviating before or after the most promising period of December to January of Bangladesh.

Some other discussion on the utilization of summer spinach (*Beta vulgaris*) is added at the end of this column in its place to be a substitute of real spinach.

4.2 Materials and Methods

A. Varieties Tested:

120. Orient, 121. Pacific (both from Sakata Seed Co., Japan) and 157. Nepali (Produced by Nepali Government)

B. Times of Trial and Outline of Cultivation

1st Trial: using all three varieties, sown on 30-10-78 and examined on 20-12-78.
2nd Trial: using 3 varieties at the trial field of CERDI, Joydevpur, sown on 5-11-78.
3rd Trial: using Japanese 2 varieties, sown on 19-12-78 and make observation.

Linear sowing in widthwise lines of 20 cm apart, first thinning done at one true leaf stage at crowded place and another thinning at 3-4 leaf stage to set plants 5 - 7 cm apart. Other field managements were more or less the same as other brassica greens. Seed germination in both trials were very good.

4.3 Performance and Discussion

(1) Performance of the Three Varieties

A. Remarkable difference was seen between Japanese varieties and Nepali one, that is, the former two were not yet bolted and continuing active vegetative growth making tillering, while Nepali had already botled and flowering, its plant height or stem length reached 51.0 cm in average. It was yet only 51 days after sown (see Plate 35).

B. Nepali (157) is regarded as a typical type of oriental spinach having sharp prickle seeds but it seems to be one of the examples of degenerated cultivar in tropical area because it has bolted so early as within 40 days from sown under the complete short day condition of December notwithstanding spinach belongs to longday plant. That is, radically the species belong

Table 24 Performance of Spinach in 1st Trial Examined on 20-12-78 with Annex

No.	Variety		Weight (g)		No. of leaves	Size of largest leaves (cm)				No. of tillers	Remark
			Whole plant	Root		Blade			Petiole length		
						Length	Width	L/W			
120	Orient	Average	91	2.3	26.5	15.4	11.4	1.35	20.3	2.6	No bolting
		Best	120	4	32	18.0	12	1.50	22.5	4	
121	Pacific	Average	107	2.0	36.0	14.7	11.7	1.26	22.0	3.0	No bolting
		Best	152	3	48	17.0	14	1.21	20.5	5	
157	Nepali	Average	56.7	5.4	32.3	9.3	8.2	1.13	6.8	Flowering, plant height aver.51.0cm	
		Best	64	6	33	9.3	8.0	1.16	9.0		

Note: (i) Average data are average of 3-4 representative plants.
(ii) Total weight of 4 representative plants on 7-1-79 recorded as Orient-372g and Pacific-298g.

to long-day plant but this tropical type does not require long-day condition for its flower industion, just like Bangladesh oil mustard which species belongs to long-day plant but this cultivars can flower and fruit in December to February.

C. Two Japanese varieties are hybrid between Japanese orient type variety and European type, therefore, their characters are intermediate, that is, their uplight leaf style and long petiole with some lobation are come from orient type but their dark green leaf and petiole colour, somewhat thick blade and much tillered heavy yield are come from European type. Most important character of heat resistancy is also come from Japanese oriental variety and being never found among pure European varieties.

Therefore, these Japanese Hybrid varieties are very promising varieties to cultivate in Bangladesh as well as other subtropical places and tropical high lands.

D. In more detail, refering Sakata's catalogue, Pacific is an F_1-Hybrid variety and Orient is F_2-Hybrid one, and both are supposed to be stemed from very similar origin.

E. Both have almost the same general characteristics as mentioned the above but somewhat different leaf shape, that is, the former has much uniform leaf shape and the latter has some diversity, perhaps due to the difference of F_1 and F_2 generations. Pacific has much pointed long blade with one or two lobations but Orient has a range of leaf shapes, from unpointed roundish short blade without lobation to pointed long and somewhat narrow blade with two clear lobations, centering on dully pointed intermediate shape with one shallow lobation. Both are of course very heavy yielder harvestable from 40 days to more than 60 days with sparser spacing in the later harvesting, but actual yields and qualities seems to be not much difference each other in this cropping pattern.

(2) Flowering Habit of Japanese Varieties

Lather important observation was obtained from the trial field of CERDI, Jaydevpur. Being left growing as it is in the field for long time, sharpe difference was realized between two Japanese varieties, that is, bolting had begun in Orient from the middle of February while no bolting at all had been seen with Pacific until the end of February. The Photo was

taken on 20-2-79 showing majority of Orient had bolted but no bolter at all with Pacific. As to the cultivation condition, Joydevpur trial field were less fertilized and watered than Gulshan Garden. Regretfully, the photo showing the above picture could not be put on the Plate due to no space available.

(3) Resistancy to Winter Aphid and Susceptibility to Higher Temperature

Another important two evidences were seen in the 3rd Trial sown on 19-12-78. That is;

(i) No aphid damage was seen with spinach while other brassica greens sown at the same time were killed by sudden and severe appearance of aphids.

(ii) The plant growth was sharply checked with sudden appearance of sun-scald and leaf spot disease at the end of February and the expert therefore decided that this is the last limit of spinach culture in Dacca.

4.4 Conclusion

(1) On the Varieties

A. Nepali cultivar can not be recommended due to its extraearly bolting habit having risk of premature bolting wholly in a year with the reason discussed in (1)-B.

B. Japanese two varieties can be highly recommended due to their high productivity with their hybrid vigour and heat resistancy which perhaps cannot be found among European and American varieties, since the temperature condition of Bangladesh winter is corresponded to that of early summer and late summer in Japan, more than mid-summer of West Europe, when a limitted heat resistant varieties is essential to grow successfully.

A little early bolting habit of Orient does not be big problem since its actual bolting time is already limit to cultivation itself.

C. This type of Japanese hybrid spinach is now rushed to extend in Cammeron Highlands, not only extenidng the variety but also extending spinach production itself getting those wonderful spinach varieties, where place is one of the biggest leaf vegetable production centers supplying to Kuala Lumpur, Penang and Singapore, as obtained by the expert's survey in November, 1978.

(2) On the Adaptable Cropping Patterns in Bangladesh

A. From the evidence mentioned in (3)-(ii), the limit of production can be concluded as the end of February. It has been realized that since spinach prefers so much mild climate, it is sensitive even a medium high temperature comes up rapidly from the end of February when the condition is not yet so much harmful for other tropical type brassica green etc.

B. Although the expert did not make experiment before 30-10-78, but refering the above mentioned evidence, he can conclude that the earliest limit of cultivation would be at the end of October.

C. Eventually the adaptable cultivation period of spinach in Bangladesh can be concluded from the end of October to the end of February. The cropping pattern is to be designed as: the sowing time should be limitted from the end of October to the middle of January by sowing every 10 - 15 days, counting about 50 days for growing period, the harvesting time will be fallen into the period from the middle of December to the end of February.

D. This spinach production time involves another important meaning. That is, this period involves a big risk of damage of aphids, appearing so suddenly and severely, for all the cruciferous vegetables but the aphids do not attack spinach, therefore, spinach can be concluded as the easiest growing leaf greens during winter, that is one of the important role of spinach in Bangladesh.

(3) **Seed Production with Severe Notice for the Utilization of Hybrid Seeds**

A. Since Orient has bolted and produce some seeds in Joydevpur, there is a hope to produce spinach seed locally in Bangladesh. However, the expert wants to suggest a big caution with this concern as follows:

B. Since Orient is an F_2-generation varieties, it does segregation for a wide range which involves a big risk of degeneration. Firstly, as for their morphological characters, of cause, this factor can be a big problem in degeneration but theoretically it can be overcome with untiringly continuous selecton practices on the characters. The second problem is the deterioration of hybrid vigour, that is, in case of duplicating reproduction the heterosis may vanish within a few generation, then the cultivar becomes no atractive for its yield. The expert wants to point out here the third terrible sort of degeneration. That is the degeneration by genocological factor.

C. As mentioned in (1)-B, Nepali spinach is recognized as no good due to its habit of extreme-tropical type, always facing at premature-bolting. The expert concludes with his genecological aspect that this is a result of duplication of careless seed production without any selection of late bolting type plants. In this case, the most adaptable plant type is rapidly predominated in the population maybe within a few generation, as the result, an extreme-tropical type is estalbished under the tropical condition.

D. Inasmuch as Orient is F_2-generation, the population of Orient involves a wide range of diversity even for the character of flower formation, from early bolting habit to late bolting habit. In fact, the population of Orient being flowering and fruiting showed such a range of diversity, that is, some plants produce a lot of seeds, some produce medium, another produce less seed but some percent of plants do not bolt, fruit and eventually died without flowering. In this case, the plant showed heavy yield of seeds means the tropical type or the worst type while the best type for cultivation is really the last one which does not bolt like Pacific. If the seeds produced repeatedly without any selection of late bolting type from Orient in Bangaldesh, the result would be certainly the same as Nepali spinach within several generations.

E. The expert should like to recommend that (a) the best way is to buy seeds from Japan and (b) even if plan to produce seed locally, the duplication should be stopped for only one time renewing the original seed from Japan. Moreover, the duplicated seeds must not be called by the same name of Orient because it is not Orient any more due to the change of true characters.

4.5 Summer Spinach (*Beta vulgaris* var. *flavescens*)

Only one time trial was done for this so-called summer spinach in Gulshem Garden but most of observations discussed here were taken from Kashimipur BADC-ADE Field and other farmer's fields.

(1) Evidences Observed

A. In Gulshan Garden, a local caltivar of summer spinach (50) was on trial sowing on 26-7-77 together with other leaf greens in linear sowing 18 cm apart. Seed germination and plant growth seemed to be smooth but the growth rate was much slower than the tropical brassica greens, Chinese radish and Kankong growing at the same time, therefore, it could not harvest at 30 days after sowing being not enough large as other said greens. But it has started bolting about 40 days of growing and on 19-9-77, 56 days after sown, all the plants flowered showing more than 100 cm of plant height. It means this cultivar had to be harvested at about 40 days after sown but the yield was clearly inferior to Kangkong and other brassica greens (Plate 28-D).

B. With another observation with summer spinach at Kashimipur BADC-ADE Field, in the seed production field on 16-1-79, a wide range of diversity in bolting time was seen in the seeding population, that is, some 10% earliest plants had already reached full blossoming with nearly 100 cm plant height, majority had been just bolting time but other a few percents were showing still rosset style which had flower buds at the center. The expert had therefore made an advice to take off the earliest 10% of plants in order to maintain good capacity of the cultivar, otherwise, it will degenerate to be a premature bolting type just as afore-explained Nepali spinach. The same state of seed production field was recognized at Savar farmer's field which seemed to be self-supporting production and very poor tiny summer spinach was growing at the neighbouring field.

