

Present Condition of
the Vegetables Raising, and Its Improvement

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Present Condition of the Vegetable Cultivation, and Its Improvement.

1. Present Condition of the Vegetable Cultivation, and Its Problems.

In the agriculture of East Pakistan, the vegetable cultivation is one of the remarkably backward cultural techniques. People, usually eat rice too much, and the vegetables too little. From a viewpoint of the sanitary condition of the people, this is an important problem. Considering the rapid increase in the population of the people, especially the concentration of the people in cities, the future development of industries, etc., the yield increase and qualitative improvement of vegetables by means of the increase of areas under crop, and the improvement of cultural technique are the urgent problems, the improvement of food of the people has a close relation to the promotion of the health of people and the enhancement of the economy of farmers. From the current condition of vegetable culture, the following several problems can be pointed;

- a. Cultural technique is so backward that the yield of vegetables is very low.

General farmers are remarkably low in the cultivation technique, and have still followed their local farming way so that the yield per unit area is surprisingly low. This could be chiefly attributed to the sole dependance of farmers' economy upon the rice crop, the mere self-supplying production of most of farmers and their indifference to the technical improvement. It is, however, also undeniable that the Government authorities are backward in technical researches and in steps for promoting the vegetable production. In this connection, the present production could be easily doubled, even if only the cultural technique is improved.

- b. Vegetables are remarkably inferior in quality.

Except a very small number of special farmers living in the suburbs of cities, most of farmers have cultivated the vegetables for self supporting, and only the excess has been brought to market. Therefore,

most farmers are little enthusiastic to improve their qualities.

In the advanced countries, the issue of the quality of vegetables in production is especially an important problem. Unlike the rice, etc., the price of vegetables is greatly dependent upon their quality. At the current stage of the vegetable production in this country, the problem on quantity would have priority over other problems. With the improvement of diet of the people, however, the quality would come into question. In the suburbs of big cities such as Dacca, etc., the issue of quality has already become an important problem. In this connection, it is an urgent need not only to improve the cultural method but also to promote the spread of species of excellent quality by solidification of research organs, and expanding the organizations for seed production.

c. The area of vegetables is very small.

According to the census in 1940, it is as follows:

Sweet patato:	118,000	acre
Potato	140,000	"
Onion	96,000	"
Other vegetables		
in summer	51,000	"
in winter	96,000	"
Total	499,000	"

As mentioned above, the acreage under cultivation is approx. 500,000 acres. In relation to the whole farmer households, 6,130,000, it is only 0.08 acre per family, and no more than 0.01acre per head of the total population, 51,000,000. At present in Japan, it is 0.017 acre per head. Not only from such a small acreage in crop but also from the difference in yield etc., it is conceivable that the people of this country eat very little vegetables. In Japan, where the increasing demand for vegetables is not satisfied, the Government has made every effort to increase their production. In this country, however, there are much areas to be cultivated.

It is said that only approx. 20% of the land is utilized in dry season. It is, therefore, important to increase the acreage under cultivation, by utilizing the rest fallow land.

- d. Production of vegetables is seasonally deflected.

From reasons of the serious change of climate between rainy and dry seasons, the land utilization due to the flood, etc., the vegetable production concentrates in dry season. In rainy season, consequently, the fresh vegetables run short seriously. It is, therefore, important to take steps for promoting the vegetable production in rainy season.

- e. Market organization is imperfect.

In relation to the commodities such as the vegetables, which cannot be stored for a long time, the local marketing system cannot encourage the farmers to produce more vegetables. And also, fluctuation of the prices are very big. Such a situation has checked the will of farmers to produce the vegetables. In this connection, it is necessary to open public markets chiefly in cities, and subsequently complete an unified organization for production, collection and sale of vegetables.

II. Improvement of the Vegetable Cultivation.

1. Improvement of the Vegetable Cultivation Technique.

First of all, stabilization of amount of products and increase of vegetables of good quality are most necessary. No profitable vegetable culture would be possible for farmers. It must not be forgotten that the improvement of technique is a base of the development of vegetable culture.

In relation to various kinds of major vegetables, we have hereunder given a comparison between the local and the improved techniques (Table 1) and added some explanation of the important improvement points. For information, we have further attached a table of the cultivating period of each system (Table 2), a table of the cultural Method based upon the improved

technique system (Table 3), and a table showing representative kinds of vegetables in East Pakistan, and the kinds, which had been proved to be better in the trial in Dacca (Table 4). These data should, needless to say, be constantly examined and corrected in future, as the condition somewhat varies with each region. It must be kept in mind that these data are a general standard. Under the present condition of this country, it would not be so easy to bollow up these methods. But we expect that efforts should be made to improve it step by step.

- a. Selection of the varieties of excellent quality, and the preservation of seeds of superior quality.
- b. Improvement of the cultural method for seedlings.
- c. Rationalization of manuring.
- d. Thorough control over the disease and insect pest.
- e. Irrigation for the vegetables in dry season and the drain for those in summer.

The above are the important improvements common to all the vegetables.

Technical system for the major vegetables (Table 1)

		<u>Tomato</u>		
	<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remarks</u>
1	Sowing season	Late in Sept. - Late in Oct.	Early in Sept. - Mid. Oct.	
2	Sowing quantity (per acre)	Direct seeding, 1.5kg. seeding, 400g.	20g.	Preservation of seed shall be improved to promote germination of seeds.
3	Production of the seedlings.			
4	(1) Condition of bed	on the farm without covering	on the farm without covering	
5	(2) Nursery	1m.wide x 6m. long x 200cm. high	1m.wide x 3m long x 20cm. high	
6	(3) Manuring quantity for the nursery	cow dung, 15-20 kg per bed	Compost, 8kg Oil cake, 110g, Superphosphate of lime, 50g, ammonium sulfate, 20g. potassium chluride, 20g.	Nursery Fertilizer on 10-15 days before the sowing.

	(4) Required number of the seedbed	4 beds per acre	5 beds per acre	
	(5) Sowing quantity for the seed	100g.	26g.	
	(6) Sowing method	Scattering	Scattering and line-sowing	
	(7) Soil covering		Thickness: 0.3-0.4cm.	The surface shall be covered with soil to make even the germination
	(8) Number of the days required for germination	5 - 7 days	3 - 5 days	
	(9) Frequency of the transplantation	Non-transplantation	Once	
	(10) Transplantation period		When the main leaf is 1-2 (in the 8th day after germination)	Seedlings become stronger, when they are transplanted
	(11) Density of seedlings		Row width, 8cm. Plant space, 5cm.	
	(12) Number of the plants transplanted		750 pcs. per bed	
	(13) Required number of the transplantation bed		17 bed per acre (12,750 pcs.)	

(14) Maintenance of the bed		Irrigation, twice a day, quantity per hour 3 l.: weeding, twice: inter-tillage, once
(15) Sunshade for the bed	Bamboo-blind only in the daytime	The same blind 7 hr. in the daytime
(16) Disease and insect pest	Loss caused by aphid is large	Endrin emulsion once for controlling the aphid
(17) Number of the days for the growth of seedlings	25 - 30 days	35 days
4 Plowing	Only in case of the direct sowing, plowed 3-4 time by cattle.	Harrowing after the plowing
5 Planting row	Planting hole is dug. Diameter of the hole 20 cm. and the depth 10cm.	Two-row planting, 1.2 wide, and the passage width, 30cm.
6 Density of plants	Random planting, 12-15 plants per 33m ²	Row width $\frac{1}{2}$ $\frac{1}{2}$ 20+80+20 30 plant interval, 40cm.
7 Number of the plants fixed	14,500 - 15,000 plants	12,500 plants per acre
		Number of approx. 10,000 Plants is prepared

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8	Fix-planting period	Late in Oct.-early in Nov.	Early in Oct.-mid. Nov.																																	
9	Manuring quantity	<p>Basic fertilizer</p> <p>Cow dung, 100 mounds</p> <p>Oil cake, 1</p> <p>Top dressing</p> <p>Ammonium sulfate, 1 mound</p> <p>Required chemical components per acre</p> <p>Nitrogen, 70 kg.</p> <p>Phosphate, 50 "</p> <p>Potassium 80 "</p>	<table border="1"> <thead> <tr> <th rowspan="2">Name of the fertilizer</th> <th rowspan="2">Quant. kg</th> <th colspan="3">Addition</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> </tr> </thead> <tbody> <tr> <td>Compost</td> <td>6,000</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Oil cake</td> <td>350</td> <td></td> <td>50</td> <td></td> </tr> <tr> <td>Ammonium sulfate</td> <td>40</td> <td>20</td> <td>20</td> <td>20</td> </tr> <tr> <td>Potassium chloride</td> <td>120</td> <td>20</td> <td>20</td> <td></td> </tr> <tr> <td>Superphosphate of lime</td> <td>60</td> <td></td> <td></td> <td>30</td> </tr> </tbody> </table>	Name of the fertilizer	Quant. kg	Addition			1	2	3	Compost	6,000				Oil cake	350		50		Ammonium sulfate	40	20	20	20	Potassium chloride	120	20	20		Superphosphate of lime	60			30
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10	Manuring method	<p>Basic manuring</p> <p>In case of direct sowing, and plowed.</p> <p>In case of seedlings, the plant holes manured additional manuring</p>	<p>Additional manuring</p> <p>Manure 2-3 times.</p> <p>After manuring the shoulders of ridges, soil covering.</p> <p>Basic manure shall be given 10-15 days before the sowing or plantation.</p>																																	

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	Sunshade after the setting	Leaves and banana stems	
11			
12	Irrigation	None	Irrigation between rows once 8-10 days by means of pump
13	Pruning	None	One support per plant and the buds shall be nipped 3 - 4 times
14	Support		As for the dwarf type, the length of support 70 - 80 cm.
15	Maintenance	Intertillage and weeding 3 - 4 times	Length of the support, 1.5 m. tied by jute or straw
16	Disease and insect pest	Virus, aphids. No control measure	Insecticide shall be applied mostly to the back of leaves
17	Harvest period	Mid-Jan. - late in Mar.	After mid-April, the fruits are rot colored due to the high temperature

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18.	Yield per acre	Direct sowing 4,800 kg Setting 6,000 kg	12,000 - 13,000 kg per acre
19	Number of the days required for growth	170 - 180 days	

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Cautions about the improvement

As the tomato contains various vitamins, it is an important vegetable for maintaining the health of people. Though the demand for tomato is larger than that of any other vegetable, its yield is surprisingly small, less than 1/3 of the yield in Japan because of the shortage of the seeds of excellent quality and the cultural method. The fruits are of poor quality. Therefore, it is necessary to breed or introduce the varieties of superior quality as early as possible, at the same time make effort improve the cultural technique.

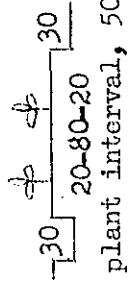
In relation to the cultural technique, the following points must be considered.

1. In case of the directly sowing, live-sowing system should be employed. When the seeds are scattered, the maintenance becomes difficult, and the growth becomes uneven.
2. Seedlings to be fixed shall be sound seedlings which had been about once transplanted. Non-transplanted seedlings would die due to the bad rooting after the setting.
3. In order to increase the yield, not only the compost but also such chemical fertilizers as the potassium, phosphate, etc. are required.
4. When the seedlings are left alone after the plantation, no yield increase cannot be expected. Laterals shall be pruned in good time, and only 1 or 2 main branches shall be grown.
5. In any case, the standing or creeping types, support should be used to reduce the spoiled fruits and obtain the fruits of good quality. If the support are used, furthermore, the work would be easy, growth be uniform, and the yield be increased.

Item	Experiment		Remark
	Present local technique	Improved technique	
1 Sowing season	(1) Sept. -- Oct. (2) Feb. -- Mar.	(1) Mid-Sept. -- mid-Oct. (2) Late in Feb -- mid-Feb.	The early sort can be sowed throughout the year
2 Sowing quantity	240 g per acre	140 g	
3 Production of the seedlings			
(1) Condition of bed			
(2) Nursery	1 m. wide x 6 m. long x 20 cm. high	1 m. wide x 3 m. long x 20 cm. high	
(3) Manuring quantity	cow dung, 30 kg per bed	Compost, 10 kg, oil cake, 100 g, ammonium sulfate, 50 g, superphosphate of lime, 50 g, and potassium chloride, 20 g.	Manure shall be mixed with the bed soil about 15 days before the sowing
(4) Quantity of seeds	81 g per bed	35 g per bed	
(5) Required number of the seedbed	4 beds per acre	3 beds per acre	

(6) Sowing method	Scattering of seeds	Scattering of seeds
(7) Soil covering	Thickness, approx. 0.4 cm.	Another soil prepared should be covered to make even the base
(8) Germination	8 - 9 days	
(9) Transplantation	Non-transplantation	
(10) Transplantation period	When the main leaf becomes two (on the 15th day after the germination)	
(11) Density of seedlings	Balk width, 8 cm, and the plant space, 8 cm.	
(12) Number of the plants transplanted	540 pcs. per bed	
(13) Required number of the transplantation bed	13 beds (7020 plants)	
(14) Irrigation	Irrigation twice approx. 31 per time	

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(15) Sunshade for the bed	Bamboo blind only in the daytime	The same as the left Blind approx. 3 hr. per day
(16) Number of the days for the growth of seedlings	35 - 40 days	40 - 45 days
4 Plowing and harrowing	Plowed by cattle 2 - 3 times	
5 Row making	Planting holes dug	
6 Planting space	Random planting, row width; approx. 80 cm, plant space, approx. 50 cm.	Row width  plant interval, 50 cm.
7 Number of the plants	10,000 plants per acre	10,000 plants
8 Fix-planting season	Late in Oct. - mid. Nov.	Late in Oct. - mid. Nov. Mid-Mar. - Mid-Apr.

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9	Manuring quantity	Cow dung, 150 mounds (± 5500 kg.) Oil cake, 2 mounds (80 kg.)	Name of the fertilizer	Basic manuring	Additional manure
					1 2 3
			Compost	4,000	- - -
			Oil cake	100	50 - 50
			Superphosphate of lime	100	- - -
			Potassium chloride	40	40 40 40
			Ammonium sulfate	60	20 20 20

Required chemical components per acre

Nitrogen, 80 kg.
Phosphate, 50 kg.
Potassium, 80 kg.

Planting holes are manured

Sunshade of tree leaves for 3-4 days

Basic manuring in Planting ditches
Additional manuring
Manure about 3 times.