C. From the above two, three observation evidences, the expert severely realized that local summer spinach is degenerating now in Bangladesh and the cultivar tested at Gulshan Garden is already come down to a tropical degenerated type.

(2) Role of Summer Spinach in Bangladesh

(2.1) Evaluation of Its Nutritive Value

Although the taste and nutritious value are inferior to ordinary spinach, summer spinach is the most resembled green vegetable with spinach, therefore, it may have the first priority to be the substitute during the season when spinach can not be produced.

(2.2) Evaluation of Its Capacity for Cyclonic Season Culture

A. Since summer spinach is much more resistant to heat than spinach, it must share summer production in place of spinach. However, since Kangkong is much more enjoying humid condition, it must share the production during dense rainy season. The role of summer spinach falls therefore into the production from March to early May and late September to November. Because of belonging to long-day plant, the latter cropping can be successfully done but in the former cropping, there is a big risk of premature bolting, therefore, it is necessary to choose a slow bolting cartivar, in other words, with such tropical type cultivar as tested at Gulshan Garden, the production for March to May cannot be successfully managed due to its premature

bolting. In present condition, leafy amaranth would be better yielder than local summer spinach in the said season.

Table 25 Nutritive Value of Several Leaf Greens per 100 g of Fresh Weight of Edible Part

Kind	Water	Carbon hydrate		Ash	Minerals (mg)			Vitamin				
		Total	Fibour					A (I.U.)		B_1	B_2	C
	%	Sugars (g)	(g)	(g)	Ca	P	Fe	Effec-tive A	Caro-tene	(mg)	(mg)	(mg)
Spinach, ordinary	90.2	3.9	0.9	1.6	98	52	3.3	2,600	8,000	0.12	0.30	100
Summer spinach	91.9	3.9	0.5	1.8	100	26	2.0	830	2,500	0.15	0.25	25
Kangkong	84.1	8.0	2.5	1.7	70	45	2.2	1,600	5,000	0.08	0.15	30
Petsai	94.0	3.2	0.9	0.4	47	55	1.6	1,300	4,000	0.12	0.20	35
Komatsuna (Choisan)	92.7	2.6	0.8	1.3	170	63	3.3	2,000	6,000	0.10	0.15	90
Radish Leaf	83.5	7.1	1.4	2.1	190	30	1.4	3,000	9,000	0.10	0.30	90

Note: Data from "Japanese Standard of Elemental Components of Foods" issued by Japanese Government, 1963 (Abstracted from "Yasai-Engei Daijiten", 1977.

B. In this respect, the expert wants to recommend here Japanese variety or called "Hudanso" in Japanese. He guesses that Japanese Hudanso is the most resembled leaf beet to Bangladesh local summer spinach having good heat tolerancy and slow bolting capacity for March to May production in Bangladesh.

CHAPTER 10 RESULTS OF TRIALS ON SUPER SWEET CORN AND BEANS

1. INTRODUCTION

1.1 Super Sweet Corn, DMR

(1) Background of the Intorudction from Thailand

About the corn trial, at first the expert had not so definit idea on the trial and once he cultivated local flint corn for his home use sowing in May and confirmed the growth was good. At the time he visited Bangkok in early July, 1978, he was presented as his request 1 kg of the foundation seed of Super-Sweet Corn from Horticulture Department of Kasetsart University (K.U.). This variety was named K.U. No. 1, DMR, bred by Mr. Tavat LAVAPANYA at Corn and Sorghum Research Institute of K.U. 4-5 years ago, hydridizing an American Super Sweet Corn having a gene of bt_1 with a downy mildew resistant local variety; a simple variety (not F_1-hybrid) fixed in super-sweet corn character and has high resistancy to downy mildew which is the most troublesome disease of *Zea Mays* in S-E Asian monsoon zone and corn varieties cultivated this zone must have its resistancy otherwise corn culture may be failed with damage of this disease in the rainy season.

After he got this marvelous variety seed, the expert dicided with his high sprit to extent this variety in Bangladesh firstly to succeed in its seed production locally in parallel with the adaptation trials at various places in Bangladesh. Since a rule for introduction of new varieties especially in ease of seed production is existed in Bangladesh Government, he devoted to get an approval in this concern under this rule and with a big support of Dr. Altaf Ali of Planning Commission he could get the concerned approval to make a test seed production for the extension of this variety at Kashimipur ADE Field of BADC. Then with their strong support of Chairman Mr. A. Samad of BADC and Director Mr. Kahn of ADE Field, the expert had devoted to make a series of adaptation trials at Gulshan Garden, the vegetable trial field of CERDI, Joydevpur and its two Community Centers as well as the foresaid ADE Field paralleled with test seed productions at Kashimipur and CERDI.

(2) Potentiality of Utilization of this Marvelous Corn

The reason why the expert operated such a troublesome work can be summarized as follows:

A. Differed from normal sweet corn like Golden Bantam and far differed from flint corn, super sweet corn lasts its sweetness and softness for remarkably long time if compared with normal sweet corn lasts for about one day and flint corn does only for several hours after harvested.

B. This capacity is stemed from its physiological character that the metablismic nature of "assimilated sugars turn into starch" is very much inhibited by the gene of super-sweet (bt_1, in this case), as a result sugar content is accumulated and lasts with less starch accumulation for long time, maybe for 5-6 days.

C. This character produces not only excellent quality of its sweetness and softness, but also convenient to the handling of products, that is, makes a few days of flexibility on the

harvesting time, it doesn't matter missing in time harvest for a few days on the quality, but also after harvest its superior quality can be maintained for a few days in the market. Absolutely different to former local flint corn.

D. The above capacity of super-sweet corn widens remarkably the possibility of marketing of fresh corn, that is, with this corn a long distant shipping to the consuming market, for example, one day for transportation becomes possible which cannot be realized with former varieties. That is, it gives a big hope of benefit for the farmers living rural areas far from the consuming cities.

E. Moreover, it creates a possibility to set up a corn processing industry just as other countries are now rushed to produce processing sweet corn after this type of corn has been developed in the United States.

F. Since popular American super-sweet corn varieties don't have a downy mildew resistancy, K.U. No. 1 can be said marvelous due to having this resistancy.

G. Moreover, it is convenient for maintenance of this super-sweet character that this character is controlled by only single recessive gene (bt_1), that is, in case of hybridized with foreign variety pollens, the seeds change directly into flint or dent corn type owing to the xenia phenomenon, therefore, the hybridized grains can be easily taken off from the harvested seed by means of hand selection.

1.2 Yard Long Bean and Other Beans

Since the expert had learned that Yard Long bean (tropical type of *Vigna sinensis*) is one of the most important nutritive vegetable in S-E Asia, and Thailand and Philippinese as well as Taiwan are already succeeded in development of its good varieties, moreover, Thailand varieties were popular in Malaysia and Singapore, therefore, at the occasion of collecting Thailand vegetable seeds, he collected also a few varieties of Yard Long bean as well as other beans.

After arrived Bangladesh, the expert noticed that local variety of this bean was growing widely in Bangladesh but this local variety seemed to be somewhat inferior to those varieties in S-E Asian countries in its pod length and quality; that is, Bangladesh Long bean's pod is shorter, thinner flesh and flat shape than the latters. So, the expert operated the trial. However, he found thereafter that BADC has already introduced some of the S-E Asian good varieties of Yard Long bean before he introduced his seeds. Accordingly, the expert thinks that the explanation of variety itself is not so much urgent thing in Bangladesh, therefore, he wants to describe herewith only about physiological findings through his trials.

2. TRIALS ON SUPER SWEET CORN

(1) Materials and Method

(1.1) Times and Places of the Trials

Preliminary Trial:	With local flint corn, at Gulshan Garden, sown on 17-5-78
1st Trial:	at Gulshan Garden, sown on 9-8-78
2nd Trial:	at two Community Centers of CERDI, sown on 8-8-78
3rd Trial:	at BADC-ADE Field, Kashimipur, sown on 15-8-78

4th Trial:	at Gulshan Garden, sown on 25-9-78
5th Trial:	at Vegetable Trial Field of CERD, Joydevpur, sown on 7-10-78
6th Trial:	at Gulshan Garden, sown on 20-12-78

Tested variety in all the trials other than the preliminary trial is aforesaid Super sweet corn K.U. No. 1, DMR and that of the preliminary trial is local flint corn grown at Gulshan Nursery, HDB (Hort. Dev. Board, Min. Agr. For.) which is common variety for eating fresh style having orange round grains with good uniformity. Most common cultivation season of this type corn in suburban of Dacca seemed to be sowing in November and harvesting in March, earlier harvest for fresh use and later harvest for dry grains.

(1.2) Outline of Cultivation Method

A. Common to all the trials, a spot sowing of 2 grains per hill at the spacing of approximately 75 cm between lines and 30 cm between hills. In cases of Gulshan Garden, CERDI field and Community Center's field, 2 lines on the growing bed of 110 cm width with 40 cm ditch. At least 2 lines were settled for one trial considering to make sufficient pollination which condition was confirmed to be sufficient in the preliminary trial.

B. A thinning was done at 2 - 3 leaves stage leaving only one plant per hill. Fertilizer application was more or less similar rate of other vegetables as a basic and some oil cake and urea were put at about 4 weeks after sown when plant height became some 30 cm, with an earthing up at the base of plants at the same time. About 2 months after sown when plant height became some 150-160 cm, another top dressing was operated refering the plant growth, that is, more rate was dressed at the part of inferior growth.

(2) Performance and Discussion

(2.1) Preliminary Trial

A. The germination and plant growth was fairly good without any problem. Two ears were borne per one plant but only one was marketable and another was very small. Harvesting time was 22-28 July, that is, 65 - 70 days after sown.

B. The out-look of the ears was not bad with compactly fulfilled grains and had common taste of fresh flint corn, that is, estable solidness but not so sweet as sweet corn, which was eatable only for harvested day and became hardened and not delicious on the next day.

(2.2) Trials Sown in August, Trials at Gulshan, C.C. of CERDI, and Kashimipur

A. With the 1st and 2nd Trials, the number of plants grown was about 30 in two lines due to alloted areas were small, while with the 3rd Trial nearly 2,000 plants were grown in about 400 sq. m. field since this field was used for seed production as well as adaptability test of the variety. The seed germination and early plant growth of all those 3 Trials had been excellent.

B. The plants in the 1st and 3rd Trials grew up very smoothly and plant height become about 2 m with dark green sound leaves and canes, of course, no branching sucker, no downy mildew and other diseases even though grown in dense rainy season but it infected rather severely by aphids around at the earning time, maybe owing to high sugar contents of leaves and stems

like the grains do. Therefore, single special notice for cultivation of this super-sweet corn can be said a good management of spraying for the aphid, maybe, a few times from plant height comes up about 150 cm.

C. With the 2nd Trial, the plant growth became poor at late period due to less fertilizer and irrigation water supplies being its height only about 100 cm and plant colour turned yellowish green showing delayed and almost no productivity. This shows that cultivation method of this variety needs formal management being not easy as Kangkong and spring onion which were grown at the same time.

D. The first silking from the ear in the 1st Trial was seen around on 30 - 9 and lasted for about a week, that is, 52-58 days after sown. Reminding a suggestion for harvest time of super-sweet corn in the United States as 21-23 days after silking, the expert harvested the first ears on 21-10 and made an eating test by boiled, salt and butter. It was of course much softer and sweeter than local sweet corn but not so sweet as expected. Then he rushed to come to Kashimipur Field to confirm if this super-sweet corn were not so nice as American super-sweet corn produced in Japan. In the 3rd Trial field, the earliest ears become harvestable age, so harvested a dozen of ears and made another eating test there. The expert was completely relieved with his finding that the quality of ears harvested from Kashimipur field were confirmed as just the same quality of those produced in Japan.

E. The reason why the products in Gulshan Garden were worse was confirmed due to delayed harvest. Since the 3rd Trial was sown one week after the 1st Trial, 21-10 was just the beginning of harvesting time and about 4 - 5 ears out of 12 had been somewhat young being somewhat smaller grain and so soft and juicy as capable eaten raw. The quality of ears harvested at Gulshan Garden seemed to be 3 - 4 days delayed harvest but within the range of acceptable for fresh use; in fact, the 2 ears expert tested were the most matured ones out of 7 and other 5 ears presented to his friends had been informed as excellent as never be expected in Dacca.

F. Eventually, the harvesting time of this super-sweet corn variety in this cropping pattern can be estimated as 70 - 80 days after sown with the diversity of silking time, and as 18 - 20 days after silked.

G. Generally 2 ears were borne per one plant out of which only one ear was marketable sufficiently but another one was usually less marketable. Since the second ears were small but contained sufficiently good grains despite of less number, they can be utilized for self-sufficient seed-production in case of marketing farmers.

H. The ears for seed production were harvested in late November, a few weeks after the fresh ear harvesting time.

(2.3) Trials Sown in 2nd Cyclonic Season, Trials at Gulshan and Joydevpur

A. The plant number of the 4th Trial was about 30 and those of 5th Trial was more than 500 owing to expected seed multiplication. The plant growth was generally good without problems of disease and pests, except 1/3 part of 5th Trial where soil fertility seemed to be worse than other and double rate of 2nd dressing was supplied at that worse place.

B. In the 4th Trial sown on 25-9-78, the first silking was seen around on 28-11 and lasted 2 weeks and harvest examination was done on 29-12-78 but harvesting seemed to be con-

tinued for another two weeks, that is, it can be counted from sowing time 64 - 80 days for silking and 95 - 110 days for harvesting.

C. In the 5th Trial sown on 7-10-78, the first harvesting was done on 30-12-78 but it was still young then a harvest examination was done on 9-1-79. The harvest for seed was done around on 7-2-79, some of the ears contained still somewhat soft grains. Kept in the room, it was found that the grains in about 1/3 number of husked ears became germinate their roots, therefore, at once all the ears were dishusked and dired up.

Table 26 Performance of Super-Sweet Corn in 4th and 5th Trial

	Husked ear			Number of Husk	Dishusked ear				
	Weight (A) (g)	Length (cm)	Diameter (cm)		Weight (B) (g)	B/A	Length (Up to tip) (cm)	Length (Grains) * (cm)	Diameter (cm)
4th Tria, sown on 25-9, examined on 29-12-78, 95 days									
Average of 7	258.6	25.9	5.6	7.5	207.9	0.80	18.4	13.9	4.7
Best ear	320	27	6	8	250	0.78	21	16	5
5th Trial, sown on 7-10, examined on 9-1-79, 94 days									
Average of 4	211.3	21.0	5.4	8.0	181.3	0.86	-	13.3	4.4
Best ear	255	24	5.5	9	215	0.84	-	13	5.5
Another biggest sample	365	27	6	-	-	-	-	-	-

D. As seen in Table 26, size and weight of ears produced in these two trials are fairly good but only the fulfill of grains was generally somewhat less, remaining ungrained part at the tip (See * mark) than previous trials though the products in previous trials were unfortunately not recorded.

E. Maturity of this growing time was about 25 days delayed than previous growing time (95 - 70 = 25), further more, the grains seemed to keep it softness (or maturing) so long time as more than 10 days for individual ear and nearly one months for all the ears growing in whole field with diversity. This phenomenon of tardily ripening of the grains was considered that the sudden dropped down temperature in December checked the ripening as discuss again on plant growth in next Trial. The viviparity seen in the 5 Trial (C) seemed to be also due to the low temperature.

F. The above evidence shows that October seems to be the latest sowing time for this super-sweet corn to be harvested in winter but having some risk for producing insufficient mature grains due to the low temperature. It is convenient, in other hand, to maintain softness for long time means to extend the marketable life of the products.

(2.4) Trial Sown in December at Gulshan

A. In the 6th Trial sown on 20-12-78, the plant growth showed a critical feature, that is, as a whole the plant growth has been retarded very much during December through middle of February keeping the height 40 - 50 cm, moreover, since the direction of rows was N-S, rows were situated closed to south fence and southern part of rows had been somewhat shadowed, the plants growth in the south part was remarkably checked than northern part as seen in the photo, although in the 1st Trial grown at the same place did not show such a critical feature (Plate 36).

B. The plant growth of southern part of rows, regarded as representing this season's trial, became suddenly active from the end of February when the temperature came up rapidly thereafter.

C. Accordingly, it can be concluded that the temperature of coolest period in Dacca, from December through the middle of February is not enough for corn growth although it is not so severe as to kill the plants, just as boro rice does.

D. Silking had been seen in the middle of March, really the photo taken on 11-3-79 shows the first plant was just opening the male inflorescence, and the ears matured around on 6-4-79 with big diversity as a whole. That is, it can be estimated 110-120 days after sown, the longest growing period. The ripenning seemed to be no tardy as in the 4th and 5th Trials but rather rapidly since the temperature came up more than 30°C. The products at this time were somewhat smaller than previous ones but enough marketable, maybe 150-200 g comparing with previous products though they were not measured.

(3) Conclusion

(3.1) General Aspect:

A super-sweet corn K.U. No. 1, DMR is highly recommended for Bangladesh horticulture with its marvellous characteristics of not only its superior quality and downy mildow resistancy but also its flexibility on the harvest and long marketable life.

B. The above mentioned capacity can widen the possibility in corn production in Bangladesh as follows: (i) It can realize a market production of fresh corn not only in suburban areas but also rural areas far distant from consuming cities by shipping. (ii) The products can fulfill the lacking season of vegetable from September to November with July and August sowing. (iii) It can creat a big possibility of sweet corn processing industry both canning and freezing.

(3.2) Prospective Cropping Patterns with Notices

A. Prospective cropping patterns can be designed as seen the Table in Part 1, but the following notice should be kept:

B. Since the low temperature from December through the middle of February is not enough for the growth of plant and ripenning of seeds; (i) maturity may be much delayed with a wide range of diversity in case of maturity fallen into December to February, (ii) in this case, if seed production is designed, it has a risk of producing insufficiently fulfilled grains and result in a kind of viviparous germination of the seeds. (iii) Plant growth of sowing December may be much delayed and practically the result may not be so much different to being sown in February. (iv) In the early sowing during dense rainy season, the control management for aphids should be done exactly from mid-growing period to mid-ripening period. Since the husks of ears of this variety are long enough covering the ear up to 2-3 cm above the tip, it has less suffering from ear-borers.

(3.3) Problem on the Flower Induction

Inasmuch as maize (*Zea mays*) belongs to short day plant, it is considered that

this variety bred in Thailand may have so deep photosensitivity for short day condition as this habit had been realized in Thailand cultivars of yards long been and soy bean as discussed in the next subject. If this variety has the same habit, it cannot be grown in the sowing from March up to the end of June or under long-day condition, continuing only vegetative growth, and grow up some 3-4 m height without appearance of ear up to the end of August or the beginning of September. Accordingly, the expert urgently recommend to make an experimentation to confirm this habit.

(3.4) Seed Production

A. This variety can produce its seeds rather easily in Bangladesh as shown in the Table in Part 1. Notice on the seed production is: (i) To be isolated from other variety field at least more than 2,000 m in case of big acreage of other maize are cultivated at the neighbourhood. (ii) Plan more than 0.5 - 1 acre of seed production field and better to omit gathering seeds from margine plants which have much risk to receive foreign pollens. (iii) In case of seeds spoiled by foreign pollen, the hybridized seeds becomes the shape of flint or dent corn by xenia phonomenon, therefore, it can be easily taken off from the bulk of seeds by hand selection.

B. In case of marketing farmer's field, a self-supporting seeds can be produced utilizing the second ears. In this case, however, it is of course better to renew the original seeds from the trustable resources at least once in a few generation.

(3.5) Remarks

Since this super-sweet corn is considered certainly and rapidly to be extended in Bangladesh horticulture but this variety was really bred at Corn and Sorghum Research Institute of Kasetsart University, Thailand. The expert hopes, therefore, when its cultivation is settled in Bangladesh, the Authorities of Bangladesh Government would deliver its official thanks to Mr. Tavat LAVAPANYA, Professor of Department of Horticulture, Kasetsart University for the benefit of Super-Sweet Corn, K.U. No. 1, DMR as well as Chinese Radish K.U. No. 1. At the same time, he recommends also that the foundation seeds of both varieties should be regularly received from the University in order to maintain their purity in the local seed production.