After the additional manuring, slight inter-tillage shall be given.
In case of sunshading for 3-4 days, the plants shall not be dried until the setting.

12	Irrigation	Plants are left alone for 2-3 days after the planting	When the pump is used, the plants should be irrigated once 8-9 days.
13	Pruning	No pruning	3 stalks should remain
14	Support		70-80 cm. long
15	Maintenance	Intertillage, 3-4 times in the stump section	Soil slightly dressed
16	Disease and insect pest	Red mite, no measure	Control Red mite, Oebia undalia
17	Harvest period	1) Feb. - Apr. late in Apr. 2) Jul. - Aug. late in May - late in Jul.	Insecticide shall be applied to reduce the disease
18	Yield	5,500 - 6,000 kg.	12,000 - 13,000 kg.

Cautions about the improvement

In this country, the eggplant is mostly used for cooking, and greatly suits the taste of the people. As the eggplant is well grown at high temperature in sunshine, it is cultivated in various places of this country.

Yield is higher than that of other vegetables, and the harvest period is also long. Though the name of varieties is unknown, the medium-long, long and round varieties are cultivated. But the flesh of all these varieties are loose, and the fruits are also lusterless. In this connection, efforts should be made not only to increase the yield but also to improve the quality.

1. Sound seedlings shall be planted for the good rooting after the planting, and the subsequent vigorous growth.
2. Random planting shall be given up. Planting shall be given at regular intervals.
3. Not only the cow dung but also the chemical fertilizers shall be used to make the growth vigorous, and improve the fruit bearing.
4. When the plants are somewhat thickly planted, they would grow better. Overgrowing would make the blossoms fall. It would be enough, if it is grown too densely, pruning is necessary.
5. Renewal pruning shall be given to the plants which had been planted in dry season, or which are past their best (in April - May). Pruning should be about 1/3 of the space of each plant occupied. After the pruning, top dressing shall be given. In approx. 40 days after the pruning, the harvest time comes after the rainfall. Even in rainy season, the harvest can be continued. In order to increase the yield, therefore, it would be advisable to plant newly provided sound seedlings for the rainy season.

	<u>Item</u>	<u>Cucumber</u>		<u>Remarks</u>
		<u>Present local technique</u>	<u>Improved technique</u>	
1	Sowing season	March -- April	<u>Setting sowing</u> Mid-Aug - Mid-Nov. for the sort of pre- mature fruit bearing	Direct
2	Sowing quantity	180g. per acre	540g.	800g.
3	Production of seedlings			
(1)	Condition of bed		Natural cultivation	
(2)	Nursery		30cm. wide, 1m. long	
(3)	Manuring quantity		Compost, 6kg. oil cake, 100g and superphospha- te of lime, 50g.	
(4)	Quantity of seed (per bed)		720g.	
(5)	Required number of seedbeds		7 beds	
(6)	Sowing method	Spot-sowing, 6 - 7 seeds per each	Scattering	Spot-sowing 3-4 seeds

(7)	Soil covering	0.5 cm. thick
(8)	Number of the days for germination	3 - 4 days
(9)	Frequency of the transplantation	once
(10)	Transplantation period	In time of young leaves (on the 7th day after germination)
(11)	Density of trans-plantation	8 cm x 8 cm
(12)	Number of the plant transplanted	432 pcs. per bed
(13)	Required number of the transplantation bed	32 bed per acre
(14)	Irrigation	3 l. twice a day
(15)	Sunshade for bed	Bamboo-made blind
(16)	Number of the days on the bed	25 - 30 days
4	Plowing and harrowing	The whole plowing twice

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5	Planting density	Row width, 3 m. Plant interval, 2 m.																										
6	Number of the plants	800 pcs. per acre																										
7	Setting period	9,880 pcs. per acre																										
8	Thinning (in case of direct sowing)	3 times after germination																										
9	Manuring quantity	Cow dung, 6,000 kg.																										
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		Thinning shall be given to obtain a single stem																										
		Chemical components required per acre: N. 70 kg., P. 40 kg., K. 60 kg.																										

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10	Manuring method	Sowing holes are manured on the day before the sowing, or on the sowing day	Apply manured 10 days before sowing or planting, mix manure with soil, 2 - 3 times	Lack of the manure would decrease the quality and yield
11	Support	Shelf-support: Bamboo piles 3 m ² to make a shelf 1.5 m. high	Chopped bamboos 1.8 m. long, each shall be plaited	Chemical fertilizer shall be given
12	Pruning	No pruning	Pruning branches so that the main two branches and the laterals with 2 - 3 leaves may remain	As the sort of fruit-bearing on branches bears fruits on small vines, small vines shall grow, when the main leaf becomes 3 - 4
13	Irrigation		Pumping once 8 - 10 days	
14	Weeding	Weeding is given twice	Intertillage and weeding 2 - 3 times	As the root is small, deep plowing shall not be given at inter-tillage
15	Disease and insect pest	Few disease found, aphid found throughout the period	The insecticide once 8 - 10 days	

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16	Harvest season	Jun. - Aug.	Oct. - Mar.
17	Yield	6,400 - 6,500 kg. per acre	11,500 - 12,000 kg. per acre

Caution about the improvement

In this country, cucumber is chiefly used for making the salad. The cucumber is the creeping high temperature resistant. Fruit is light-green and large. But the flesh is soft, and the quality is not so good. As the sowing is conducted in March, however, cucumber is an important vegetable in rainy season when the vegetable run short. It is chiefly cultivated for family use. The people has a taste for cucumber, and the cucumber can be harvested for a shorter period. So, from a viewpoint of the land utilization, too, cucumber is a hopeful vegetable.

1. As the cucumber likes much manure, and grows vigorously for a short period, the shortage of manure would immediately affect the growth of leaves and stems, and the quality of fruits.
2. In connection with the above, it is necessary to give enough basic fertilizer, and then the top dressing chiefly composed of nitrogen 2-3 times.
3. In case of direct sowing, thinning shall be given. If the thickly rowing plants are left as they are, their growth would be weakened. In case of the cultivation on a big area, the shelf-support system is difficult, considering the material and labor. Therefore, it is advisable to select the variety of creeping type. If the row is heighten-ed for the drain, and the straw is laid, the yield is almost the same as that for the shelf-support system.

Watermelon

	<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1	Sowing season	Oct. -- Nov.	(1) Jan. - Mar. (2) Oct. - Nov.	
2	Sowing quantity	720 g	500 g	
3	Sowing method	Direct and spot sowing, 6 - 7 grains per each row	Direct and spot sowing, 3 - 4 grains	
4	Soil covering	Plowing approx. 1.5 cm	Thickness, 0.8 - 1.0 cm	
5	Days required for germination	7 - 10 days	5 - 6 days	
6	Plowing	Only the soil around the sowing hill is plowed	Plowed 1 - 2 times	
7	Making of the hill	Approx. 30 cm dia. and 20 cm deep	50 cm dia, and 20 cm deep	
8	Planting density	Row width, 3 m, and the plant interval, 2 m.	Row width, 2.5 m, and the plant interval, 2 m.	
9	Number of the plants	800 plants per acre	960 plants per acre	

10	Manuring quantity	Cow dung, 64.00 kg Oil cake, 100 kg	Name of fertilizer	Basic manuring	Additional manuring		
					1	2	3
			Compost	4,880	-	-	-
			Ammonium sulfate	50	10	20	20
			Superphosphate of lime	100	-	-	-
			Kalium chloride	30	-	-	-
			Oil cake	120	-	30	-
11	Manuring method	On the day before the sowing, or on the sowing day, cow dung approx. 8 kg per hill. Top dressing, oil cake is given once on the 30th day after the sowing	Basic manuring compost, 5 kg, ammonium sulfate, 50 g, superphosphate of lime, 100 g., potassium chloride 30 g., and oil cake, 120 g. Top dressing 1st time, when the leaf becomes 3 - 4; 2nd time, when the leaf becomes 7 - 8; 3rd time, when the leaf becomes 11 - 12	Basic manure shall be given 15 days before the sowing Additional manure shall be given in accordance with the growth condition			
12	Thinning	No thinning	Thinning given 2 - 3 times	One plant per hill			
13	Repairing of the hill	Soil heaped around each plant	Ditch in the center of row heep both rows with soil				

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14	Straw to be laid	In accordance with the growth of vines, straws laid all over the surface				
15	Maintenance	Intertillage 2 - 3 times	Intertillage covering and fertile soil 3 times			
16	Arrangement of vines	Vines spread all over the rows				
17	Node to be fruited	1st flower on the 5th - 6th node of the main vine, 2nd flower on the 6th - 7th node thereafter				
18	Changing of the position of fruit	None	When the fruit grows to the cup-size, it shall be quietly turned upside down	This operation is required to prevent the fruit from going bad. In rainy season, bricks, etc. shall be laid.		
19	Disease and insect pest	Fusarium wilt aphid	Bactericide 2 - 5 times	Insecticide shall be mixed with the bactericide		
20	Harvest	Mar. - May	(1) May - Jul. (2) Jan. - Apr.			
21	Yield	4,800 - 5,000 kg/acre	8,000 - 9,000 kg/acre			

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Caution about the improvement

Watermelon grows well at so high a temperature as approx. 30°C. In this country, it has been grown only in dry season. The flesh of the local sort is light-colored and contains little sweetness. It is, therefore, keenly desired to introduce the varieties of good quality. The trial of the Japanese varieties in this Institute has disclosed that they can be cultivated not only in rainy season but also throughout the year. Major care items are as follows:

1. At the sowing, seeds are usually deeply inserted into the soil. But, it would impede the germination and spoil the seeds. Therefore, the seeds shall be laid aside and then be slightly covered with soil. They shall be further covered with hay; etc. to prevent the drying.
2. As for the manuring, not only the cow dung, but also chemical fertilizer shall be given. Above all, the oil cake, which is easily made available in this country, is effective in increasing the sweetness.
3. Thinning shall be given so that 1 - 2 stems may grow. No thinning would be unfavorable for the growth.
4. The largest damage in the cultivation in rain season is that the green fruit, 8 - 10 cm diameter becomes gradually dark-gray and goes bad. These symptoms are similar to those of the disease observed in rainy season in the warm areas of Japan. Damage is far serious than that in Japan. In 1 - 2 days, the whole fruits are spoiled. This decay begins with the contact surface with wet soil. In order to prevent this rot, the fruits shall be kept off the ground to make a clearance for ventilation. For instance, in this Institute when the fruit became approx. 5 cm diameter, three bricks were laid in triangular shape thereunder, and the decay could be prevent. In addition, it is important to heighten the row for the drain, and lay somewhat thick straws. Especially at the intertillage, meanwhile, deep

and rough plowing shall be given. Soil shall be not cracked, and the clods shall be left as they are, because the clearance in clods would prevent the rainwater from stagnating, and the air from escaping to rentilate the soil and prevent the damp of roots.

Japanese cantaloup, Oriental Pickling Melon

<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remarks</u>
1 Sowing season	Oct. - Nov.	1) Aug. - Nov. 2) Feb. - Mar.	
2 Sowing quantity		720g.	
3 Sowing method	Direct sowing	Direct and spot sowing	
4 Days required for the germination	5 - 6 days	5 - 6 days	
5 Plowing and harrowing	Plowing by cattle, 1 - 2 times		
6 Planting density	Row width, 1.8m., and the plant interval, 1.8m.	Row width, 2.5m., and the plant interval, 2m.	Space should be widened, because the stems and leaves grow thickly.
7 Number of the plants	12.30 plants	960 plants	
8 Sowing hole	30cm. dia., and 20cm. deep	50cm. dia. and 20cm. deep	

Item	Fertilizer	Basic manuring	Additional manuring	
			1	2
9 Manuring quantity	Cow dung, 6500 kg.	4,000	-	-
		Ammonium sulfate 50	10	10
		Superphosphate of lime 80	40	-
		Potassium chloride 60	20	-

Required chemical components per acre:
N. 60 kg., P. 70 kg., K. 40 kg.

10 Manuring method	Manured on the day before the sowing, or on the day in the sowing hole, and then covered with soil	In sowing holes basic fertilizer before sowing
11 Making of the hill	After the application of basic manure, soil heaped approx. 15cm. high	Soil shall be heaped
12 Thinning	No thinning	After the germination thinning twice so that 1-2 stems may remain.

13	Heaping soil	Soil heaped only at the root of plant	When the leaves becomes approx. 10-12, center of the row shall be notched, and heap the soil on both.	Ditch length approx. 5m.
14	Straw to be laid		After the making of row, the surface shall be mulched by straw in accordance with the growth of stems and leaves	
15	Irrigation		Irrigation between the rows once 9-10 days by pump.	
16	Maintenance	Intertillage and weeding 1-2 times	Soil covering 2-3 times	
17	Harvest	Mar. - Apr.	1) Dec. - Mar. 2) May - Jul.	
18	Yield	6,000 - 6,500 kg.	9,500 - 10,000 kg.	
19	Days required for the growth	150 - 170 days		

Cautions about the improvement.

As the sorts similar to this melon are not raised in this country, description shall be given chiefly in relation to the Japanese cantaloup. As the Japanese cantaloup grows well at high temperature in a relatively dry climate, it has been grown in dry season from Sept. to Apr. in this country. The local variety so far raised belongs to the chayete, and its fruit surface has approx. 10 deep stripes lengthwise. The fruit is as large as approx. 2 kg., and the flesh is light white or yellow-orange-colored. Though the flavour is strong, the flesh is soft, and contains little sweetness. At present, Japanese cantaloup this variety only for the domestic use. As it is strong against the disease, and can be easily cultivated, more plants would be cultivated in future. What we desire most is the breeding of the excellent varieties containing much sweetness. In addition, attention shall be paid to the following points in cultivation.

1. After the germination, the thickly grown portion shall be thinned so that 1 - 2 plant may be per hill. Excessive thick growth of stems and leaves would reduce the sunshine and ventilation, cause the disease and insect pest, and decrease the blossom and fruits.
2. As not only the flavour but also the sweetness are made much of, nitrogen and potassium phosphate shall be applied. Above all, the lack of manure would worsen the growth, and reduce the quality and yield of the fruits.
3. Plants shall be mulched in accordance with their growth. Litter serves to protect the fruits against contamination, and the stems and leaves against the wind, and to prevent the ground temperature from increasing.
4. Muskmelon bears fruits mostly on the tertiary vines the buds on the main vine and secondary vines shall be taken off a little early. Buds on the main vine shall be taken off when the main leaf becomes 5 - 6, and those on the secondary vines when the main leaf becomes 3 - 4.