3. FACT FINDINGS ON YARD LONG BEAN AND SOYBEAN

(1) Outline of the Trials

A. Two Thailand cultivars of yard long bean, 65. white spot and 66. red seeded (both names were characters of seed color), were tested three times; the first time, sown on 20-10-77 and grown until March, 78; the 2nd time, sown on 10 (supplemental sowing on 19)-3-78 and grown until the end of August; and the 3rd time, sown on 25-9-78 and kept growing until the end of March. The cultivation method was, common to all three trials, spot sowing 30 cm apart in two lines 70 cm apart and bamboo supported. Only in the second Trial, a supplemental sowing was done for 66. at the spots missing the germination.

B. One Thaialnd cultivar of soybean was tested two times which sowing times were the same dates as the first and second trials of yard long bean. Spacing was 60 x 25 cm spot sowing but no supporting. Seed of the second trial was the harvested seed of first trial.

(2) Observation and Discussion on the Trials

(2.1) Plant Growth in Autumn Sowing Cultures

A. In the first trial, the growth of yard long bean as well as soy bean was very smooth, flowered and fruited normally. Since the expert was absent from November to January, the observation could not make sufficiently but soybean was harvested the dry seed in December and yard long bean was continued harvest up to the beginning of March; much different could not be found between the two cultivars.

B. In the 3rd Trial of yard long bean, the germination and plant growth were generally fairly good but the following points were observed: (i) The growth of pods were rather checked during the middle of December through January producing short pods tardily but by means of enough furrow irrigation the worse growth was improved some extent, (ii) The growth was recovered after the end of February but some infection of virus was seen. The virus seemed to be spread also by seeds.

(2.2) Disorder of Flower Formation in March Sown Culture

A. The biggest fact finding in this series of trials was that the growth of yard long bean and soy bean were extraordinarily continuing their vegetive growth without flower appearance.

a. About the soybean, the plant height became 120 - 130 cm spreading vines on the top of plants as shown in the photo, being contrastive with less than 60 cm of plant height without any vine appearance in the first trial. Therefore, this trial was stoped at the end of May (Plate 36-C).

b. About the yard long bean, the vegetative growth was continued up to the end of July, and very few pods were seen in August but vegetative growth was still predominant, therefore, the trial was stoped at the end of August.

B. A few examples of the same phenomenon have been observed by the expert in the past:

a. The first experience was about 40 years ago. An extra-early cultivar of soybean of Wuchang, Central China (about 30°30'N) which he confirmed very short stemed earliest type of fresh pod soybean sowing at early April there, when he sowed this cultivar at early May at Kizaki, Gunma-ken, Japan (about 36°30'N), it showed the same as the above, tall plant emerging vine and no flowered.

b. Several years later, he observed a few times on cow pea, the same species of yard long bean but bushy plant: the cultivars got from Cerebes and Philippines showed tall plants with vines and no or very retarded flowering when they were grown in Gunma-ken and Kanagawa-ken, Japan (36°30'-35°30N) sowing in May.

c. Recently he confirmed also the same phenomenon on a few cultivars of maize, that is, with a few cultivars from Guatemala (around 15°N) and Philippines (Manila at 15°N), which have normal height of about 160-180 cm, in home places when they were grown sowing in May in Ibaraki-ken (36°30'N), the plant height became nearly 3 meters and ear emergence was very much delayed until the end of Agusust.

d. That is the reason why tropical type varieties of cow pea and maize become fodder plant varieties in the United States and Japan growing abundant of foliage with less fruits.

e. The expert has many other observation of similar retarded flowering up to the end of August or September on low latitude varieties of some cucurbitaceous plants such as Lufa, Gurkin (*cucumis auguria*), Wax ground (*Benincasa hispida*) etc. when cultivated in Japan by spring sowing.

(3) Discussion and Conclusion

A. All the above mentioned phenomena are regarded as caused by strong short day sensitivity of the varieties in question since all the above mentioned species belong to short day plant. When a short day sensitive cultivar originated in low latitudal area is cultivated in high latitudal place in summer or under long-day length condition, the flower induction cannot take place until the shorter day condition as its home-place comes; that is, because of the higher the latitude is, the longer the day length condition becomes. General speaking, with this type of plant species, the tropical or subtropical varieties become very late flowering or non-flowering type in the higher latitudal places just opposed phenomenon of low-temperature and long-day plants such as brassicas and radish that their temperate zone origin varieties cannot or hardly produce seeds in tropical and subtropical areas.

B. The observed phenomena on yard long bean and soybean in (2.2)-A is the same as explained in (2.2)-B; that is, Dacca is situated around at 24°N but Bangkok situated around at 14°N; that is, the day-length of Dacca is much longer than Bangkok.

C. Accordingly, those yard long bean and soybean sown in March showed no flowering until the middle of August until effective short day condition came, while they showed normal growth and fruiting by sowing in September and October because of growing under complete short day effective condition.

D. The reason why local cultivar of long bean can be fruitfully grown by March sowing is due to belonging to the type of less sensitivity for short-day. All the Japanese varieties of long bean, soy bean, Lufa etc. have less sensitivity than those of low latitude origin varieties do, just comparable to tropical brassica and radish can easily produce their seeds in tropical and subtropical places.

E. Eventually, the cropping patterns of yard long bean and local long bean are designed as seen in the Table of Part 1.

F. The discussion made with Thailand super-sweet corn is just based on the above mentioned genecological aspect from the behavious of yard long bean.

CHAPTER 11 SOME OBSERVATION AND DISCUSSION ON FRUIT VEGETABLE TRIALS

A few times of trials on the introduced seeds of tomato, cucumber and other gourds from S-E Asia and Japan have been carried out parallelling to aforementioned trials, however, the expert could not yet reached to his confident idea to extend them into Bangladesh horticulture because he found some problems on each improved variety on their cultivation in Bangladesh; that is, it needs some extent of further research works in order to solve respective problems. Accoringly, the expert wants this time simply to point out and discuss the problems in their cultivation in Bangladesh.

1. ON THE DAMAGE BY VIRUS INFECTION

1.1 General Observation

A. At the early stage of his work in Bangladesh, in May and June, 1977, the expert made several observation trips for vegetable production and research works visiting at some institutes and farmers fields in suburban areas of Dacca, Comilla, Ishurdi, Rajshahi etc. The most impressional events of observation in this series of trips were (i) Almost all the plants of okra cultivated here and there had clearly yellow chlorosis on the top leaves which were regarded as virus infection, (ii) All the tomato and chili pepper fields had been terribly damaged by disease, most of the plants were died or dying with dried blackish brown foliage and even about the living green plants, in most case about 20% of whole planted, their leaves were not sound with small, curled, and mosaic chlorosis (Plate 37).

B. The expert saw similar damage on tomato culture during his stay in Egypt, 1965-67, which was regarded as virus infection. Therefore, the expert attached a suspicion of virus infection on the above mentioned phenomena. Such a severe damage from virus infection is never seen on tomato fields in Japan. Therefore, during his stay in Egypt, the expert was used to tell them that those severe infection or damage of virus should be understood that it is not simply caused by infection of some sorts of virus but the damage is developed with some synchronized physiological disorders, otherwise, the damage of simple virus infection of tomato would stop at only 20-30% of yield reduction but never kill the plants themselves as seen in Japan. This suspicion has been always held in his heart and again the expert suddenly met the similar phenomenon in Bangladesh, it was doramatic for him.

1.2 Virus Observation in Tomato on the Trial

(1) On the Tomato Trial Started in Dense Rainy Season

(1.1) Materials and Method (First Trial)

A. Varieties tested: 11. Plum from Thailand, small oblong yellow fruit, and 41. Tropic Ace from Taiwan,medium sized oval red fruit, both were recognized as heat resistant because growing August and September in Thailand and Taiwan.

B. Outline of Cultivation: Sown in the seed box 31-7-77, Transplanted in the open field nursery bed on 14-8, and Set in the growing bed on 6-9, in two lines of 60 cm apart and 30 cm between plants, supported with split bamboo cane on 30-9-77.

(1.2) General Growth Progress and Appearance of Virus

A. The seedings were grown very smoothly and completely sound in out-sppearance without any simptom of virus, being grown up to about 7 true leaves stage which seemed to be somewhat over-grown for setting.

B. After transplanted, the plants settled in the growing bed very smoothly without any checking of growth and no problem was seen on the plant growth at the first step by around on 20-9.

C. At the end of September when the bamboo support was going to set up, some symptom of mosaic chlorosis was seen on the top leaves of about 30% of the plants. About 10 percent of plants showed some necrosis on the top faliage and wilting, that is, some plants were wholly wilted and some other plants showed partial wilting. Therefore, at the time of setting support on 30-9, about 20% of heavy infected plants were taken off from the field. There was no varietal difference, that is, the damage seemed to be completely beyond of varietal difference.

D. At that time, sound plants showed young fruits set on the first clusters and mid-flowering on the second clusters.

E. After entered in October, when the weather become fine and hot, the disease suddenly developed spreading heavy necrosis on whole plant bodies, so quickly as more than 50% of plants were killed within a two weeks.

F. On 13-10, another expert who handled tomato virus for long time fortunately came to his home, therefore, the expert could confirm him that this disease could be recognized as a sort of virus. Taking the photo on 18-10 and stopped the trial then (Plate 37-B).

G. Although a general discussion is described together with cucumber, but the expert points out here particulars on this trials as follows: (i) He cannot clear where the virus came from, only point out the possibility is infected from cucumber discussed in the next column. (ii) The infection and spread of virus in this case is quite different from common sense in Japan, that is, the severe damage of virus is usually appeared when the tomato plants have been infected at young stage or appearing the symptom in the nursery bed, and in case of infected in the field or after grown up like this case, the damage of virus is not developed so severely, that is, only showing 10-20% of yield reduction. Therefore, this case can be said extra-ordinary. Although this trial was failed as a whole but the above mentioned virus observation can be said one of the great fact findings in the expert's work in Bangladesh.

(2) On the Tomato Trials in Dry Season

(2.1) Materials and Method (Second and Third Trials)

A. Varieties tested: 11. Plum and 41. Tropic Ace in the 2nd Trial, 11. Plum, 41. Tropic Ace and 124. Pink (Sakata Seed Co.) in the 3rd Trial.

B. Outline of Cultivation: The process and design of cultivation were almost the same as the 1st Trial. Planting programmes were carried out as follows:

2nd Trial: Sown in open seed bed on 17-10-77, Transplanted in the nursery bed on

30-10, Set in the growing bed at the beginning of 12-77 and kept growing in the field until on 7-4-78.

3rd Trial: Sown in open field inserted lines between radish on 30-10-78, Transplanted in the nursery bed on 20-11, Set in the growing bed on 15-12-78, and kept growing in the field until the end of March, 1979.