Red and Green Pepper

<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1 Sowing season	Transplan- tation raising Sep.-Oct. Feb.-Mar.	Green pepper 1) Sep.-Nov. Aug.-Sep. 2) Jan.-Feb.	
2 Sowing quantity	330g. 8kg.	165g. 130g.	
3 Production of seedlings			
(1) Condition of bed		Without any covering	
(2) Size of the bed	1m. wide, 6m. long	6m. wide, 3m. long, 20cm. high	
(3) Manuring quantity (per bed)	15 - 20 kg.	Phosphate of lime, 50g., ammonium sulfate, 100g., potassium chloride, 50g.	
(4) Sowing quantity (per bed)	65 g.	32 - 33 g.	

(5) Required number of the seedbeds	4 beds per acre	5 - 4 beds	
(6) Sowing method	Scattering	Scattering	Soil shall be so carefully laid that the germina- tion may be even.
(7) Soil covering	Mixed with ladder the surface or soil spade	Thickness, 0.5cm.	
(8) Germination Budding	8th-9th day 10th day	6th - 7th day	
(9) Transplantation	No transplantation	Transplantation shall be once during the bud stage.	No transplantation is required, if the thickly grown portion is thinned
(10) Transplantation space		row width, row width, 4cm. 5cm. Plant inter- Plant inter- val, 4cm. val, 5cm.	
(11) Number of the plants to be transplanted		1875 plants 1200 plants per bed per bed	
(12) Required number of the transplan- tation bed		12 beds 14 beds (22,500 (16,800 plants) plants) per acre per acre	

(13) Irrigation	7 - 8 l. once a day per bed	3 l. twice a day per bed	3 l. once a day per bed
(14) Sunshade of the bed			Bamboo-blind
(15) Disease and insect pest			Aphis shall be controlled once - twice
(16) Number of the days required for the growth	30 - 40 days		35-40 days
4 Land preparation	Plowed by hand 3 - 4 times		The whole surface shall be tilled 1 - 2 times
5 Planting space	Random planting, row width, 70cm. plant interval, approx. 40cm.	Row width, 50cm. Plant internal 35cm.	Especially in case of direct sowing, land shall be prepared uniformly.
6 Number of the plants	approx. 11,100 pcs.	22,200 pcs.	16,680 pcs.
7 Setting period		1) Oct.-Dec. 2) Feb.-Mar.	

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8 Sunshade of the setting	Waterplant	1) Oct.-Dec. 2) Feb.-Mar.																											
9 Irrigation		When the pump is used plants shall be irrigated once 8 - 10 days																											
10 Maintenance	Intertillage 2 - 3 times	Covering soil 2 - 3 times	In rainy season, caution shall be used to drain.																										
11 Manuring quantity	Cow dung, 6,000 kg.	<table border="1"> <thead> <tr> <th rowspan="2">Name of the fertilizer</th> <th rowspan="2">Basic manuring</th> <th colspan="2">Additional manuring</th> </tr> <tr> <th>1st</th> <th>2nd</th> </tr> </thead> <tbody> <tr> <td>Compost</td> <td>4,000 kg</td> <td>kg</td> <td>kg</td> </tr> <tr> <td>Oil cake</td> <td>100</td> <td>15</td> <td>15</td> </tr> <tr> <td>Ammonium sulfate</td> <td>80</td> <td>20</td> <td>20</td> </tr> <tr> <td>Superphosphate of lime</td> <td>60</td> <td>-</td> <td>-</td> </tr> <tr> <td>Potassium chloride</td> <td>80</td> <td>-</td> <td>-</td> </tr> </tbody> </table>		Name of the fertilizer	Basic manuring	Additional manuring		1st	2nd	Compost	4,000 kg	kg	kg	Oil cake	100	15	15	Ammonium sulfate	80	20	20	Superphosphate of lime	60	-	-	Potassium chloride	80	-	-
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Potassium chloride	80	-	-																										

Chemical components required per acre
N. 60kg., P. 40kg., K. 50kg.

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12	Manuring method	Manuring before sowing or planting	Manuring all over the ground	Basic manure 10 days before the setting. Additional manure on the 10th day after the rooting, and then on the 30th day thereafter.
13	Disease and insect pest	Damage of insects is large		Insecticide against aphids 2 - 3 times
14	Harvest season	Feb.-Apr.	Jun.-Jul.	1) Jan.-May Dec.-Feb. 2) Apr.-Aug.
15	Number of the days for growing	150 - 200 days		150 - 180 days
16	Yield			1800-2000kg. 2800-3000kg.

Cautions in the improvement.

Peppers raised in this country are mostly the sort of hot taste containing little sweetness. Throughout the year, there is a demand for in state of raw and dry. They are the necessities indispensable to the staple food of the inhabitants, as a ingredient of curry and salad.

The direct sowing and the transplantation systems have been employed. But the yield of the latter is larger than that of the former, because the perfect maintenance is possible in the transplantation method.

1. In case of the direct sowing, line-sowing shall be used. The thickly grown portion shall be thinned.
2. Before the direct sowing of setting, the farm-land shall be well rolled. Especially in case of direct sowing, attention shall be paid to the land preparation and the soil covering to make the germination even.
3. As for the variety to be dried, the ripe fruits shall be harvested a little early to prevent the discoloring. Discolored fruits are of bad quality and cannot be stored so long. In drying the fruits, they shall not directly be laid on the ground but dried on the marsh-reed screens or cloth sheets for 10 - 12 days (until the moisture becomes approx. 10%)

Pumpkin

<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1	Sowing season 1) Sept. - Oct. 2) Feb. - Mar.	1) Aug. - Oct. 2) Feb. - Apr.	
2	Sowing quantity 525 g. per acre	375 g.	
3	Sowing method Direct and spot sowing	In case of direct sowing, 3-4 grains	
4	Soil covering	Thickness, 0.8 - 1.0cm.	After covering, the ground slightly tamped
5	Number of the days required for germination 4 - 5 days	3 - 4 days	
6	The land preparation Only the portion where the sowing holes are to be dug is plowed.	Plowing 1 - 2 times	
7	Making of the hill 30 cm. dia. and 20 cm. deep	50 cm. dia. and 20 cm. deep	
8	Planting density Row width, 2.5m. Plant interval, 2m.	Row width, 3m. Plant interval, 2m.	Plants shall be somewhat roughly planted.

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9	Number of the hills sowed 960 plants per acre	800 plants per acre																							
10	Manuring quantity Cow dung, 6,000kg. per acre		<table border="1"> <thead> <tr> <th rowspan="2">Name of fertilizer</th> <th rowspan="2">Basic Manuring</th> <th colspan="2">Additional manuring</th> </tr> <tr> <th>1st</th> <th>2nd</th> </tr> </thead> <tbody> <tr> <td>Compost</td> <td>3,850</td> <td>-</td> <td>-</td> </tr> <tr> <td>Ammonium sulfate</td> <td>40</td> <td>10</td> <td>10</td> </tr> <tr> <td>Superphosphate of lime</td> <td>80</td> <td>40</td> <td>-</td> </tr> <tr> <td>Potassium chloride</td> <td>60</td> <td>-</td> <td>20</td> </tr> </tbody> </table> <p>Chemical components required per acre: N. 60 kg., P. 50 kg., K. 70 kg.</p> <p>Compost, approx. 4kg., Basic manure ammonium sulfate, 50g., shall be given a superphosphate of lime, little early. 80g. and potassium chloride, 70g. shall be given per hole 10 days before sowing, and mixed with soil.</p>	Name of fertilizer	Basic Manuring	Additional manuring		1st	2nd	Compost	3,850	-	-	Ammonium sulfate	40	10	10	Superphosphate of lime	80	40	-	Potassium chloride	60	-	20
Name of fertilizer	Basic Manuring	Additional manuring																							
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Compost	3,850	-	-																						
Ammonium sulfate	40	10	10																						
Superphosphate of lime	80	40	-																						
Potassium chloride	60	-	20																						
11	Manuring method In the day before the sowing day or on the sowing day, compost 8kg. is given.																								
12	Additional fertilizer To be given 2 - 3 times.																								

13	Making the row	The soil close to the plant is heaped.	When the number of leaves becomes 14-15, centre of row deeply plowed, and heaped	Ditch between the rows shall be deeply plowed for the drain in rainy season
14	Mulching		After the heightening	
15	Pruning	No pruning	2-3 stems (1 large vine and 1 small vine) shall remain Irrigation 9-10 days by pump.	No pruning would decrease the yield.
16	Irrigation			
17	Maintenance		Intertillage, weeding and soil dressing twice respectively.	
18	Disease and insect pest	Damage caused by cucurbit leaf beetle is large.	Control shall be regularly given.	
19	Harvest period	1) Jan. - Mar. 2) Jun. - Aug.	1) Dec. - Feb. 2) Jun. - Aug.	
20	Yield	5,500 kg. - 6,000 kg. per acre	9,500 kg. - 10,000 kg. per acre	

Cautions about the improvement.

Among the vegetables, pumpkin is a plant relatively adaptable to any climate, which can grow well not only at the high but also at the low temperature. Though it is chiefly grown in dry season, it can be also raised even in rainy season, and some is harvested throughout year for the household use. With the development of communications, pumpkin would be shipped to the remote places, and subsequently their cultivation would increase.

1. Planting space shall be wide enough to obtain the sunlight and ventilation. Especially in rainy season, caution is necessary against the thick growth of stems and leaves.
2. Mulch shall be given not only to the creeping but also to the shelf varieties. As for the creeping varieties, the whole surface of rows shall be mulched. As for the shelf varieties, mulch shall be spread at the root of plants.
3. Disease is relatively slight. Cucurbit leaf beetle and the aphid, which grow throughout the period, damage the crop. Especially as the cucurbit leaf beetle do great damage, when the main leaf becomes 8-10, insecticide shall be applied all over the surface.
4. After the fruits become fully ripe, they shall be harvested, especially in case they are to be sold or stored.
5. Fruits shall be stored under the eaves or indoors well-ventilated and not exposed to the sunlight.

Calabash

	<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1	Sowing season	Feb. - Mar.	Feb. - May	
2	Sowing quantity	300g. per acre	300 g.	
3	Sowing method	Direct sowing, 4 - 5 grains		
4	Planting hill	30cm. dia and 20cm. deep	50cm. dia. and 20cm. deep	
5	Number of the days required for germination	Approx. 6 days	Approx. 6 days	
6	The land prepara- tion	Only the sowing holes plowed.	Plowing once by tiller.	
7	Planting space	Row width, 25m. Plant interval, 2m.	Row width, 3m. Plant interval, 2m.	
8	Number of the plants	960 plants per acre	800 plants per acre	
9	Manuring quantity	Cow dung, 6,000 kg.	Compost 2,000	

Number of the fertilizer	Initial manuring	Additional manuring	
		1	2
		-	-

Ammonium sulfate	40	20	10
Superphosphate of lime	60	40	
Potassium chloride	40	20	

Chemical components required per acre:
N. 50 kg., P. 40 kg., K. 40 kg.

10	Manuring method	On the day before the sowing day, or on the sowing day.	Basic manure to the sowing holes approx. 10 days before sowing, soil.
11	Top dressing		Top dressing 2-3 times
12	Heaping the balk	The soil close to the plant is heaped with soil.	Row center digged to make the drain ditch. Both rows heaped with soil.
13	Thinning		Thinning 2-3 times so that one stem may remain finally
14	Making of the trellis	On the point, 3m ² wide, bamboo pole, 1.5m. long is laid cross wise to make the trellis	The soil at the root of plant mulched to protect the root.

15	Pruning	When the number of leaves becomes 6-7, pruning so that secondary vine may grow.	More fruits are born on secondary vine than on the main vine.
16	Maintenance	Weeding and intertillage 2 - 3 times	Intertillage and soil dressing about 2 times.
17	Disease and insect pests	Damage of cucurb: leaf beetle is large.	Leaf beetle control 2 - 3 times.
18	Harvest period	Jun. - Aug.	May - Sept.
19	Yield	6,000 kg. per acre	8,500 - 9,000 kg. per acre

Cautions about the improvement.

People like the calabash gourd for the vegetable diet. As it can be also harvested even in rainy season, it has occupied the important position among the vegetable in rainy season.

It has been cultivated in the gardens of most families for their household use. Though it has not been grown on the farm, the calabash gourd is so resistant against the disease and damp as to be easily raised.

1. Throughout the period, the drain is an important work. As the stagnant water would damage the root and impede the growth, the root of plant shall be heaped with soil.
2. In any system, row or trellis system, the plants shall be mulched to prevent the surface soil from flowing in time of rainfall, and the stems and leaves from being soiled.
3. As the growth is powerful, stems and leaves would thickly grow to worsen the ventilation and make many blossoms fall, if no pruning is given. Pruning shall be, therefore, given as far as possible. As the main vine bears many fruits, the unnecessary buds of the main vine shall be taken a little early so that the secondary vine may grow.
4. The proper harvest time is 30-45 days after the florescence. When the fruits are to be stored, the ripe fruits shall be harvested.

Spnce gourd and (Bitter Melon)

Item	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1	Sowing season	Mar. - May	Feb. - May
2	Sowing quantity	300 g.	300 g.
3	Sowing method	4 - 5 grains per hill	6 - 7 days
4	Germination	6 - 7 days	
5	The land preparation	Only the ground close to the sowing hole is plowed.	The whole farm shall be plowed 1-2 times.
6	Sowing hole	30cm. dia, and 20cm. deep	50cm. dia, and 20cm. deep
7	Planting space	Row width, 2.5m. Plant interval, 2m.	Row width, 3m. Plant interval, 2m.
8	Number of the plant	960 plants per acre	800 plants per acre
9	Manuring quantity	Cow dung, 6,000 kg.	
10	Manuring method	Manuring on the day before the sowing or on the sowing day.	
11	Thinning		Basic manure shall be given 12-15 days before the sowing.
12	Heaping of the row with soil	Heaping soil on ground close to the plant root	Thinning 1-2 times so that one stem may remain. Ditch is necessary for the drain.
13	Trellising	On an area, approx. 3m ² , bamboo piles, 1.5m high.	
14	Mulching		Centre of rows shall be ditched, and both row heaped In case of trellis, ground close to the root shall be mulched.
15	Disease and insect pests	The aphid and cucurbit leaf beetle.	
16	Harvest season	Jun. - Aug.	May - Sept.
17	Yield	5,500kg. per acre	7,000-7,500 kg. per acre

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13471

Name of fertilizer	Basic manuring	Additional manuring
Compost	2,000	-
Ammonium sulfate	40	20
Superphosphate of lime	80	-

Kalium chloride 40
Chemical components required per acre: N. 50 kg., P. 40 kg., R. 40 kg.