(2.2) General Progress and Observation in the Field

A. About the 2nd Trial, when the expert came back from Japan on 3-2-78, the tomato plants were growing very soundly without infection of disease; the plant height of Plum was about 2 m bearing 4 clusters of fruits, that is, indeterminate type and Tropic Ace was about 1.5 m but branching and bearing also 3-4 clusters of fruits, that is, determinate types. Fruits were harvested as mid-season in February and graduary lessened up to middle of March when the temperature came up rapidly and the plants seemed to be tired. The plants died one by one from the middle of March and majority was exhausted by the beginning of April when finish the culture on 7-4-78.

B. The damage or exhaust of plant seemed to be firstly affected by high temperature, secondly a kind of physiological disorder and thirdly by diseases.

C. About the 3rd Trial, the progress of plant growth is more or less the same as the 2nd Trial. At this time, Japanese variety of Pink, large globe shape pink fruit and indeterminate type, also had grown up similar rate as other varieties.

D. The fruits became adult size at middle of January but did not ripen coloured until February when temperature became warm. The low temperature of January was not enough tomato fruits to be ripened but enough for the plant growth soundly. Variety pink seemed to be somewhat later than other two in fruit ripening.

E. In this year, since the irrigation management had been better than last year, the harvesting could continued almost fully up to the middle of March but thereafter the same deterioration on plant growth was seen as last year, however, no remarkable varietal difference was seen among the three varieties.

(3) Comparison between Two Types of Trials and Conclusion for Tomato Cultivation in Bangladesh

Comparing the above two types of Trials, their growing patterns are just contrastive, that is, the former can be said impossible as discussed the below while the latter seems to be the best growing time. There would be no definite varietal difference in case of culture in dry season. If some difference is found, it would be but a question of how far extent the variety can continue its harvest but it would be still 1 or 2 weeks problem. Accordingly the cropping pattern is designed as shown in the Table of Part 1.

1.3 Virus Observation in Cucumber on the Trial

(1) On the Cucumber Trial Started in Dense Rainy Season

(1.1) Materials and Method

A. Varieties Tested:

Thailand varieties:	18. Local Early, 19. Local Hybrid; both short cylindrical small.
Taiwanese varieties:	46. New Market No. 1, 47. do. No. 2, 48. do. No. 3; long cylindrical.
Japanese variety:	49. Chojitsu-Ochiai No. 2, slender long fruit.

B. Outline of Cultivation: Sown in the seed box on 31-7-78, Transplanted in the open field nursery bed on 5-8, Set in the growing bed spacing at 60 x 25 cm on 20-8, Set up bamboo support on 14-9, it seemed to be delayed for about one week since the plant height became already to 30-40 cm.

(1.2) General Progres of the Growth

A. The seed germination was generally good except 46, growing in the nursery bed was fairly good. Although transplanting time was somewhat delayed, the plant set in the field was fairly good without checking plant growth.

B. Characteristics of the varieties are: (i) 49. Chojitsu-Ochiai was complete main stem fruiting type, or almost no branching, early and the fruits were harvested from around 15-9; 3 varieties of New Market (46, 47, 48) were semi-branching type, and two varieties of Thailand were complete branching type which develops many branch vines with less fruiting and suited more to spreading culture than to supporting culture.

(1.3) Appearance and Spread of Virus Disease

A. The order of rows of the varieties was (18, 19); (46, 47); (48, 49), that is, one row per one variety and two raws were paired in a support set arranged in the above order. Only a part of the row of 18 were planted with 49.

B. The first sign of the symptom of virus appeared on 48 at several days after plant set, which seemed to be a seed borne because no other significant resources of virus could be considered since the trial field was newly reclamated land from a lawn. At first a little mosaic chlorosis was found on the leaves of a few plants of the variety 48 but it was spread very quickly for other plants and developing severer on the original palnts.

C. The virus development on a plant was as follows: (i) At first a few yellowish chlorosis mosaic appeared on the leaves but quickly widened the area, (ii) the infected part turned brown and died drying (necrosis) and this part soon spread in whole leaf and died drying up completely. (iii) At that stage, the same development of necrosis appeared on the upper part of stem then whole upper part died. (iv) Spreading stem necrosis down to lower part, eventually whole plant died. (v) All the above process was developed so quickly as within 10 days or one week. (vi) The infection spread a plant to another at stage (ii).

D. Started this virus infection from the variety 48, it was spread in an instant to all New Market varieties, 47 and 46. On the variety 49 neighboured to 48, the virus infection was spread appearing chlorosis on many leaves around on 15-9 and it was developed into all the plants so quickly and severely as getting upper stem necrosis as seen the photo taken on 19-9. But the plants of the same variety in neighbouring raw of 18 had been rather sound by 19-9,

although they were also infected virus later on.

Majority of the plants in the former raw died as of 29 - 9 as well as those of 46, 47 and 48 as seen in the Photos taken on the date (Plate 37-C and D).

E. As to the Thailand varieties of 18 and 19, almost no clear sympton of chlorosis was yet seen on their leaves as of 19 - 9, even on 28 - 9, all the plants of those two varieties were rather safety growing, continuing to produce their fruits. Although some simptom of disease was seen, the simptom were seen rather on the lower leaves, contrasted with the virus infection had appeared from upper part on other varieties, moreover, the symptom was looked like that of downy mildew (*Pseudoperonospora cubensis*) rather than virus chlorosis.

(2) Discussion on the Particulars in Culcumber Virus

A. In cucumber, the virus invasion showed rather clear varietal difference that the varieties 46, 47, 48 and 49 were susceptible being the most susceptible with 49 counting the spead of virus development, although the first sign was appeared in 48. The varieties 18 and 19 can be said resistant.

B. The spread of virus is supposed to be spread by a contact transmission by hands or plants themselves since the 49 plants standed distant to 48 got spreading remarkably later than those of neighbouring to 48, and also since no aphid was seen in the field.

C. The susceptibility seemed to be parallelled to the balance of fruit set and foliage growth, that is, the most susceptible of 49 seemed to be caused by its habit main stem fruiting that many fruits bear on the plant having less number of leaves. On the contrary, 18 and 19 grew vigorus foliage with many branches but less number of fruits, tremendous difference was seen in number of leaves per one fruit between 49 and 18, 19.

(3) Some Observations on the Dry Season Growing Cucumber

A. A trial of cucumber was carried out using 4 Japanese F_1-hybrid varieties of Natsu-fushinari and Suyoo types and one Thailand variety of 19, sowing on the banana leaf pots at the end of October, 1978, set in the growing bed 10 days after, in the vegetable trial field of CERDI.

B. No severe invasion of virus disease as the previous trial was seen in this trial although the plant growth was not always satisfactory especially with Japanese varieties.

C. Japanese varieties did not show their productivities like in Japan. It seemed to be caused by far less fertilizer supply especially the rate of matured compost than Japan and also by less air humidity in dry season. In present Japan, cucumber is generally cultivated in the plastic house in which air has high humidity and abundant of matured compost is supplied, and most of Japanese cucumber varieties have been bred under such condition. Therefore, Japanese varieties are delicate for less fertility and less air-moisture and difficult to realize their good capacity of produce abundant of good quality fruits under dry condition.

1.4 Combined Discussion on Virus in Tomato and Cucumber

(1) General Aspect

As mentioned in the above respective columns, the virus invasion seen in both tomato and cucumber trials in September and October seemed to be unusual case which can be never seen in Japanese condition and supposed to be a combination damage of virus with some physiological disorder.

(2) On the Transmission Insect

A. With a hypothesis of virus is transmitted by aphid, this case cannot be understood since no aphid appeared in those day from July to October not only on tomato and cucumber but also all the plants grown in the field.

B. Since the appearance time of abundant aphids especially that of winged aphid in Bangladesh is recognized from December to February, the virus infection on tomato and cucumber should be in dry season if aphid is in fact transmitting their virus, however, the facts observed this time were diametrically opposed.

C. In Egypt, there are an established theory that tomato viruses are transmitted by an insect called white fly, one of the kinds of plant hopper, just as Rice stripe virus is transmitted by small brown plant hopper (*Laodeephax striatellus*) in Japan.

D. The expert has once realized in May that a small white winged insect supposed to be a kind of white fly are lying hidden in the grasses near by the field and with a brushing over the grasses by hands, numerous of this white fly are flying off from the grasses. Thereafter, he is throwing a suspicion on this insect that it might spread virus to tomato, okra, cucumber etc. in Bangladesh as white fly does on tomato in Egypt because the climate of April and May in Bangladesh, if the cyclonic rain times are omitted, is rather similar to that of Egypt; that is, terrible hot and drying and the invasion feature of virus on tomato in Bangladesh is rather similar to that of Egypt.

E. Accordingly, the expert would like to request Bangladesh entomologists or virologists to confirm this point whether the insect in question is really spread transmitting virus or not.

(3) On the Hypothized Physiological Disorder

A. As mentioned here and there in the Chapters of Radish, Cabbage, Cauliflower etc., the 1st Cyclonic Season of April to June involves the problem of physiological disorder in those vegetable crops culture. Perhaps, it could be a born deficiency and supposed to be caused by alternative appearance of heavy wetting or saturation of soil and subsequent severe drying up of soil with tremendous hot temperature and sunshine, that is, a diametrical change of soil water concentration.

B. When rain comes and water content of soil comes up, the concentration of water in the soil becomes therefore dilute and the plant growth becomes accordingly active developing new cells or tissues. While, when the soil is dried up, the concentration of soil water become concentrated under such condition, an antagonism among elemental ions takes place and the more the soil water concentrated, the weak ions such as boron, magnesium, calcium, iron etc. become inactive or precipitated from the order of weaker ion. As the result the inactivated element can not be absorved by plant root, that is the mechanism of minor element difficiency or a physiological disorder.

C. Since the physiological disorder appeared on the radish mentioned before showed a typical symptom of born deficiency, the similar physioloigcal disorder of necrosis appeared on the pith of stem in other crops can be also regarded as born deficiency.

D. Since actively development tissue is more sensitive for deficiency, the foresaid condition of diametrical change of soil water concentration is certainly accelerating the appearance of such physiological disorder. The expert has 2 - 3 examples of calcium deficiency of cabbage, Chinese cabbage as well as celery which appeared on the soil having rather rich content of calcium in Shizuoka-ken and those calcium deficiencies were of course experimentally proved using even calcium isotope in those days around in 1960. Therefore, there is some possibility that even calcium deficiency may happen in some crops in the two Cyclonic Seasons in Bangladesh. Calcium and born deficiencies are typical physiological disorders which happens on the actively developing tissues of various plants always connecting with necrosis of the tissues.