Cautions about the improvement.

Sponge gourd and "Nigauri" (Bitter Melon) are, like the bottle gourd, the representative vegetable raised in rainy season in this country. As they can be stored for a long time, they have occupied an important position as the vegetables for family use and as a cash crop. Cultural technique shall conform to that for pumpkin and bottle gourd.

Strawberry

Technique

<u>Item</u>	<u>Technique</u>
1 Formation of flowering bud	Formation of flowering bud is stimulated by the temperature lower than 16°C for several days. And this formation is promoted by short-day method. The growth of flowering bud is promoted by high temperature and long-day method.
2 Cropping system	There are two: one-year system. The plants are renewed every year by using the runners, and the permanent system crops are continuously harvested for several years from the same plants. In this country the one-year system is suitable for the warm areas, where the growth period is long.
3 Propagating method	Though there are three ways by using, the runner, sucker and seed, the runner system is most practical.
4 Runner	After the fruits begin to ripe, many runners come out from the roots gradually in order of the 1st to the 4th. As about 20 young runner can be obtained from one stem, the earlier grown runners are sound.
5 Runner propagating method	Harvested main stem shall be transplanted on a separately prepared bed, and the runner from this stem shall be used for the next cultivation.
(1) Transplantation bed	As for the bed size, it shall be a rectangular, 1m. wide, 6m. long, and approx. 20 cm. high.

- (2) Manuring of the bed
Compost, 5 kg., oil cake, 600g. and superphosphate of lime, 200g. shall be applied per bed 12 - 15 days before transplantation.
- (3) Selection of the main stems
Sound and full plant shall be chosen, and the number of leaves shall be limited to 3 - 4. The root shall be cut to approx. 2/3 to promote the newly rooting from the cut section.
- (4) Transplanting space
Row width and plant interval can be approx. 50cm. and 40cm. respectively (24 - 25 plants per bed).
- (5) Transplantation method
At the transplantation, and immediately thereafter, the plants shall be sheltered from the direct sunshine. Deep planting would worsen the rooting. Before planting, bed shall be fully irrigated, but not immediately after the transplantation.
- (6) Maintenance
Intertillage, weeding, irrigation, drain, etc. shall be properly given to promote the growth of runner.
- 6 Temporary planting method
In some cases, runners are used directly as the setting seedlings. In order to obtain the sound seedlings, however, runners shall be once planted temporarily after they are taken. From the temporarily planted seedlings, large fruits of excellent quality can be expected.
- (1) Time of the temporary planting
Runner with 4 - 5 leaves is suitable for temporarily planted, 40 - 50 days before the setting time. The proper time seems to be from mid-Sept. the end of rainy season to mid-Oct.

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- (2) Bed and manure
This is the same as the case of the transplanting bed for main plant.
- (3) Temporary transplantation space
Row width, 10cm., plant interval, 15cm.
Approx. 400 plants shall be temporarily transplanted per bed.
- (4) Maintenance
Irrigation, weeding, intertillage, etc. shall be properly given to grow the sound seedlings. Runners sprouting during the temporary bed shall be taken off immediately.
- 7 Sound seedling
Sound seedling is as follows; leaf is large and thick, petiole short, and the stem thick. Number of the leaves shall be 7 - 8, and the weight of each plant be 25 - 30 g.
- 8 Setting period
The time of formation of flowering bud in this country seems to be from late Oct. to mid-Nov. As the seeding should not be moved during that season, the proper setting period is from late Dec. to mid-Dec. In this period, the temporarily planted seedlings shall be come full.
- 9 Preparation for the setting
As the seedlings shall be fixed in 3 lines on the row, 1.2 m wide, the row shall be made after plowing. Between the rows shallow ditch. Both rows shall be made even with raised soil. As the drying is serious, the rows shall not be heaped too much.
- 10 Manuring
Excessive application of nitrogen would over-propagate the stems and leaves, put back the ripening period,

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and reduce the color of fruits. N., 60 kg, P., 49 kg and K., 50 kg are required per acre. Example of the manuring quantity for strawberry

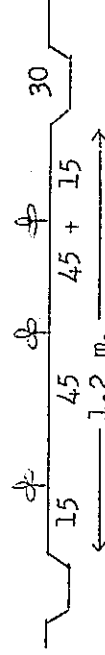
	Compost	Oil Cake	Superphosphate of lime	Potassium chloride	Ammonium sulfate
Basic manuring	4,000kg.	100	80	80	60
Additional manuring		20	-	-	20

11 Manuring quantity

Basic manure shall be applied to the whole surface of balk 12 - 15 days before planting, and mixed well with soil. Additional fertilizer shall be applied 1 - 2 times, the growth condition being observed. It shall be applied by the end of Jan. so as not to be late for the season.

12 Planting space

To be planted in 3 lines on the row, 1.2m wide. Plant interval shall be 30 cm.



Number of the plants to be fixed per acre shall be 4,800 - 5,000.

13 Planting method

Before the setting, the nursery shall be well watered. Seedlings shall be so carefully taken off that the sticked soil block may not be broken, and the carried

to the farm. They shall never be deeply planted. After planting, the portion of their root shall be slightly pushed and irrigated so that the planted seedling may not fall aside.

14 Maintenance

(1) Picking of flowers

If the plant is left alone, it comes into blossom at the rate of 80 - 90 pcs. per plants. If the flowers are too much, good fruit cannot be obtained. In this connection, flowers shall be picked to 15 - 25 pcs. per plant.

(2) Intertillage and weeding

Intertillage and weeding shall be properly given to promote the growth of runners. If the intertillage is given after the runner is grown up, there is a danger of its damaging the roots of plants.

(3) Mulching

The whole surface of rows shall be mulched 2 - 3 weeks before the fruits ripen. In making the mulch, rice straw should be cut into pieces, 20 - 30 cm long each. Mulch would prevent the fruits, stems and leaves from being soiled and dried.

(4) Irrigation

If necessary, the plants shall be irrigated. Row space shall be irrigated approx. once 7 - 8 days.

15 Disease and insect pests

As for the disease, there are the Alternaria alternai, Mildew, etc. which are, however, small in number. As for the pests, the aphid and red mite are found. In destroying these pests, the Nikkarin, TEPP solution,

16	Harvest period	etc. shall be used.	
		Fruits become ripe on the 30th - 40th day after the efflorescence. In this country, harvest begins in early Feb. harvesting in the morning or evening, not in the daytime.	
17	Yield	3,500 - 4,000 kg per acre.	

At present, when the trial cultivation is under way, we expect that a proper cultural method should be found in near future.

Lady's Finger (Okra)

	<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1	Sowing season	Mar. - Apr.	Feb. - May	
2	Sowing quantity	7 - 8 kg per acre.	6 kg	
3	Sowing method	Direct and spot sowing.	Direct and spot sowing	
4	Germination	Germination on the 6th - 7th day	Germination on the 6th - 7th day	
5	Plowing	Plowed twice by cattle		

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6	Manuring quantity	Cow dung, 1,000 kg per acre	Name of fertilizer	Basic Manuring kg	Additional manuring	
					1	2
			Compost	4,000	10	-
			Ammonium sulfate	80	-	-
			Superphosphate of lime	60	-	-
			Potassium chloride	80	10	10
		Chemical components required per acre: N. 60 kg., P. 50 kg., K. 60kg				
7	Manuring method	On the sowing holes on the day before the sowing day, or on the sowing day				
8	Planting space	Mostly random planting, row width, 90 cm, and the plant interval, 10 cm				
9	Number of the plants	7,400 - 7,500 plants per acre				
10	Thinning	8,300 - 8,500 plants per acre Thinning twice after germination so that only one stem may remain finally				

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11	Intertillage and soil covering	Soil heap around the plant	Intertillage and soil dressing shall be given twice - thrice	Drain shall be given
12	Disease and insect pests	Damage of aphids and Oebia undalia	Control is necessary	Side of the leave would be easily affected by pests
13	Harvest period	Jan. - Sept.	May - Sept.	If the harvest is late, fruits would be discolored
14	Yield	1,800 - 2,000 kg	3,500 - 4,000 kg	

Caution in the improvement

Lady's finger is served by frying, and cultured in rainy season. The present varieties are mostly green, and the white variety is small in number throughout the period, the damage of aphid and *Uebia undalia* is serious to reduce the yield.

Cautions are as follows:

1. In cultivating, seeds shall be sown at regular intervals for the uniform growth and make the maintenance easier.
2. After germination, the thickly grown portion shall be thinned so that one stem may remain finally.
3. Soil covering is necessary, and the drain shall be given. The stagnant water would impede the growth.
4. Pests shall be controlled immediately when they are found.
5. When the ripeness is so advanced to harden the leaves, fruits cannot be eaten. Fruits shall be harvested a little early.

Cabbage

<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1 Sowing season	In October	Late in Aug.,-mid-Nov.	
2 Sowing quantity	260 g. per acre	170 g. per acre	Seed preservation shall be improved to promote the germination.
3 Production of seedlings			
(1) Nursery	1m. wide, 6m. long, and 20cm. high	1m. wide, 3m. long, and 20cm. high	long bed is inconvenient for maintenance.
(2) Manuring quantity	Cow dung, 20kg. per bed	Compost, 8kg., superphosphate of lime, 50g., ammonium sulfate, 300g, and potassium chloride, 50g.	
(3) Required number of the bed	Approx. 4 bed per acre	3 beds	
(4) Sowing method	Scattering of seeds	Scattering of seeds	
(5) Sowing quantity per bed	85 g.	43 g.	
(6) Soil covering	Slightly covered mixed with bed soil.	Thickness, approx. 0.5 cm.	Soil for covering shall be separately prepared.
(7) Germination	Evenly on the 7th day after sowing.	Evenly on the 4th day after sowing.	
(8) Transplantation	No transplantation	Transplantation or thinning shall be once given.	
(9) Transplantation time		In time of the growth of young leaves, 5-6 days after germination	
(11) Transplanting space		6m ²	
(11) Number of the plants to be transplanted		768 (48x16) per bed	
(12) Required number of the transplantation beds		14 beds (10752 plants) per acre	
(13) Irrigation	8-10 l. every other day per bed	3 l. twice a day per bed	

(14)	Sunshade of the bed	Bamboo blind	Sunshade only in the day time.
(15)	Maintenance		Slight intertillage 1-2 times
(16)	Disease and insect pests	Damage of aphid is large.	Pests controlled 1-2 times.
(17)	Number of the days in the bed	30 - 35 days	35 - 40 days
4	Plowing and land preparation	Plowed by cattle 2 - 3 times	
5	Making of the rows	After the rough plowing, sowing holes, 20cm. dia. and 10cm. deep each.	After the plowing row width, 1.2m., and the field path, 30cm. wide row width.
6	Planting space	Random planting, row width, 70cm., and the plant interval	<p>30 20 80 20 30 ← 1.2m →</p>
7	Number of the plants	9,000-9,500 plants per acre	10,000-11,000 plants per acre
8	Planting time	Nov. - Dec.	Late in Sept. - mid.-Dec.
			Random planting would make the growth uneven, and reduce the yield.

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9	Manuring quantity	Cow dung, 6,000 kg., oil cake, 120 kg., and ammonium sulfate, 50 kg.	Name of fertilizer	Basic Manuring	Additional manuring
			Compost	4,800	- - -
			Ammonium sulfate	60	20 20 20
			Super phosphate of lime	100	- - -
			Potassium chloride	80	20 - -
			Oil cake	40	15 15 -
			Chemical components required per acre:		
			N. 80 kg., P. 50 kg., and K. 60 kg.		
10	Manuring	Planting holes are manured.	On the planting ditch Basic manured shall be applied a little early.		
11	Additional manuring	Before curling, ammonium sulfate, approx. 20 kg., and oil cake, 40 kg. are added.	Additional manuring with the beginning of curling. If late, it can not curl		
12	Sunshade after the setting	Pruning or weeding	No sunshade required after the latter part of Nov.		

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13	Irrigation	Irrigation once 9-10 days.
14	Maintenance	Intertillage is given 3-4 times
15	Disease and insect pests	Disease slight. As for the pests, aphids propagate throughout the period.
16	Harvest season	Nov. - Apr.
17	Yield	18,000 - 20,000 kg.
18	Number of days for the growth	120 - 130 days

Cautions about the improvement.

During the seedling period, cabbage is highly adaptable to the climate. During the curling period, however, it is subject to the hot damage. The optimum temperature for the growth is 18° - 28°C. In East Pakistan, therefore, it can be grown in dry season at low temperature. Though it could be cultured throughout the year, if the period is combined with the varieties of cabbage, it is necessary at present to breed the proper varieties. The varieties so far cultured belong to the early-summer varieties mostly, and almost their seeds have been imported. The Japanese Nakano early, early-summer and the succession varieties could display their characteristics. As the cabbage can be transported to the remote places, and roughly cultured to some extent, it is a hopeful vegetable in this country. Major cautions are as follows:

1. When the seedling is transplanted about once, the rooting after the transplanting is improved. Though the transplantation does not promote the curling, non-transplanted seedling would grow uselessly and worsen the rooting, as the root hair is small in number. The reason why there are found many plants bearing fruits on the farms comes from the bad rooting. In case the transportation is impossible for various reasons, the nursery shall be thinned 1 - 2 times to grow the sound seedlings.
2. In planting, small seedling with 3 - 4 leaves is better than the large in rooting, and can be more easily rooted after the planting.
3. Cabbage bears its fruit after its outer leaves fully develop, and is subsequently in need of much fertilizer. Therefore, top dressing shall be finished a little early.
4. Flenting shall be given at regular intervals. Random planting would make the cultivation and maintenance difficult, and the growth uneven, and reduce the yield.

5. If the plant is dried, its growth would be weakened. In this connection, irrigation and mulching shall be given. But the cabbage is little resistant against the dump. After the irrigation, especially, water shall not stagnate for a long time.
6. As the outer leaves are highly nutritious fodder, they shall not be dumped on the farms on the farms, but effectively utilized.

Califlower

	<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1	Sowing season	Aug. for the early, Sept. for the middle, and Oct. for the late maturing sort.	Late in July -- Oct.	
2	Sowing quantity	260 g. per acre	180 g. per acre	Improvement of the germination rate
3	Production of the seedlings			
	(1) Seedbed	1m. wide, 6m. long and 20cm. high	1m. wide, 3m. long.	Long bed is in- convenient for maintenance.
	(2) Manuring quantity	Cow dung, 15 kg. per bed	Compost, 8 kg., super- phosphat of lime, 50g. ammonium sulfate, 100g.	
	(3) Sowing quantity	90 g. per bed	40 g.	
	(4) Required number of seed beds	3 beds per acre	3 beds	
	(5) Sowing method	Scattering	Scattering	

(6) Soil covering	Mixed with bed soil	Thickness, 0.5cm.	Soil shall be suitably prepared for covering.
(7) Germination	8th day after sowing	4th day after sowing	If the covered soil is thick, germination would be late.
(8) Transplantation	No transplantation	Transplantation or thinning once.	
(9) Transplantation time		In time of young leaves (7-8 days after budding)	
(10) Transplantation space		6 cm ²	
(11) Number of the plants transplanted		768 pcs. per bed	
(12) Required number of the transplantation bed		4 beds (10,752 pcs.) per acre	
(13) Irrigation	Once 1 - 2 days	Approx. 3L. twice a day per bed.	
(14) Sunshade of the bed	Bamboo screen	Shade only in daytime	

(15) Disease and insect pests	Damage of aphid is large.	Pest control 1 - 2 times	Large seedling is tardy in rooting.
(16) Number of the days required in the bed	30 - 25 days	35 - 40 days	
4 Preparation for planting	Plowed by cattle 2 - 3 times.	After the plowing row 1.2m. wid.	
5 Planting space	Random planting, row width, 80cm., and the plant interval, approx. 60cm.	$30 \left\{ \begin{array}{l} 20 + 80 + 20 \\ \leftarrow 1.2m. \rightarrow \end{array} \right. 30$	
6 Number of the plants	8,330 - 8,400 pcs. per acre	9,000 - 10,000 pcs. per acre	
7 Planting time	Sept. for the early, Oct. for the middle and Nov. for the late sort.	In time of 4 - 5 leaves	
8 Manuring method	Sowing holes are manured	Manure shall be given 12-15 days before planting	

9	Manuring quantity	Cow dung, 6,000 kg. Oil cake, 80 kg. Ammonium sulfate, 40 kg.	Name of the fertilizer	Basic manuring	Additional manuring
			Compost	4,000	1 2
			Ammonium sulfate	40	20
			Superphosphate of lime	90	-
			Potassium chloride	50	-
			Oil cake	100	20

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Chemical components required per acre:

N. 65 kg., P. 50 kg. and K. 50 kg.

Additional manuring Fertilize of con- shall be finished before tinuous effect fruiting shall be given.

10 Additional manuring Once
11 Sunshade after the setting Shad materials small branches of trees and the grass.

12 Irrigation Irrigation once 7-10 days.

13 Maintenance Intertillage, 2 - 3 times
Soil dressing, 1 - 2 times

14 Disease and insect pests Damage of aphids is large.

15 Harvest period Late in Nov.-early in Dec. for the early variety.
Mid-Jan. for the middle
Mid-Feb. for the late

16 Yield Per acre;
3,500 - 4,000 kg. for the early
8,000-9,000 kg. for the middle
8,500-9,500 kg. for the late variety
12,000 kg. - 15,000 kg.

17 Number of the days for growth 100 - 140 days

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Insect pest control 2 - 3 times.

Nov. - Feb.

Cautions about the improvement.

Like the cabbage, cauliflower is less resistant against hot climate, and its proper temperature for the growth is approx. 20°C. Growing season in East Pakistan is as follows: Late in Aug. for the early variety, Jul. - Oct. for the middle and late varieties. In case of sowing after Nov., no fruit is born, because it is too warm for fruiting. Though the harvest period is short, cauliflower is brought into market earlier than any other vegetable in dry season, as there are the early middle and late varieties. It is much to the liking of the inhabitant. Though its cultural method is like that of cabbage, attention shall be paid to the following points:

1. Planting shall be given at regular intervals so that the maintenance may be easily given.
2. If the flower buds remain exposed to the direct sunlight, the fruit quality would reduce, therefore, the fruit should be wrapped by outer leaves as early as possible.
3. Harvest shall be given not too late, but a little early. If the harvest is late, the fruit would be discolored and its quality reduced.

Lettnoc

	<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1	Sowing season	Oct.	Late Sept. - Nov.	
2	Sowing quantity	150 g. per acre	90 g. per acre	Seed preservation shall be improved to enhance the germination rate.
3	Production of the seedlings			
(1)	Nursery	1m. wide and 3m. long	1m. wide, 3m. long, and 20cm. high	
(2)	Mamuring quantity	Cow dung, 12-15kg. per bed	Compost, 10kg., ammonium sulfate, 100g., superphosphate of lime, 50g. and potassium chloride, 50g.	
(3)	Required number of seed beds	6 beds per acre	3 beds	
(4)	Sowing quantity per bed	250 g.	30 g.	
(5)	Sowing method	Scattering	Scattering	

(6)	Germination	Uniform germination on the 5th-6th day
(7)	Temporary planting	Temporary planting, once
(8)	Temporary planting period	In case of young leaves (on the 7-8 day after budding)
(9)	Temporary planting space	5 cm ²
(10)	Number of the plants	1,200 pcs. per bed
(11)	Irrigation	Irrigation, 3l. twice a day per bed
(12)	Required number of the bed	25 beds per acre
(13)	Sunshade for the bed	Sunshade in the day time
(14)	Number of the days in the bed	25 - 30 days
4	Plowing	Levelling after the plowing

5	Planting space	Row width, 30cm. plant interval 30cm. $\frac{-}{20 \quad 40 \quad 40 \quad 20} \frac{1}{30} \leftarrow 1.2m. \rightarrow 30$ Plant interval, 30cm.	3 line planting on the row, 1.2m.																										
6	Number of the plant fixed	44,000 pcs. per acre	34,000 - 35,000 pcs. Plants shall be fixed shallowly.																										
7	Setting period	Nov.	Oct. - Dec. Large seedling is better than the small in rooting.																										
8	Manuring quantity	Cow dung, 6,000 kg.																											
<table border="1"> <thead> <tr> <th rowspan="2">Number of the fertilizer</th> <th rowspan="2">Basic manuring kg</th> <th colspan="2">Additional manuring</th> </tr> <tr> <th>1st</th> <th>2nd</th> </tr> </thead> <tbody> <tr> <td>Compost</td> <td>4,000</td> <td>-</td> <td>-</td> </tr> <tr> <td>Oil cake</td> <td>120</td> <td>-</td> <td>-</td> </tr> <tr> <td>Ammonium sulphate</td> <td>100</td> <td>20</td> <td>20</td> </tr> <tr> <td>Superphosphate of lime</td> <td>80</td> <td>-</td> <td>-</td> </tr> <tr> <td>Potassium chloride</td> <td>100</td> <td>-</td> <td>-</td> </tr> </tbody> </table>				Number of the fertilizer	Basic manuring kg	Additional manuring		1st	2nd	Compost	4,000	-	-	Oil cake	120	-	-	Ammonium sulphate	100	20	20	Superphosphate of lime	80	-	-	Potassium chloride	100	-	-
Number of the fertilizer	Basic manuring kg	Additional manuring																											
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Compost	4,000	-	-																										
Oil cake	120	-	-																										
Ammonium sulphate	100	20	20																										
Superphosphate of lime	80	-	-																										
Potassium chloride	100	-	-																										
Chemical components required per acre: N. 60 kg., P. 30 kg., and K. 50 kg.																													

9	Manuring method	Before plowing	The whole surface of rows shall be manured 10-12 days before setting. Liquid and immediate effective additional fertilizer.
10	Sunshade after the setting	Trees and weeds	Sunshade 3-4 days after the setting.
11	Irrigation		Irrigation once 7-8 days.
12	Disease and insect pests	Damage of white rot and aphid is large.	Pests control 2-3 times.
13	Harvest season	Jan. - early Feb.	Nov. - Mar.
14	Yield	5,500 - 6,000 kg.	8,000 - 8,500 kg.

Harvest shall not be late.

Caution about the improvement.

Lettuce likes a cool climate, and is weak against the hot and dry. The proper temperature for its growth is 15°C. Though there is some demand for the salad use, lettuce is less to the liking of the inhabitants, and mostly supplied to the foreign residents.

1. Before sowing, the pretreatment of seeds are necessary to improve the germination of seeds. That is to dip the seeds into water one day, spread on the straw mats, and dry under the shade. Only if the water is hot, the seeds would germinate in 2-3 days. Before germination, seeds shall be sowed.
2. If seedlings are temporarily planted before the setting, they become sound, and rooting good.
3. Spare seedlings shall be prepared to supplement the dead plants.
4. If the harvest is late, the quality would reduce.

Spinach

<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>
1	Sowing season Oct.	Sept. - Dec.
2	Sowing quantity 40 kg.	20 kg.
3	Sowing method Scattering with seeds	Fine-sowing
4	Plowing Plowed by cattle 2 - 3 times.	Plowing and levelling
5	Planting space	Row width, 75cm.
6	Manuring quantity Cow dung, 6,000 kg.	

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Name of the fertilizer	Basic Manuring		Additional Manuring
	1	2	1 2
Compost	4,000	-	-
Ammonium sulfate	80	20	20
Super-phosphate of lime	60	-	-
Potassium chloride	50	-	-
Lime	150	-	-

Chemical components required per acre:
N. 50 kg., P. 30 kg., and K. 80 kg.

7	Manuring method	The whole surface after the plowing.	Lime before plowing. Manure in Sowing ditch with basic fertilizer 12-15 days before sowing.	
8	Additional fertilizer		Immediate effecting fertilizer 1-2 times.	Refer to the item of Lettuce.
9	Preparation of seeds			
10	Thinning		Thickly grown portion shall be thinned.	
11	Irrigation		Irrigation by pump in Aug. - Oct.	
12	Maintenance	Intertillage, 2 - 3 times.	In addition to the intertillage and weeding, soil dressing a little.	
13	Disease and insect pests	Disease is slight, but the damage of such pests as the aphid etc. is large.	Insect pest control by Endrin 1 - 2 times	
14	Harvest period	Jan. - Mar.	Dec. - Mar.	
15	Yield	2,200 - 2,500 kg.	3,500 - 4,000 kg.	

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Cautions about the improvement.

Spinach in this country is of straight standing type. The taste is bitter and smell of soil. Though it is little to the liking of inhabitants, now leaves can be harvest throughout the long period. Therefore, spinach can be the major vegetable before and after the rainy season.

1. As for the spinach seed, its pericarp is hard, and the germination would often be ununiform. In order to make the germination even, seeds treatment is necessary.
2. Line-sowing shall be employed, the scattering system would make the maintenance inconvenient and the germination uneven, and require a very large number of seeds.
3. As the growing period is relatively short, and the absorption of fertilizer is weak, basic manure shall be given a little early. When the manure runs short, the leaves would be discolored, and the quality reduced. As the additional fertilizer, therefore, the manure liquid of immediate effect is preferable.

Onion

<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1 Sowing season	Oct.	Sept. - Oct.	
2 Sowing quantity	4 kg. for the direct sowing, 2kg. for the transplantation	950 g.	
3 Production of seedings			
(1) Nursery	Irregular-shaped	1m. wide, 6m. long and 20cm. high	
(2) Manuring quantity for the nursery	Cow dung, 10 kg. per 3.3m ²	Compost, 15kg., ammonium sulfate, 300g. superphosphate of lime, 200g. and potassium chloride, 150g. per bed.	
(3) Required number of the seedbeds	10 beds per acre		
(4) Sowing quantity		96 g. per bed	
(5) Sowing method	Scattering with seeds	Scattering with seeds	

(6) Soil covering	Mixed with the surface soil	Thickness, approx. 0.5cm.	Soil shall be separately prepared for covering.
(7) Germination		Uniform germination on the 5th-6th day.	
(8) Soil covering		1 - 2 times to prevent the plant from falling down.	
(9) Irrigation		Approx. 3L. twice per bed.	
(10) Sunshade for the beds	Bamboo-screen	To be screened for 3-4 days at the beginning of germination	
(11) Insect pests	Damage of aphid is large	Endrin 1-2 times	
(12) Number of the days for growth	35 - 40 days	35 - 40 days	
4 Tillage	Plowed by cattle 2 - 3 times.	Levelling after the plowing.	
5 Planting space	Row width, 25cm. and the plant interval, 10 cm.	3-line planting on the row, 1.2m. wide	

6	Number of the plants	66,000 pcs. per acre	Plant interval, 15cm. 65,000 pcs. per acre	20 40 40 20 30 ← 12m →
7	Planting period	Nov.	Nov. - Dec.	
8	Manuring quantity	Cow dung, 6,000 kg.		
9	Manuring method	After plowing		

Name of fertilizer	Basic manuring	Additional manuring	
		1st	2nd
Compost	4,000	-	-
Ammonium sulfate	80	20	20
Superphosphate of lime	100	-	-
Potassium chloride	40	-	-
Oil cake	100	20	-

Chemical components required per acre:
N. 70 kg., P. 50 kg., and K. 60 kg.

Basic manure 12-15 days before planting. Additional fertilizer 1-2 times according to the growth.

10	Maintenance	Intertillage 2 - 3 times	Intertillage and soil dressing 2 - 3 times.	Soil dressing shall be shallowly.
11	Irrigation		Row once 9 - 10 days.	
12	Disease and insect pests	Damage of rust disease and aphids	Control 2 - 3 times.	
13	Harvest period	Mar. - Apr.	Feb. - Apr.	To be harvested a little early
14	Yield	2,800 - 3,000 kg.	7,500 - 8,000 kg.	

Cautions about the improvement.

Onion in this country is planted from Nov. to Mar. suitable period for the growth. This is the small-ball variety, which is chiefly used for making the salad. Though the growing area is big in the suburbs of cities, its yield per unit area is very small, because the cultural method is negligent.


As the onion can be stored for a long time, it is a vegetable of highest use, which can be used and shipped to the remote places throughout the year.