E. As mentioned in 1.4-(1) and elsewhere, since the damage of virus on tomato and cucumber, perhaps also another plants are considered as extraordinarily severe, it may be caused by combinating damage of virus with physiological disorder, that is, the latter is accelerating the invasion and damage of virus.

F. The sudden development of virus invasion on the tomato and cucumber in the 1st trial can be understood as follows:

(i) The seedlings were apparently sound, to say enjoying low concentration of soil water, but maybe somewhat infirmly grown being juicy under moisty air and high night temperature condition in the August.

(ii) After set in the field, the weather changed into 2nd cyclonic weather with sudden dryness from the end of September and the plants got a physiological disorder, most probably a born deficiency in the pith of stem.

(iii) This unbalanced physiological condition accelerated the invasion and development of virus up to such severeness as foresaid.

(iv) If the plants were completely physiologically sound, the virus necrosis would not develop so severely on the stem as killing upper part or whole plant, and even if necrosis happened it would be limitted on the leaf vein or only on the stem tip as seen in Japan.

(4) **Conclusion**

A. The above mentioned hypotheses are a whole idea of the expert. He would like to suggest here that, in order to solve the problem of virous in Bangladesh, simple research works on virus disease, for example, (i) identification of virus race, (ii) identification of transmitting insect, and (iii) their controlling method, are not enough but should be combined with research works on the physiological disorder such as (i) identification of deficient element, (ii) deficient mechanism measuring the change of soil solution concentration, and (iii) comparison of metabolic and catabolic balances under dense rainy season and cyclonic season conditions.

B. It cannot be solved by merely searching for resistant varieties and improvement of cultivation method because those virus damage may be a problem beyond on variety. Before a result of the above mentioned systematic research works is obtained, it would be better to limit

tomato production only dry season when most of varieties can be safely grown.

2. SOME OBSERVATION AND DISCUSSION ON FRUIT BORER, STEM BORER AND SOME OTHER PROBLEMS

2.1 General Observation

The most troublesome insect in fruit vegetable culture in Bangladesh seemed to be the fruit borer on brinjal, tomato and various gourds as well as stem borer on brinjal.

(1) Vicissitude of Main Insects Appearance in Dacca

General vicissitudes of main injurious insects of vegetable crops in a year around in Dacca was observed impressively as follows:

A. Most of them have a symbolic appearance according to the change of diametrical difference of weathers in the dense rainy, cyolonic, and dry seasons.

B. Most of lepidopterous insects appear almost none during the dense rainy season which seemed to that their adult emergence cannot complete smoothly owing to the extra-ordinarily high humidity, therefore, they cannot emerge during this time.

C. Those insects, most of leaf worms, appear when a fine weather continue a week or 10 days after it enters into cyclonic season.

D. Aphids appears and spread suddenly during dry season with the appearance of winged aphid in December and January while almost no aphid appears during dense rainy season as well as in the two cyclonic seasons, except the aphid on super sweet corn.

(2) Special Appearance of Fruit Borer and Stem Borer

Nevertheless the above mentioned, the said fruit borers and stem borers appear almost evenly in whole year. The expert regrets that he cannot identify the species and characters of those insects because he is not an entomology specialist but it seemed to him they cannot be easily controlled, therefore, it would be an urgent problem to set up an effective control method for them. The fruit borer seemed to be different from popular moth-warms because it appears even in dense rainy season and the invading character of the stem borer is very similar to those of chrysanthemum longicorn beetle (*Phytoria rufiventis,* or Kikusui) on compositaeous plants and rose stem sawfly (*Syrista similis* or Bara Kukibachi) on roses which are very difficult insect to be controlled in Japan.

2.2 Observation on Brinjal (Egg Plant)

(1) Outline of the Trials

The varieties tested and their cultivation schedule were as follows:

A. 1st Trial: 42. Pingtung Long (Taiwan): Sown in the seed box on 31-7-77, Transplanted in the nursery bed on 16-8, Set in the growing bed on 17-9-77, and kept growing in the bed until on 29-4-78.

B. 2nd Trial: 42. Pingtung and 87. Chunaga (Japan): Sown in the open seed bed on 17-10-77, Transplanted in the nursery bed on 4-11, Set in the growing bed around on 10-12-77, and kept growing in the bed until on 29-4-78 for 87 and until on 20-5-78 for 42.

C. 3rd Trial: 42. Pingtung: Sown in the seed pot on 12-5-78, Transplanted in the nursery bed on 25-5, Set in the growing bed on 24-6-78, and kept growing in the field until the middle of April, 1979.

D. 4th Trial: 4 varieties of 42. Pingtung, 122. Large Fruited No. 25, 123. Large Fruited No. 29 and 144. Shinkisshin (latter 3 are Sakata Seed Co.): Sown on in the seed pot on 26-8-78, Transplanted in the nursery bed on 4-9, Set in the growing bed on 20-10-78 and kept growing in the field until the middle of April, 1979.

(2) Progress of Growth

(2.1) In Rainy Season Culture:

A. Differed from Tomato, Taiwanese Pingtung Long bringal sown on 31-7 and on 12-5 had grow up rather smoothly getting no suffering from virus disease, as well as Thailand varieties which were not described here due to being grown so few number of plants as 5 or 6. Those varieties can be said belong to a tropical type. Pingtung Long had a plant habit of longstanding upright with green coloured leaf and stem but its fruits were characterized long shaped but purple and thin soft skin like Japanese long egg plant.

B. It have withstood well under the severe hot temperature of April and May in adult plant stage in the 1st and 2nd Trial, and under September and October condition in the 3rd Trial. Therefore, it was proved to be grown for all year round in Bangladesh but in fact its aged branches had been cut and regenerated from time to time about once in a few months. No clear simptom of virus appeared on the leaves like local bringal of Bangladesh.

(2.2) In Dry Season Culture:

A. In the trials sown in October as well as the end of August (the 2nd and 4th Trials), the plant growth could be said generally smooth.

B. In the 2nd Trials, almost no problem happened except fruit borer by the middle of March. After the end of March when the temperature suddenly went up severely hot, Japanese Chunaga variety was suddenly got tired, majority of the plants got partial wilting of branches, some of them died, and its fruits became lost glossiness as if withered and non-esculent, therefore, stop the culture at the middle of April, a few after tomato did.

C. While Pingtung withstood fairly under this condition and the most of plants continued its fruit production until the end of May when the field was forced to change for other cropping.

D. As to the 4th Trial, the condition was somewhat particular. After the plants set in the field, may wilting plants appeared almost commonly to all the varieties, somewhat more with 144 and somewhat less with 41. Meanwhile, with the earliest variety of kisshin started harvest around on 20-10, then started harvest with Pingtung about a week later and with Large fruited 122 and 123 around on 15-12.

E. All the varieties produced their fruit with rather good productivity on the alive plants as far as good furrow irrigation was operated until the beginning of March, 1979.

F. The exhaust of plants started firstly with Shin Kisshin from the beginning of March, secondly with Large fruited 122 and 123 from the middle of March; those Japanese varieties seemed to be suceptible to severe hot temperature in Bangladesh while Pingtung again were withstanding under the condition up to the middle of April when the expert left Dacca.

(2.3) Observation Stem Borer and Fruit Borer

A. The plants of Pingtung Long brinjar got much trouble from the stem borer. When the plant grew up some 1 m height, the young shoots of the branches suffered for wilting from oviposition of insect. By examination of the wilted shoots, a worm was found in the pith of stem just like chrisanthemum and rose plants suffered for the same phenomena from their longicorn or sawfly in Japan. When it appeared much, the fruiting was therefore stopped or even stopped the growth of whole plant.

B. The appearance of stem borer seemed to be all year round but somewhat more during 1st and 2nd cyclonic seasons and somewhat less in the dry season, although it was not precisely traced.

C. About the fruit borer, when the fruit was invaded with this borer, the shape became irregular with a hole about 1 - 2 mm, sometimes more than one hole, and a few worms were found inside of flesh, rotting the flesh of the fruits and non-esculent. The appearance seemed, as for brinjal, to be much during December through February, while it was found also during two cyclonic season invading on the fruits of Pingtung Long. With Pingtung Long, the invasions seemed to be more on the fruits situated upper part and outerside of the plants.

D. In the 4th Trial, it was observed that Shin Kisshin was attacked severest, that is, all most all the fruits harvested in January were invaded. The next was Large Fruited No. 25, purple calyxed roundish black fruit, and Large Fruited No. 29, green calyxed oblong black fruit, and Pingtung Long were somewhat less.

E. From the above observation, it was considered as: The thinner and softer the skin is, the more the invasion becomes, since the above order is just the order of thinner or soft to thick or hard. May be, some of the Bangladesh local varieties having a thick and hard skin would be resistant to this borer. Therefore, it can be said most of improved varieties are susceptible to this borer.

(2.4) Observation on Diseases

A. About the wilting appeared in the 4th Trial: It would be more common to consider it to be a soil borne disease such as bacterial wilt or Fusarium wilt because the said field was the second year of cropped many kinds of vegetables and supplying much amount of unknown resources cowdung. However, there was still some suspicion of foresaid physiological disorder on accelerating the damage by the above mentioned soil borne disease since the wilted dying was violently appeared from the end of October through November and declined in December to January and became violent again from the beginning of March.

B. In fact, some extent of virous simptons were recognized on the leaves of Japanese

egg-plant although it was not so severe as lethal on tomato, but really checked the growth. The simptom was that the leaves got shrinked and slight mosaic, which can be hardly seen in Japan. It was appeared remarkably on Shin-Kisshin and Chunaga which are most popular type varieties in Japan.

C. Refering the facts of susceptible to fruit borer and virus, the expert cannot recommend popular Japanese egg plant varieties in Bangladesh although they produce excellent quality fruits.

2.3 Observation of Fruit Borer Damage on Gourds

The damage of fruit borer was seen everywhere on various cucurbitaceous vegetables as follows:

A. Severe damage was seen on the Thailand improved variety of bitter gourd (*Momordia charantia*) at the end of September on the plants sown on 31-7-77 and from the beginning of July through the beginning of August on the plants sown on 18-5-78. In the latter case almost all the fruits bearing were invaded and those fruits were turn yellow outside and rotted inside in young stage producing almost no marketable matured fruits.

B. More than 50% of cucumber fruits of Chojitsu Ochiai and New Market No. 2 sown on 31-7-77 were invaded by this worm, making irregularly curved short fruits and no marketable.

C. The similar fruit borer damage was seen in June, 1978 on the improved extra-long fruited variety of ribbed gourd (*Lufa acutangula*) at Gurshan Nursery of HDB. The officer in charge said that fruits of that variety were badly invaded, majority of fruits had been accordingly rotted and no seed could be produced owing to no matured fruit, nevertheless local variety were not so much invaded.

2.4 General Discussion and Conclusion

(1) Susceptibility of Improved Varieties to the Borers

A. In fact, all those introduced improved varieties had been strongly anticipated on the excellent quality of their fruits comparing with the poor quality of local varieties, that is:

a. Thailand bitter gourd was anticipated on its stout cylindrical fruit having very thick juicy flesh with very less bitterness, that is, very delicious with every cooking method

b. Thailand extra-long ribbed gourd was also anticipated on its slender long fruit with fibreless tender and juicy flesh.

c. Japanese and Taiwanese brinjals have also tender and thin skin with solid inside flesh.

(2) Discussion on the Hardiness of Fruit Skin for the Resistancy

Common to all the above improved varieties, their skins are tender and thin which is the particular character for delicious of eating, however, this particular character seemed to make susceptible for the borers. Therefore, the expert cannot imprudently recommend those varieties

to Bangladesh farmers.

C. On the contrary, common to all the local varieties of bringal and those gourds, they may have a resistancy to those borers but they have thick and tough skin with poor quality, in the other words, those poor quality local varieties have been remainded in Bangladesh owing to their resistancy to those borers. This is the biggest pitty of Bangladesh people.

(3) Conclusion

A. As the conclusion of the above, the expert would like urgently to make a systematic research to set up an effective control method of those fruit and stem borers, otherwise, Bangladesh people cannot enjoy delicious fruit of those improved varieties.

B. Only a single way for the control of fruit borer which the expert can recommended at this moment is a baging method which is popularized in Thailand, and which was already practiced by Mr. Tazaki at Kashimipur Field on the foresaid long ribbed gourd in 1977. That is, the fruits are covered by paper bags at the very young stage before the borer adut deposits eggs on the fruit. This manner can be recommended temporary in ribbed gourd, bitter gourd, large fruited egg plant, until the better controlling method is developed.

ANNEX I. SOME DATA AND DISCUSSION ON SEED PRODUCTION OF CRUCIFEROUS VEGETABLES

1. INTRODUCTION

The expert is planning to write detailed techniques of seed production about the said tropical varieties of each vegetable in another paper, therefore, he wants to describe here only some data taken from the practical seed production fields and short discussion for references on the cropping patterns of seed production designed in places of every capable vegetable in the Tables of Part 1.

Table 27. Yield of Various S-E Asian Vegetable Seeds Produced in Bangladesh

Kind and Variety	Produced at	Actual data			Yield converted into kg/10a	Sown on	Harvested on	Spacing (cm)
		Area (m^2)	Number of plants	Yield (g)				
Green Choisan	Kashimipur	39	-	3,750	96	Sep., 77	Feb., 78	53 x 35*
Canton Petsai	do.	75	-	3,900	52	do.	do.	35 x 35*
Kailaan, Narrow Leaf	do.	53	-					40 x 30*
	Gulshan	9	70	396	44	28-9-77	1/10-3-78	40 x 20*
Kailarn, Broad Leaf	Kashimipur	74	-	-	-	-	-	40 x 40*
Chinese Radish, KU No. 1	do.	720		28	39	Sown on 3-11-78 Plant on 20-12-78	28-3-79	75 x 30
Super Sweet Corn	do.	570	-	60	105	15-8-78	23-11-78	80 x 35
Kang Kong	do.	300	-	4	No good	Plant at end of Sep.	Dec - Jan	—
Cauliflower, Native	do.	2,000	-	24	12	Sown on 25-7-78 Plant on 26-8-78	25-2-79	75 x 40

Note: Spacings for plant to plant in the column of * were actually 3 lines on the bed of about 100 cm width with some 50 cm watering ditches.

2. DISCUSSION ON GREEN CHOISAN AND CANTON PETSAI

A. With actual data in Table 27, Green Choisan resulted in 96 kg per 10a while Canton Petsai showed 52kg per 10a; that is, the former is more productive seeds than latter. Examining the actual feature of seed plants in the Photos, this data can be understandable since Choisan seed plants seems to be more sound than Petsai, but examining more detail, the seed plants of Petsai are supposed to be bolted from rather aged plants. In fact, it was explained that those seed plants were transplanted a September sown large plants in late November and when the expert took this phto on 20-2-78, much half dying frame leaves were recognized still attached at the bases of seed plants and most of them were half falling down to the ground (Plate 39-A).

B. With his long experience of examining seed production field of cruciferous vegetables, this feature means that the yield is somewhat inferior to those if the younger plants went to seed with more dense spacing. Therefore, in case of later sown seed plants in denser spac-

ing, this data of 52kg per 10a can be much more improved. Therefore, the cropping pattern of seed production of those two brassicas was designed as shown in the Table of Part 1. If the seed production cultivation management is adequately operated and if the weather goes on smoothly, the yield can be expectable as 100 - 120 kg per 10a for Choisan and may be 20% less for Petsai, which data can be comparable to normal seed yield of similar kind of brassicas in Japan.

3. ON KAILAAN

A. With the data of Table 27, the seed production of narrow leaf Kailaan had resulted in 44 kg per 10a at Gulshan Garden.

B. These data is of course not bad but it was only the test case for the first experience. By means of accumulation of experience, adequate management and fertilizer and watering is improved more yield can be expected. Some 50 - 60 kg or more per 10a can be expected by both types of Kailaan.

4. ON CHINESE RADISH

The data at Kashimipur was 39 kg per 10a in 1979, which was sown in November, mother plants were selected and transplanted in the seed production field on 20-12-78 and harvested seen on 28-3-79.

Since this seed production schedule was designed by the expert and cultivation management especially on the spraying for aphid was operated fairly good, the result can be said showing a standard with some improvement by accumulation of experience.

5. OBSERVATION IN EXHIBITION GARDEN OF COMILLA ACADEMY

A. An observation on seeding plants of various S-E Asian brassia and radish was done on 23-2-78. The actual feature was that an exhibition garden was settled planting all the varieties growing side by side in some 10 m^2 plots and left them as it is until seeds were produced. Therefore, this field cannot be a seed multiplying ones since all the pollens were mixed pollinating and the harvested seeds would be terribly disturbed by natural hybridization. But this can be utilized for comparing the physical results of seed production of those varieties as seen in Plate 39.

B. Choisan showed the best performance for seeding among them, may be due to flowered earliest, and Petsai seconded to Choisan. Kailaan also showed fairly good performance but later flowered part of them had been some extent attacked by aphid.

C. The pod of Chinese radish was badly invaded by aphids and a half of borne pods seemed to be abotive and not able to ripen their seeds. With Broad Leaf mustard (5. Chia Tai Seed) showed the worst case; that is, although it bolted and grew its flower branches normally but aphids invaded the flower buds terribly growing in numerous number and as the result all the flower buds came to be abortive being not able to open flowers.

D. The grade of damage by aphid in this exhibition garden was just the oder of flowering time; that is, Choisan and Petsai were almost relieved of aphid invasion, Kailaan was half-relieved because of earlier flowering while Chinese radish was attacked badly and mustard flowers were killed by rapid generation of aphid due to the latest flowering.

6. CONCLUSION FOR EXTERMINATION OF APHIDS

A. From the above mentioned invasion rate of aphid, the following points can be learnt.

a. Appearance of aphids is almost the same time on all the varieties.

b. In case aphid appear after the pods and stem grow up and hardened, aphid can not generate so much, therefore, damage is small.

c. But at the time of aphid appearance, if the flower buds and thestems are still young and juicy, the aphid generate very active on the flower bud masses getting in numerous number, then all the flower buds are killed by aphid.

B. Therefore, extermination of aphids from young inflorescenses is an essential management for seed production of cruciferous vegetables. When one recognizes winged aphids are flying in the air, the spray must be started. The aphid is firstly attacking on the back face of rosset leaves, those back faces must be examined from the middle of December and start spraying when aphids are founded.

7. RECOMMENDATION OF FOUNDATION STOCK SEED BREEDING IN CAULIFLOWER

Cauliflower and Broccoli can produce seeds normally as seen in the photoes, but the yield of seeds may be heavy yield for early variety and poor yield for late variety. In Kashimipur BADC-ADE Field, the heading times of the plants were marked selecting in every 5 days, maybe for the purpose of mother plant selection on the earliness of heading time. This is very good practice. The expert hopes that the foundation stocks for at least three types of varieties as early, medium and late will be settled in Kashimipur Field within a few years because those three type are needed to complete the cropping patterns to supply cauliflower from late November upto the end of February as discussed in Chapter 4 (See also Plate 40).