Major cares about the cultural technique are as follows:

1. In case of direct sowing, seeds shall be sowed in lines. Scattering sowing would make the growth uneven, because the maintenance is inconvenient.
2. After the direct sowing, the thickly grown portion shall be thinned. pulled-up seedlings shall be used to supplement the dead.
3. Seedlings shall be planted shallowly, and the roots shall be slightly pushed.
4. Dressing the soil shall be 1 - 2 times to prevent the onions from covering above the ground, and the stems from falling down.
5. When the harvest is late, the onion would be cracked to reduce the quality and shorten the life. Therefore, harvest must be a little early.

The proper harvest period is that when the stems and leaves naturally fall down by approx. 70-80%, and the color of leaves becomes light a little.

Stone leek (Green onion)

Item	Present local technique	Improved technique	Remark
1	Sowing season	Nov.	Sept. - Oct.
2	Sowing quantity	150 kg. per acre (young bulbs)	650 g. per acre
3	Production of seedlings		Similar to that for onion
4	Planting space	Random planting	2-line planting on the row, 1m. wide 
5	Number of the plant		Plant interval, 15cm. 44,000-50,000 pcs. per acre
6	Planting period		Nov.-Dec. Age of seedling, 40-45 days

7	Manuring quantity	Cow dung, 6,000 kg.		
8	Manuring method	After the plowing		
9	Maintenance	Inter-tillage, 3 - 4 times		

Fertilizer	Basic manuring	Additional fertilizer	
		1st	2nd
Compost	4,000	-	-
Oil cake	100	-	-
Superphosphate of lime	50	-	-
Potassium chloride	80	-	-
Ammonium sulfate	60	20	20

Chemical components required per acre:
 N. 80 kg., P. 40 kg., and K. 50 kg.

Basic fertilizer in the sowing ditch.
 Additional fertilizer on the centre of row, and heap with soil.

In addition to the inter-tillage, soil dressing 1-2 times, not deeply at a time. Irrigation once 8-10 days.

10	Disease and insect pests	Control 1-2 times
11	Harvest period	Feb. - Apr.
12	Yield	7,500 - 8,500 kg.
	Damage of aphid is large.	
	Feb. - Apr.	
	Bulb : 1,200-1,500kg.	
	Stems and leaves:	
	5,500-6,000 kg.	

Cautions about the improvement.

Stone leek in this country is the "Wakegi" (shallot), such big-shape leek as Japanese is not found here.

Stem has approx. 8 - 15 branches. The inhabitants like, however, small balls of the roots than the stem and leaves. After the stem and leaves are yellowed, small balls are cropped in many cases.

As the stone leek can be, like the onion, stored for a long time, there is found a demand throughout the year.

1. In planting, the row shall be cut at regular space.
2. After the intertillage, soil shall be slightly dressed 1 - 2 times to prevent the plants from falling down.
3. Others are the same as in case of onion.

Radish

		<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>									
1	<u>Item</u>												
	Sowing period	Oct.	1) Sept. - Jan. 2) May - Jun.										
2	Sowing quantity	10 kg. per acre	4 kg. per acre										
3	Sowing method	Scattering with seeds	Line-sowing for save the seeds										
4	Soil covering	By plow	Thickness, approx. 0.5cm.	Soil covering method for the uniform germination.									
5	Germination	6 - 8 days	5 - 6 days										
6	Row width		60cm.										
7	Plant interval		30 - 40 cm. after budding										
8	Manuring quantity	Cow dung, 6,000 kg. Ammonium sulfate, 80 kg.	<table border="1"> <thead> <tr> <th>Name of fertilizer</th> <th>Basic manuring</th> <th>Additional manuring</th> </tr> </thead> <tbody> <tr> <td>Compost</td> <td>2,000</td> <td>1st - 2nd -</td> </tr> <tr> <td>Ammonium sulfate</td> <td>80</td> <td>20 20</td> </tr> </tbody> </table>	Name of fertilizer	Basic manuring	Additional manuring	Compost	2,000	1st - 2nd -	Ammonium sulfate	80	20 20	
Name of fertilizer	Basic manuring	Additional manuring											
Compost	2,000	1st - 2nd -											
Ammonium sulfate	80	20 20											
9	Manuring method	Cow dung as the basic manure by plowing. Before the intertillage, ammonium sulfate as additional fertilizer.	<p>Chemical components required per acre:</p> <p>N. 60kg., P. 30kg., K. 40kg.</p> <p>Basic fertilizer 8-10 days before sowing. After the thinning, additional fertilizer 1-2 times.</p>	<table border="1"> <tbody> <tr> <td>Superphosphate of lime</td> <td>60</td> <td>-</td> <td>-</td> </tr> <tr> <td>Potassium chloride</td> <td>60</td> <td>-</td> <td>-</td> </tr> </tbody> </table>	Superphosphate of lime	60	-	-	Potassium chloride	60	-	-	
Superphosphate of lime	60	-	-										
Potassium chloride	60	-	-										
10	Thinning		On the 7th-8th day after germination, 1st thinning. In 10-15 days thereafter, thinning 1-2 times.	Thinning during the growth is especially important.									
11	Intercultivation and soil dressing	Only intercultivation is given 2-3 times.	After the intertillage, soil dressing slightly 2-3 times.										
12	Irrigation		Irrigation once 9 - 10 days.										
13	Insect pests	Damage of plant lice is serious	Dusting of Emdrin and Aldrin agents										

14	Harvest period	Jan. - Feb.	Nov. - Mar.
15	Yield	6,000 - 7,000 kg. 4,000 - 5,000 kg.	1) 18,000 - 20,000 kg. 2) 7,500 - 8,000 kg.

Caution about the improvement.

Radish in this country is the medium size variety, and leaves are hard and deeply cut.

The color of root is, white, red, purple, etc. On account of the lack of the improved organization of seed renewal, the quality of radish also has degenerated during the long years. The surface of root became like a cork, and the flesh is hard. But the radish of this variety has much resistance to high temperature, and damp, it can grow even in rainy season from Jul. to Aug., and young roots in this season can be used.

In this connection, it is keenly desired to breed the new varieties in near future.

1. The deep plowing before sowing could prevent the root from branching, and enhance the quality.
2. Line-sowing is effective to save the seeds and improve the effect of such works as the thinning, weeding, intertillage etc.
3. As for the fertilizer, not only the nitrogen but also the potassium have a large effect. Immature cow dung would branch the root.
4. Thinning would affect the evenness of root and the yield. In response to the growth, the bad portion shall be thinned 2 - 3 times.
5. If the harvest is late, the flesh of the root does not become compact, and it would reduce the quality. In relation to the local variety, it should be properly harvested 40 - 50 days after sowing.

Turnip

<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1	Sowing period.	Nov.	Sept. - Jan.
2	Sowing quantity	2.5 kg. per acre	1 kg.
3	Sowing method	Scattering with seeds	Line-sowing
4	Soil covering	Plowed	Thickness, 0.3-0.5cm.
5	Germination	On the 6th-7th day	On the 3rd-4th day
6	Row width		60 cm.
7	Plant interval		20-30cm. after thinning
8	Manuring quantity	Cow dung, 6,000 kg.	

<u>Name of fertilizer</u>	<u>Basic manuring</u>	<u>Additional manuring</u>
Compost	4,000	-
Ammonium sulfate	80	20
Superphosphate of lime	100	-
Potassium chloride	60	-

9	Manuring method	The manuring on the sowing day or on the day before that	Chemical components required per acre: N. 60 kg., P. 30 kg., and K. 40 kg. The basic fertilizer 10 days before sowing. Additional fertilizer after thinning.
10	Thinning		Thinning 2-3 times after germination so that the final plant interval may be 20-30 cm.
11	Intertillage	Twice	After intertillage, soil dressing several times, slightly
12	Disease and insect pests	Disease is relatively slight. Damage of aphid is large.	Control 1 - 2 times
13	Harvest period	Jan. - Feb.	Nov. - Mar.
14	Yield	4,500 - 5,000 kg.	9,500 - 10,000 kg.

Cautions about the improvement.

Turnip in this country is a cylindrical small-shaped variety. Its shape is irregular, branch root is thick, and the surface is rough. Color of the surface is white, red, purple, etc. Flesh is hard.

Though the crop is so small to satisfy the demand for home use, its cultivation would be hopeful, viewed from the land utilization, because the growing period is short, and the cultivation is relatively easy.

Points in the improvement are the same as radish.

Carrot

<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1	Sowing period 1) Oct. 2) Jan.	1) Aug. - Feb. 2) Apr. - Jul.	
2	Sowing quantity 5 kg. per acre	2 kg. per acre	
3	Sowing method Scattering	Line-sowing	
4	Soil covering Hoed or plowed by cattle	Thickness, approx. 0.5 cm.	After the soil is covered, tamping
5	Germination On the 8th-10th day after sowing	On the 7th-8th day after sowing	
6	Planting interval	Line-sowing on the row, 1m. wide	
		<p>30 20 60 20 30 ← 1m. →</p>	
		Planting interval, 15-20cm. 15-20 cm.	

7	Manuring quantity	Cow dung, 6,000 kg.			
8	Manuring method	The whole surface is manured.			
9	Thinning				
10	Insect pests	Damage of aphis is serious.			

Name of fertilizer	Basic manuring kg.	Additional fertilizer	
		1st	2nd
Compost	2,000	-	-
Ammonium sulfate	80	15	15
Superphosphate of lime	60	-	-
Potassium chloride	70	-	-

Chemical components required per acre:

N. 60 kg., P. 30 kg., and K. 40 kg.

Basic fertilizer 10 days before sowing.

Additional fertilizer, intertillage and soil dressing.

Thickly grown portion thinned 2-3 times.

Aphis control

11	Harvest period	1) Jan. - Mar. 2) Apr. - May
12	Yield	1) 4,000-4,500 kg. 2) 2,500 - 3,000 kg.

1) Nov. - May
2) Jul. - Sept.
1) 8,000 - 8,500 kg.
2) 4,500 - 5,000 kg.

Cautions about the improvement.

Carrot likes the cool climate. In this country, therefore, it grows chiefly in dry season at low temperature. Even in rainy season, it can grow by virtue of such protective measures as the drain, mulching, etc. In some area, it is actually cultivated. In rainy season, the growth of stem and leaves is well. Because of the high temperature and over-damp, however, the root is not well grown and badly colored. As the carrot is only the colored vegetable which can be stored in this season, however, it is necessary to increase the yield chiefly in rainy season.

A. Attention must be payed as follows.

1. Row shall be 1m. wide, and as high as 35-40cm. for the drainage.
2. After the soil covering succeeding sowing, the carrot plants shall be covered thinly with straw and weed. This cover would prevent the soil from splashing in the rainfall, and from being hardened. If these covering materials are left alone after germination, they would hinder the germination because they are too thick.
3. Thinning shall not be given too early, because on the portion, where the density of the plants is somewhat thick, the growth is rather better. Only the too thickly grown portion shall be thinned 1-2 times.
4. No water shall stagnate at the root. Attention shall be, therefore, paid to the drain.

B. Cares in dry season

1. Row shall be flat or high, line-sowing shall be employed.
2. Soil shall be kept some moisture to make the germination uniform. After the soil is covered, it shall be pressed so that the soil may stick to the seeds.

3. Unripe cow dung and compost would make the root branch
Therefore, the ripe material shall be applied.
4. Thinning 2-3 times. After thinning, soil shall be
shallowly dressed so that no root may come above the
ground.

Potato

Item	Present local technique	Improved technique	Remark																				
			1st	2nd																			
1	Sowing period	Nov.	Sept. - Dec.																				
2	Required sowing quantity	600 kg. per acre	550 kg. per acre																				
3	Row width	40cm.	50 cm.																				
4	Plant interval	15cm.	25cm.																				
5	Number of the plants	66,700 pcs.	32,000 pcs.																				
6	Planting method	Depth, 8-10cm.	5-6 cm.																				
7	Manuring quantity	Cow dung, 6,000 kg., Oil cake, 150kg. and the Urea, 60kg.	<table border="1"> <thead> <tr> <th rowspan="2">Name of fertilizer</th> <th rowspan="2">Basic manuring</th> <th colspan="2">Additional manuring</th> </tr> <tr> <th>1st</th> <th>2nd</th> </tr> </thead> <tbody> <tr> <td>Compost</td> <td>4,000</td> <td>—</td> <td>—</td> </tr> <tr> <td>Ammonium sulfate</td> <td>40</td> <td>10</td> <td>10</td> </tr> <tr> <td>Superphosphate of lime</td> <td>100</td> <td>—</td> <td>—</td> </tr> </tbody> </table>	Name of fertilizer	Basic manuring	Additional manuring		1st	2nd	Compost	4,000	—	—	Ammonium sulfate	40	10	10	Superphosphate of lime	100	—	—		
Name of fertilizer	Basic manuring	Additional manuring																					
		1st	2nd																				
Compost	4,000	—	—																				
Ammonium sulfate	40	10	10																				
Superphosphate of lime	100	—	—																				
- 401 -																							
8	Manuring method	Basic fertilizer, cow dung and oil cake 10 days before planting. Top dressing, urea before irrigation.	<table border="1"> <tbody> <tr> <td>Potassium chloride</td> <td>60</td> <td>—</td> <td>—</td> </tr> <tr> <td>Oil cake</td> <td>80</td> <td>—</td> <td>—</td> </tr> </tbody> </table>	Potassium chloride	60	—	—	Oil cake	80	—	—												
Potassium chloride	60	—	—																				
Oil cake	80	—	—																				
9	Soil dressing	2 - 3 times	Thickness, 7 - 8 cm. at the interstilla-ge and additional manuring.		To prevent the ground temperature from increasing, and promote the growth of stems.																		
10	Irrigation	Irrigation once 30 days.	Approx. once 10-12 days.		To use the pump.																		
11	Disease and insect pests	Late blight and Bacterial wilt	Insecticide regularly																				
12	Harvest period	Feb. - Mar.	Feb. - Apr.																				
13	Yield	7,000 - 7,500 kg.	8,500 - 9,000 kg.																				

Problems and cares in the cultivation.

Of the vegetables in this country, potato is most systematically cultivated, and in some areas potatoes are cultivated collectively.

Seed potatoes have been chiefly imported from Burma, India, and Holland. Though the seeds could be obtained in some mountain areas of this country, but in the case of the selection of the potato seeds, these items should be considered, i.e. the ripe period, productivity, physiological characteristics, dormancy, disease resistance, etc. In growing the seeds, there are the following problems.

1. According to the present system, the planting interval seems to be too small.

As for the potato, planting space approx. 18-20cm² is required per plant. Such a small interval as mentioned above is one of the reason why the potato is small-sized and the yield is also poor for the thick growth of stem and leaves.

2. As the planting depth has no relation to the number of tubers, no production increase cannot be expected, even if deep planting is given. Deep planting would retard the germination and worsen the germination rate.
3. As the growth is rapid, stress shall be laid on the basic fertilizer. Top dressing shall be given early. If the compost is laid on the soil above the potato, it could serve to prevent the drying.
4. Unlike the other vegetables, potato is collectively cultivated in some area. But the disease and insect control and irrigation works are still going quite individually. It is very uneconomical. In order to increase the yield, therefore, it is desirable to use the machinery, tools, etc. as planned.

String Bean

<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>
1 Sowing period	Sept. - Oct.	1) Sept. - Nov. 2) Jan. - Feb.	
2 Sowing quantity	25 - 30 kg.	20 kg.	
3 Row width	Random planting	75 cm. (creeping type) 90 cm. (vine type)	
4 Plant interval		40 cm.	
5 Number of the plants		13,300 pcs. (creeping type) per acre 11,100 pcs. (vine type) per acre	

Name of fertilizer	Basic manuring	Additional manuring
Compost	2,000	(once)
Superphosphate of lime	80	-
Potassium chloride	100	-
Ammonium sulfate	40	15

Cow dung, 5,000 kg.

Manuring quantity

Chemical components required per acre:

N. 25 kg., P. 40 kg., and K. 50 kg.

At plowing

Manuring method

Basic initial fertilizer 10-12 days before sowing. After germination 1-2 stem may remain.

Additional fertilizer once at the early stage of efflorescence.

Sowing method

Spot-sowing, 3-4 seeds per point.

Soil covering

Thickness: approx. 1cm.

Germination

On the 5th-6th day after sowing. If the covered soil is thick, germination would be late.

11 Support

4-6 supports bound to make a set.

12 Maintenance

Intercultivation, 2-4 times

As for only the vine sort, supports tied to each other on the basis of two rows to form a roof. Length of the support shall be 1.8-2m. In dry season, irrigation once 8-10 days between rows. After the intertillage slight soil dressing.

13 Disease and insect pests

Disease is relatively slight. Damage of the red mite and aphid is serious

Insect pest control 1-2 times.

14 Harvest period

Jan. - Mar.

1) Nov. - Mar.
2) Mar. - May

15 Yield

Nut 250 - 300 kg.

Nut 800 kg.
Pod 5,000 kg.

Cautions about the improvement.

Of the vegetables, string bean is the most easy to cultivate. Most of the cropped string beans are the vine type. The creeping type is very small in number. The bean pod is supplied chiefly for the edible use.

The local variety can continuously grow throughout the year. But the percentage of sterility is high, the yield is very small. Especially in rainy season, the beans are apt to germinate in the pods, and so harvesting becomes difficult.

As the string bean is a hopeful as a short period vegetable, efforts shall be made to breed the excellent varieties and increase the yield.

1. Plants shall not be left alone after sowing. As for the vine type, supports shall be given, and proper maintenance shall be given in accordance with the growth.
2. Scattering seeds, and the random planting are inconvenient maintenance.
3. After germination, the thickly grown part shall be thinned so that the stem may be 1 - 2.
4. In rainy season, the row shall be high for the drain. The water stagnant at the root would weaken the growth.
5. The plants for the green pods shall be harvested a little early. The plants for the beans shall be harvested after perfectly ripen.

Pea

<u>Item</u>	<u>Present local technique</u>	<u>Improved technique</u>	<u>Remark</u>	
1 Sowing period	Nov.	Sept. - Nov.		
2 Sowing quantity	25 - 30 kg.	15 kg.		
3 Sowing method	Scattering	Spot-sowing (2-3 grains)		
4 Row width		80 cm.		
5 Plant interval		40 cm.		
6 Number of the plants		12,500 pcs.		
7 Manuring quantity	Cow dung, 5,500 - 6,000 kg.		Additional manuring	
			1st	2nd
			4,000	-
			80	10
			Superphosphate of lime 80	-
			Potassium chloride 120	-

8	Manuring method	<p>Chemical components required per acre: N. 40 kg., P. 40 kg., and K. 50 kg.</p> <p>Basic manuring: 10 days before sowing. Additional manuring: 1-2 times towards the efflorescence.</p>
9	Supports	<p>When the plant becomes 15-20 high, supports 1.2-1.5m. long each bound up to form a</p> <p>Not only the bamboo but also the jute stem can be used for the supports.</p>
10	Maintenance	<p>intertillage 2 - 3 times</p> <p>After intertillage, soil dressing shall only 1-2 times. Vine led to the support only once for the first time. Irrigation once 8 - 10 days,</p> <p>The stagnant water would damage the root, and the watering shall be so much as to sprinkle.</p>
11	Disease and insect pests	<p>Dusting of the nicotine and Drin solution</p> <p>Disease relatively slight. Damage of leaf miner is serious.</p>
12	Harvest period	<p>Feb. - Mar.</p>
13	Yield	<p>1,200 - 1,500 kg.</p>

Cautions about the improvement.

Peaplant in this country is a short-size type, 40-50 cm. high. Though it has many branches, pod is small and as short as 2cm. Epicarp is thick and the bean is small. As it does not grow in the hot, it is cultivated in dry season at low temperature.

Though it is for the beans, the yield is small, if no care is given after sowing. But it branches and grows vigorously. Therefore, it is suitable as the cattle fodder and green manure.

As the medium and large bean varieties, yield is also high, introduction of these varieties is desirable. Other cares are the same as those for the beanplant.

(Table, No. 2-a)

Legend: ○ : Sowing period

Cultivation period

□ : Setting period

▭ : Harvest period

(Present local technique)

Month : Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May Jun. Jul.

Sort:

- 1. Tomato
- 2. Eggplant
- 3. Cucumber
- 4. Watermelon
- 5. Japanese cantaloup
- 6. Red pepper
- 7. Pumpkin
- 8. Calabash gourd
- 9. Bitter melon
- 10. Lady's finger
- 11. Cabbage
- 12. Cauliflower
- 13. Lettuce
- 14. Spinach
- 15. "Wakegi"
- 16. Onion
- 17. Radish
- 18. Turnip
- 19. Carrot
- 20. Potato
- 21. Sweet potato
- 22. String bean
- 23. Peaplant
- 24. Corn

Direct sowing

(Table, No. 2 - 6)

Legend: ○ : Sowing period
□ : Setting period
▣ : Harvest period

Cultivating period

(Improved technique)

Month: Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May Jun. Jul.

Sort:

1. Tomato	9. Bitter melon	17. Onion
2. Eggplant	10. Strawberry	18. Radish
3. Cucumber	11. Lady's Finger	19. Turnip
4. Water melon	12. Cabbage	20. Potato
5. Japanese Cantaloup	13. Cauliflower	21. Sweet potato
6. Red pepper Green pepper	14. Lettuce	22. Carrot
7. Pumpkin	15. Spinach	23. String bean
8. Calabash gourd	16. Stone leek	24. Peaplant
		25. Corn

Fruiting on each node Fruiting on branch

(Table, No. 3)

Table for the Vegetable Raising

Sort:	Rotation period (year)	Sowing quantity (g)	Sowing period (month)	Setting period (month)
Row width (cm.)	Plant interval (cm.)	Number of the plants set (pcs.)	Harvest period (month)	
Yield (kg)	Manuring quantity N P K (kg)	Remark		
1. Tomato	1 - 2 stems			
2. Eggplant	Cares about the drain age in rainy season.			
3. Cucumber	Vine type for the dry season. creeping type for the rainy season.			
4. Water melon	When the leaf becomes 5-8, improper buds shall be taken off.			
5. Japanese cantaloup	Improper buds shall be picked off to grow the small vines.			
6. Red pepper	In case of direct sowing, thinning 1 - 2 times.			
7. Pumpkin	When the leaf becomes 5 - 6, improper buds shall be taken off.			
<hr/>				
8. Calabash gourd	Mulching.			
9. Bitter melon	"			
10. Lady's finger	Harvest little early.			
11. Cabbage	Small seedling with 4 - 5 leaves shall be fix-planted.			
12. Cauliflower	"			
13. Lettuce	Mulching needless.			
14. Spinach	Pregenerated seeds sown.			
15. Onion	Repeated cultivation possible To be planted shallowly.			
16. Stone leek row 3 line planting			"
17. Radish after thinning			Thinning shall be given 2-3 times.
18. Turnip	"			"
19. Carrot	Selection of superior tuber for seed.			
20. Potato	In rainy season, thinning to reduce the plant interval.			
21. Stering bean	Nut Pod	Support for the vine type		
22. Peaplant	"			

(Table, No. 4 - a)

List of the Major sorts of vegetables

<u>Sort of the vegetable</u>	<u>Local Name</u>	<u>Major varieties</u>
1. Tomato	9. Bitter melon	17. Radish
2. Eggplant	10. Lady's finger	18. Turnip
3. Cucumber	11. Cabbage	19. Carrot
4. Watermelon	12. Cauliflower	20. Potato
5. Japanese cantaloup	13. Lettuce	21. Peaplant
6. Red pepper	14. Spinach	22. String bean
7. Pumpkin	15. Onion	23. Corn
8. Calabash gourd	16. Stone leek	24. Sweet potato

(Table, No. 4 - a)

List of the Major solts of vegetables

Solt of the vegetable	Local Name	Varieties
1. Tomato	9. Bitter melon	17. Radish
2. Eggplant	10. Lady's finger	18. Turnip
3. Cucumber	11. Cabbage	19. Carrot
4. Watermelon	12. Cauliflower	20. Potato
5. Japanese cantaloup	13. Lettuce	21. Peaplant
6. Red pepper	14. Spinach	22. String bean
7. Pumpkin	15. Onion	23. Corn
8. Calabash gourd	16. Stone leek	24. Sweet potato

(Table, No. 4-b)

Variety of the vegetable	Name of the Japanese variety	Remarks
1. Tomato		The Fukuju, No. 2 is largest in yield, 16,840 kg. per acre. The Sekaichi and Hikari rank next.
2. Eggplant		The Nagaoka-cho is suitable throughout the year. The Kurema-cho display its characteristics in spring sowing (crop in rainy season).
3. Cucumber		The creeping Aonaga is suitable for rainy season, and others for the dry area at low temperature.
4. Watermelon		Fruits of all three sorts are small-sized, sweet and much productive.
5. Japanese cantaloup		Both are well grown and high productivity.
6. Oriental pickling melon		Though the fruits are not so large, their quality is excellent, and the yield is high. As there is no custom of pickling the vegetables in this country, it is used for making the salad like in case of cucumber.

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7. Pumpkin		The Aizu early is suitable in dry season at low temperature, and the Shintosa in rainy season.
8. Cabbage		As it is hot in this country, flowering does not come into question. Though the Japanese varieties are proved to stop curling early, all of them display their characteristics and their yield is also high.
9. Lettuce		All can grow during the cool period from Sept. to Jan. The Penrake has resistance to the high temperature.
10. Spinach		It becomes vigorous and can be easily cultivated.
11. Onion		The early variety is more suitable than the late. The Senshu is hopeful for eating their leaves.
12. Stone leek		It has resistance to the high temperature and humidity, so suitable in rainy season.
13. Radish		It is not subject to disease, vigorous and large-sized. Above all, the early variety is excellent in quality.

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14. Turnip

Medium-sized turnip of pure white and beautiful crop can be obtained. Flesh is superior, and the yield is also high.

15. Carrot

The short-root variety is suitable for the crop because of soil character.

16. String bean

The cultivation in dry season at low temperature is proper. In rainy season at high temperature and humidity, many seeds cannot be expected on account of sterility.

17. Peaplant

As for the pod variety, the pod would be hardened early. Harvest may not be, therefore, too late.

2. Vegetable production and land utilization.

As show in the table for the vegetables cultivation period (Table, No. 2), the land occupation period of each crop is mostly controlled by temperature and the length of daytime. In East Pakistan, there two big factors which control the land utilization are the flood in rainy season, and the drought in dry season. Meanwhile, the rice is most important among of farm-cropping system, and the vegetables are grown during the crop period other than the rice. When these above conditions are combined with one another, the crop field for each vegetable and the cropping system are decided. This situation can be understood clearly, if the Table, relation between the land elevation (viewed from the flood in rainy season) and various sorts of vegetables, is observed.

On the highland, summer vegetables are grown in rainy season. In dry season, however, no winter vegetable grows because of severe drought. But when the summer vegetables are in competition with the AUS rice in growing period, and then the rice culture is stopped.

On the medium land, not only summer but also autumn and winter vegetables are cultivated, but in small area. In winter from Dec. to Mar. after the AUS rice and the transplanted AMON rice, the land lies fallow in many cases, because the soil is excessively dry next to the high land.

As for the low land (1), summer vegetables cannot grow due to the flood in rainy season. As the flood period is relatively short, however, winter vegetables can be grown. Furthermore, the soil in dry season is not so dry as in the highland and medium land. Most of the autumn and winter vegetables are cultivated in this region.

The cropping system is mostly the type, AUS (Jute) - Autumn and winter vegetables. Though the Aman is almost mixed with the AUS, no Aman is cultivated, when the vegetables are cultivated farms.

On the lowland (2), little vegetable is grown for the following reason: In the case of water AMAN, the field is occupied with rice from Mar. and Apr. - Nov., and subsequently the winter crop period is considerably shortened. But the water content of soil is so much to water, it is, therefore, possible to introduce the vegetables, which can grow for a short period.

On the lowland (3), Boro rice is generally cropped, but no vegetable is grown. If any vegetable is introduced here, it would compete with rice.

Summerizing the relation between vegetables and land type as following:

Summer vegetables in the highland.

Summer, autumn and winter vegetables in the medium land. But their crop area is small.

Autumn and summer vegetables are mostly cultivated in the lowland (1).

Little vegetable is grown in the lowland (2) and lowland (3).

In connection with the above, it is a problem, in which area the vegetable crop should be extended.

Only if the highland and medium land areas are irrigated, there is much room for the winter vegetables. As for the lowland (2) area to secure irrigation water is rather easy, short-term vegetables could be introduced. If the deep water Aman of small yield could be given up, the vegetable period can be prolonged to Dec. - May so that it is possible to introduce various vegetables. In the meantime, if the vegetables are introduced to the lowland (3) area in place of BORO rice, whose crop is considerably stabilized and profitable, it is necessary to make choice of vegetables so favorable. In the first place, therefore, it should be considered to introduce the vegetables into the lowland (2) area, where the land lies fallow in winter season.