ANNEX II. LIST OF COLLECTED VEGETABLE SEEDS BY THE EXPERT

No.	Kind and Variety	Introduced from	
		Nation	Company or Institute
1	Kailaan, Narrow leaf (Stem type)	Thailand;	Chia Tai Seed Co.
2	Kailaan, Broad leaf (Leaf type)	do.	do.
3	Choisan, Green (Kuangfu Tsoi)	do.	do.
4	Petsai, Canton (Kuangfu Pak-Tsoi)	do.	do.
5	Mustard, Heading green (Chaochow Ta-Kaitsoi)	do.	do.
6	Chinese cabbage, 55 days, Semi-heading	do.	do.
7	Chinese radish, 55 days	do.	do.
8	Lettuce, Curled white seeded	do.	do.
9	Celery, White stemed Chintsai	do.	do.
10	Kangkong, Wengtsai, Water convulvuls	do.	do.
11	Tomato, Plum	do.	do.
12	Chili pepper, Small fruited	do.	do.
13	Chili pepper, Medium fruited	do.	do.
14	Brinjal, Long purple	do.	do.
15	Brinjal, Small green round	do.	do.
16	Water melon, SB 1	do.	do.
17	Squash, Moschata group, Flat round	do.	do.
18	Cucumber, Native small fruited	do.	do.
19	Cucumber, Hybrid medium small	do.	do.
20	Bitter gourd, Long stout	do.	do.
21	Wax gourd, Early small long fruited	do.	do.
22	White gourd, Early long fruited bottle	do.	do.
23	Sponge gourd, Extra-long ribbed	do.	do.
24	Snake gourd	do.	do.
25	Yard long bean, Red seeded	do.	do.
26	Sugar pea, Extra long	do.	do.
27	Mungo bean, Green seeded	do.	do.
28	Red bean	do.	do.
29	Soy bean, yellow seeded early	do.	do.
30	Hsiao Paitsai, Pusan Petsai	Taiwan;	Known You Seed Co.
31	Yutsai, Green choisan	do.	do.
32	Mustard, Heading	do.	do.
33	Kailaan, Yellow broad leaf, yellow flower	do.	do.
34	Amaranth, Hsientsai, Leaf type green	do.	do.
35	Kangkong, Wengtsai, Dwarf green	do.	do.
36	Leaf onion, Pei-Tson	do.	do.
37	Chive	do.	do.
38	Water melon, F_1-Hybrid Jumbo, Charleston type	do.	do.
39	Water melon, F_1-Hybrid Jumbo, New Dragon	do.	do.
40	Water melon, F_1-Hybrid Jumbo, Kuokuang	do.	do.
41	Tomato, Tropic Ace	do.	do.
42	Brinjal, Pingtung long	do.	do.
43	Bitter gourd, Trial Hyb. No. 1	do.	do.
44	Bitter gourd, Trial Hyb. No. 2	do.	do.
45	Bitter gourd, Trial Hyb. No. 3	do.	do.
46	Cucumber, New Market No. 1	do.	do.
47	Cucumber, New Market No. 2	do.	do.
48	Cucumber, New Market No. 3	do.	do.

No.	Kind and Variety	Introduced from	
		Nation	Company or Institute
49	Cucumber, Chojitsu Ochiai	Japan;	KURUME Seed Co.
50	Summer spinach, Native	Bangladesh;	Nator, AETI
51	Radish, Red Bombay	do.	Rajshahi, HDB
52	Amaranth, Red Lalshak, Stem type	do.	do.
53	Amaranth, White, Stem type	do.	do.
54	Amaranth, Bengalee, Green leaf type	do.	do.
55	Cow pea, Brown	do.	FMTI
56	Chinese radish, K.U. No. 1	Thailand;	Kasetsart University
57	Mustard, Broad leaf	do.	do.
58	Lettuce, Black Simpson, Loose head	do.	do.
59	Sweet corn, Super sweet K.U. No. 1, DMR	do.	do.
60	Cow pea, White, Lagranja	do.	do.
61	Cow pea, White, V59-41	do.	do.
62	Cow pea, White, V67-3	do.	do.
63	Cucumber, Nator native	Bangladesh;	do.
64	Sweet pepper	do.	from market fruits
65	Yard long bean, White spoted red seeded	Thailand;	Chia Tai Seed Co.
66	Yard long bean, Red seeded	do.	do.
67	Yam bean	do.	do.
68	Chive	do.	do.
69	Garland chrysanthemum	do.	do.
70	Amaranth, Red leaf type	do.	do.
71	Amaranth, Green leaf type	do.	do.
72	Coriander	do.	do.
73	Parsley, Nakazato	Japan;	Kyowa Seed Co.
74	Leaf onion, Choju, Nebuka type	do.	do.
75	Cabbage, F_1-Hybrid, Kagayaki	do.	do.
76	Cabbage, F_1-Hybrid, Shoogun	do.	do.
77	Cabbage, F_1-Hybrid, YR-Shimpoo	do.	do.
78	Cabbage, F_1-Hybrid, New October	do.	Ishii Seed Co.
79	Cabbage, F_1-Hybrid, Oogosho	do.	do.
80	Cabbage, F_1-Hybrid, Toyoda Gokuwase No. 2	do.	do.
81	Cabbage, Toyoda-Wase Shin No. 1	do.	do.
82	Kaibro, KBB No. 2, F_6 of Kailaan x Broc.	do.	Shizuoka Agr. Exp. Sta.
83	Kaibro, KBB No. 4, F_6 of Kailaan x Broc.	do.	do.
84	Kaibro, Udoccoli, F_6 of Kailaan x Broc.	do.	do.
85	Tsaihsin, Hontsaitai	do.	do.
86	Petsai, Surugana	do.	do.
87	Egg plant, Chunaga	do.	Sakata Seed Co.
88	Sweet pepper, Saitama Early	do.	do.
89	Carrot, Koizumi Gosun	do.	Kyowa Seed Co.
90	Carrot, Kuroda Gosun	do.	do.
91	Leaf onion, Choju, Nebuka type	do.	do.
92	Japanese radish, MS-Akizumari	do.	do.
93	Japanese radish, Kohai Natsumino	do.	do.
94	Japanese turnip, Someya Kanamachi	do.	do.
95	Japanese turnip, Aomaru	do.	unknown store
96	Japanese turnip, Shogoin Omaru	do.	Takii Seed Co.
97	Japanese radish, Heian Daimaru Shogoin	do.	do.
98	Onion, Shugyoku Early	do.	Kyowa Seed Co.
99	Cabbage, Shogun	do.	do.
100	Cabbage, Kagayaki	do.	do.

No.	Kind and Variety	Introduced from	
		Nation	Company or Institute
101	Choisan, Green early	Malaysia;	Teck Lee Hun Seed Co.
102	Kailaan, Pointed leaf	do.	do.
103	Kailaan, Broad savoy leaf	do.	do.
104	Kangkong, Dwarf	Taiwan	unknown store
105	Chinese radish, Tongkwa-Pei	do.	do.
106	Chinese radish, Ta-Meihua	do.	do.
107	Chinese radish, Kilar	do.	do.
108	Chinese radish, Hybrid Early	do.	do.
109	Japanese radish, Heian Taibyo Wase Shogoin	Japan;	Takii Seed Co.
110	Table beet	Bangladesh;	BADC Kashimipur
111	Cabbage, Princess No. 39	Japan;	Sakata Seed Co.
112	Cabbage, Harvester Queen	do.	do.
113	Cabbage, Titan	do.	do.
114	Cabbage, Leo No. 80	do.	do.
115	Chinese cabbage, Tropical Pride No. 13	do.	do.
116	Chinese cabbage, Tropical Delight No. 23	do.	do.
117	Choisan, Pak Choi	do.	do.
118	Kailaan, Green Lance	do.	do.
119	Tsai Shim, Hon-Tsaitai	do.	do.
120	Spinach, F_1-Hybrid, Orient	do.	do.
121	Spinach, F_1-Hybrid, Pacific	do.	do.
122	Egg Plant, Large fruited No. 25	do.	do.
123	Egg Plant, Large fruited No. 29	do.	do.
124	Tomato, Pink No. 29	do.	do.
125	Kailaan, F_1-Hybrid, Tinhao	do.	Takii Seed Co.
126	Petsai, Pakchoi	do.	do.
127	Chinese radish, Hybrid No. 150	do.	do.
128	Cauliflower, F_1-Hybrid, Snow King	do.	do.
129	Cauliflower, F_1-Hybrid, Snow Queen	do.	do.
130	Chinese cabbage, F_1-Hybrid, Tropicana	do.	do.
131	Chinese cabbage, F_1-Hybrid, Saladeer	do.	do.
132	Chinese cabbage, F_1-Hybrid, 39-B	do.	do.
133	Kangkong	Thailand;	Chia Tai Seed Co.
134	Chin. cabbage, Huangching Extra early 40 days	do.	do.
135	Chin. cabbage, Huangching Early	do.	do.
136	Chin. cabbage, Michili, Long pointed cylindrical	do.	do.
137	Kangkong, K.U. No. 1	do.	Kasetsart Univ.
138	Chin. radish, K.U. No. 1	do.	do.
139	Sweet corn, Super Sweet K.U. No. 1, DMR	do.	do.
140	Kangkong, K.U. No. 1, foundation seed	do.	do.
141	Leaf onion, Kuronobori Ippon, Nebuka type	Japan;	Sakata Seed Co.
142	Leaf onion, Shiro-Senbon, Nebuka type	do.	do.
143	Leaf onion, Kujo, Tillering type	do.	do.
144	Egg plant, F_1-Hybrid, Shinkishin	do.	do.
145	Chive, Broad leaf	do.	do.
146	Gobo, Watanabe Wase	do.	do.
147	Broccoli, F_1-Hybrid, Green 18	do.	do.
148	Cucumber, F_1-Hybrid, Tokiwa Natsufushi	do.	do.
149	Cucumber, F_1-Hybrid, Natsu Sango	do.	do.
150	Koa bean	Thailand;	Chia Tai Seed Co.
151	Cabbage, Late Large Drumhead	Nepal;	Hort. Sect., Dept. Agr.

No.	Kind and Variety	Introduced from	
		Nation	Company or Institute
152	Cauliflower, Nepali	Neapl;	Hort. Sect., Dept. Agr.
153	Mustard, Khumal Broad leaf	do	do
154	Turnip, Purple top	do	do
155	Land cress, Nepali	do	do
156	Radish, Japanese White Neck	do	do
157	Spinach, Nepali	do	do
158	Soy bean, Nepali	do	Pauchkhal Hort. Farm
159	Cucumber, Suyo	Japan	Tanaka Seed Co.
160	Tsai Shim, Hontsaitai	do	Sakata Seed Co.
161	Petsai, Surugana	do	do
162	Radish, Mino Early	Bangladesh;	HDB, Gulshan Nursery
163	Pod bean, Kisando	Japan;	unknown store
164	Leaf onion, Native, Dry bulblets	Malaysia;	MARDI, Cameron HL. Exp.
165	Leaf onion, Native, dry bulblets	Singapore;	Market
166	Choisan, Green (Kuangfu Ta-Tsoishim)	Malaysia;	Teck Lee Hun Seed Co.
167	Kailaan, Pointed leaf	do	do
168	Kailaan, Broad savoy leaf	do	do
169	Yard long bean, White spoted red seeded	do	do
170	Spinach, Hybrid green	do	Chop Eng Huat, Cameron HL.
No number:	Leaf onion, Native, dry bulblets (Missed to list up but planted widely)	Thailand	Chia Tai Seed Co.

Seeds produced at Gulshan Garden

Sp.No. 1	Aojiso
Sp.No. 2	Kailaan, stem type from selected 10 mother plants
Sp.No. 3	Kailaan, stem type, mixed
Sp.No. 4	Amaranth, Taiwanese Green Leaf type

Remark: A part of them could not be on trial.