Anyway, the irrigation facilities are indispensable for the introduction of vegetables in dry season. If these facilities are made available, the vegetable area could be very easily extended to enhance the utilization of land.

SS: -

(Refer to the Table, No. 6)

(Table, No. 5)

Relation between the Elevation of Land (Viewed from the flood in rainy season) and Various Vegetables.

Period when the vegetable is cultured	Highland	Medium	Lowland (1)	Lowland (2)	Lowland (3)
	Throughout the year	Throughout the year (except Aug. - Sept. when the farms are often flooded)	Nov. - Jun.	Dec. - May	Jan. - Apr.
1. Tomato		11. Lady's finger		21. Sweet potato	
2. Eggplant		12. Cabbage		22. Carrot	
3. Cucumber		13. Couliflower		23. String bean	
4. Watermelon		14. Lettuce		24. Peaplant	
5. Japanese caulaloup oriental pickling melon		15. Spinach		25. Corn	
6. Red pepper Green pepper		16. Stone leek			

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7. Pumpkin
8. Calabash
9. Bitter melon
10. Strawberry
17. Onion
18. Radish
19. Turnip
20. Potato

Notes

- a. Classification of land in relation to the flood is almost the same as in case of rice crop. Therefore, the period when the vegetable could be grown would vary with the region.
- b. mark indicates a district where the vegetable is cultivated for a time at present
o mark indicates an area where the vegetable can be cultivated in addition to the present growing area, if irrigation facilities are available and the cultivation is not controlled by the rice crop.

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3. Correction of the seasonal deflection in the vegetable production.

In this country, so far the vegetable production concerns, it is an important problem to supply the vegetable products evenly through the year. Even though it is inevitable that some areas are submerged in rainy season, the future production of vegetables in the highland and medium land is a subject to be settled. As disclosed in the Table, No. 2-a. Growing period (Local technique), the sorts of vegetables at present in the above areas are the tomato, cucumber, red pepper, pumpkin, bottlegourd, Bitter melon, Lady's finger, and corn. If the above table is compared with the Table, No. 2-b (Improved technique), summer vegetables such as the watermelon, spinach, Stone leek, Carrot, etc. are additionally found in the latter table. If further researches are made, more other important vegetables could be cultivated.

Many people seem to have so far considered it difficult to produce the summer vegetables. If the sort and growing method for winter is applied to the summer vegetables, the production of summer vegetables would be naturally difficult. In this connection, it is necessary to employ the sort and growing method adapted to the growing environment of summer vegetables. In Dacca, for instance, we have tested to cultivate the watermelon of Japanese sort Fuken. The experiment has disclosed that the watermelon can be grown, as mentioned for the drain. If the vegetables highly resistant against hotness and disease, adapted to the daylight and temperature in summer, are found, or bred, and the researches in their growing method make advance, the seasonal shortage of vegetables in summer could be settled.

The extension of the harvest period so long as possible is also an important step to alleviate the seasonal deflection in the vegetable production. As shown in the Table, No. 2, Growing period (Improved technique), the length of harvest period can be extended, when the early and late varieties are combined each other, and the date of sowing period is changed.

In Japan, researches into the off-season and

further the all-year-round cultivation of important vegetables are under way. For instance, the cabbage, etc. can be cropped throughout the year over a wide area.

In order to make up for the shortage of vegetable supply in summer season, therefore, it would be important to increase such vegetables as the onion, potato, etc., which can be stored for a long time, and supply them throughout the year by improving the storing facilities.

4. Significance of the growing of concentrated producing districts of vegetables.

Recently in Japan, the Government has specified certain districts, where specific crops are concentrated, in producing such crops as the vegetables, fruits, etc., which have a close relation to the market. Thus the concentrated producing districts are being developed as a step of the Government policy. In consequence, concentrated production areas have been made in various regions to achieve considerable results. Such a production system has the following advantages:

- a. As individual farmers organize an union, in which the variety is unified, agreement is made upon the cultural method, and the products are checked and shipped in co-operation, the quality of products is unified, the mass-shipment possible and the profit greatly increased on the market.
- b. As the mass-production system is possible by means of collective organization, various agricultural implements and machines, which could not be purchased by individual, can be purchased to improve the productivity of farming.
- c. By means of collective system, the improved technique can be intraduced early to increase the general yield.

In East Pakistan, too, like in Japan, the farmer's holding is small. In various regions, therefore, suitable sorts of vegetables should be

chosen, and subsequently the concentrated producing districts should be developed to increase rapidly the production of vegetables.

5. Improvement of the seed collection system.

Unless the seeds of excellent quality are supplied to the demand of farmers, production increase of vegetable cannot be expected.

In East Pakistan at present, however, no seed collection system has not yet been established unlike in case of rice. Under such a condition, farmers are forced to gather seeds on their farm, or obtain seeds of lower reliability from others. Some farmers do not know even the name of variety. Many vegetables are naturally crossed and hereditary impure. In the hot and damp climate, the imperfect preservation would seriously damage the germination of seeds. It is, therefore, urgent to establish seed propagation system to supply the seed of excellent quality to all farmers. Meanwhile, the seeds imported from other countries to East Pakistan has amounted to a huge sum every year. Above all, potato has been imported from Burma, India and Holland in large quantities, and much money has so far been paid. If the seed potato is self-supplied in this country, it could contribute greatly to its national economy. When the situation was examined from such a point of view can be summarized as follows.

- (1) Vegetables whose seeds can be easily gathered in East Pakistan;
Tomato, eggplant, peaplant and beanplant
- (2) Vegetables whose seeds can be gathered, but are in need of some facility and technique such as the net-house or isotaled cultivation.
Watermelon, cucumber, pumpkin, muskmelon and onion
- (3) Vegetables whose seeds cannot be produced in East Pakistan from a viewpoint of natural condition (however, can be produced in the cool region of West Pakistan)
Cabbage, radish, furnip, carrot, cauliflower and potato

But the seed potato could be produced in the mountain district of Chittagong Hill-tract.

- (4) Vegetable whose seeds must be yearly imported
F₁ hybrid such as the watermelon, cucumber, tomato, etc.
- (1) Even though their seeds can be produced, they would degrade, if farmers continuously gather seeds on their farms. They shall be produced in a series of government-controlled seed Multiplication system: Foundation stock farm - stock farm-multiplication farm.
- (2) Some facilities or technique are required. Even if the realization in near future is difficult, it is desirable to make arrangements therefor as early as possible.
- (3) Asides from the sorts whose seeds cannot be gathered under the natural condition, the massive sorts such as the potato should be sowed, for instance, in the mountain area, Chittagong Hill-tract, if possible. Though some equipments and technique of high grade are required for examining the Virus disease, it is desirable to establish a self-supplying system as early as possible.
- (4) Recently in Japan, F₁ hybrid seeds of cucumber, tomato, eggplant, watermelon, etc. have been more widely utilized than before. Though some of them have already been introduced into this country, they must be continuously imported from Japan and others until the technique for making the F₁ hybrid is mastered in this country. In this connection, we expect that they could be produced as soon as possible. The Government should dispatch the agricultural engineers overseas so that they may master the technique immediately.

(Table, No. 6)

Difficulty of Gathering Seeds and Steps there against.

Tomato	Self-pollination, natural crossing is little. Fruits bears well. Seed collection is easy.
Eggplant	The same as in case of tomato.
Cucumber	Cross-pollination (unisexual flower), entomophilous, Natural hybrid is much, Fruits bears well net-house or isolated cultivation is required. Seed collection is possible.
Watermelon	Cross-pollination (unisexual flower). In rainy season, like the cucumber, seed collection is difficult. In dry season, seeds produced.
Pumpkin	Cross pollination (unisexual flower), entomophilous. Together with the isolated raising, artificial pollination shall be given. Fruits bears well, and the seed collection is possible.
Muskmelon white muskmelon	Cross pollination (unisexual flower), the same as the pumpkin.
Beanplant Peaplant	Cross pollination, natural hybrid is little. Fruits bear well, and the seeds can be gathered.

Cabbage Cauliflower	Cross pollination (anemophilous and entomophilous) Natural hybrid is serious. Flowering and fruit-bearing are difficult. Seed cannot be gathered except in the area of West Pakistan at lower temperature.
Spinach	Cross pollination (unisexual flower), anemophilous, isolated cultivation is required. Fruits bear well in dry season, and seeds can be gathered.
Carrot Turnip	Cross pollination, natural hybrid is much, isolated cultivation is required. For sometime, low temperature is needed. Seed cannot be easily gathered, but in West Pakistan.
Radish	Cross pollination, anemophilous, much natural hybrid. Isolated cultivation is required. Fruits bear well. Seeds cannot be easily gathered but in West Pakistan.
Onion	Cross pollination, anemophilous and entomophilous, much natural hybrid. Isolated cultivation is required. Fruits bear well, and seeds can be gathered.
Potato	Because of Virus disease and dormancy, seeds cannot be easily gathered but in the Chittagong Hill-tract or in West Pakistan.

66. Operation Manual for the Power Tiller

Introduction.

Power tiller is a Japan made agricultural implement, which was remodelled to adapt itself to the rice cultivation.

Power tiller, which had been first used only for the ploughing, has recently been utilized for all the cultural practices. The East Pakistan Government, which was greatly interested in the performance of this power tiller, is said to have the intention of importing 420 units of this tiller in 1965.

In this manual, we have chiefly described practical requirements for the maintenance and operation of Japanese power tiller to be newly introduced. In order to master the maintenance and operation technique, the understandings through the practice is the best way. In this connection, this manual should be then put to practical use for information.

Contents

- I. Features of the Power Tiller.
- II. Sorts of the Power Tiller.
- III. Construction of the Power Tiller.
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- VII. Fundamental Operation of Power Tiller.
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- IX. Sorts and Features of the Attachments.
- X. Ploughing by the Power Tiller, and its Efficiency.
- XI. Utilization of the Attachments for Dressing and Sowing, and its Efficiency.

I. Features of the Power Tiller

Power tiller is a machine, which conducts a ploughing operation, by driving ahead the ploughing unit fitted on the rear of the machine. It is very high in efficiency, as the ploughing and soil crushing are given at the same time, by the rotation of the ploughing claws. (Fig. 1). It is, therefore, especially suitable for farmers of rather big holding, or the areas where the winter crop of short plough period is given. As the power tiller ploughs the soil finely from the first, it is good for such an area of heavy clay as East Pakistan, where it is difficult to crush the soil over again, once the filled soil is dried.

Such a situation as mentioned above is also conceivable from the process of development of power tiller in Japan. When the crushing of heavy clay soil in the reclaimed land in the southern part of Okayama prefecture was found very difficult, the power tiller of Shiema type was first imported from Switzerland in 1920 on trial to settle the problem. Getting hint therefrom, the present power tiller has been devised.

Though the fine soil crushing is required for making preparation for the sowing of broadcast AMAN and AUS rice plants, the tiller, especially of rotary type is most suitable. If the iron wheel is fitted, meanwhile, the tiller can be utilized for the ploughing and puddling of the transplanted AMAN, AUS and BORO rice plants in a submerged status. It has also displayed a good performance in the ploughing, harrowing and hilling of vegetable farms. In the meantime, it can be used for the cultivation and weeding works of banana and papaya orchard. If the tiller is equipped with fertilizing and sowing units, it can be utilized for the fertilization and sowing works of the broadcast AMAN and AUS rice plants, wheat and barley, pulse, rape, etc. If further researches are made, it could be also used for the planting of jute. The use of fertilizing and sowing machine not only increases the efficiency of planting work and subsequently the yield through the enhancement of working accuracy, but also improves the efficiency of weeding and harvesting works.

When a pump is fitted on the front of power tiller, various crops can be watered. When the ploughing unit is removed, and a trailer is fitted, meanwhile, the power tiller can be used for the transportation.

As for the number of power tillers used in Japan, it was only 13,000 units in 1951, and then increased to 1,700,000 units in 1964. Thus the power tiller has become a nucleus of the agricultural mechanization. Such a rapid diffusion of power tillers indicates their fitness for the agriculture in Japan. Though East Pakistan is different from Japan in ground condition, etc., they are similar to each other in the small-scale farms chiefly based upon the rice crop at least. In this connection, we are very sure that the power tiller would be very useful for the agricultural mechanization in East Pakistan.

Fig. 1 Soil crushing work by means of power tiller.

II. Sorts of the Power Tiller

Though there are many kinds of power tillers, they can be classified into the followings: traction-type, driving-type, traction and driving type. The traction type pulls such a tractive working machine as the plow-harrow cultivator, when it is used (Fig. 2). The driving type conducts the ploughing and stamping at the same time, when a driven ploughing unit is fitted on the rear of power tiller. It is exclusively used for the ploughing and soil crushing. (This type has recently been also remodelled so that it can be equipped with manuring and seeding units). The ploughing unit is divided into three types: rotary, crank and screw types. At present -- Fig. 2 Traction-type power tiller, model 31 --, however, the rotary type is mostly used. In Japan, the traction and driving type has been most widely used, because it is equipped with both merits of the traction and driving types. In East Pakistan, too, this traction and driving type would be suitable. We shall, therefore, describe chiefly the power tiller of this type in the followings.

III. Construction of the Power Tiller

Driving type, and the tractive driving type function, when the power is transmitted not only to the wheels but also to the working unit. This type is shown in the Fig. 3 and 4. Though many power tillers of different types are made, they are almost the same in major parts. In general, the power tiller is made of the following parts:

1. Engine

This is a device converting the thermal energy into mechanical energy, which is generated, when the gasoline, kerosene, light oil, etc. are burnt. This power runs the power tiller, or -- Fig. 3 - 4 Construction of the power tiller -- drives the working unit.

2. Transmission gear

It is a transmission gear, which transmit to the running and working units the power generated by the engine. This gearing is made of clutch, speed change gear, final drive unit, etc.

3. Running unit

It consists of wheels and other units for the run of power tiller. Tiller is generally equipped with rubber wheels. Iron wheels are used for the puddling and ploughing works of submerged fields (Fig. 5). There are many kinds of iron wheels. Especially when the ground is soft, iron wheels of large lugs and diameter are generally used to prevent the sinking of power tiller, and obtain the propulsion force required.

-- Fig. 5 Iron wheels --

4. Controlling unit

Handle is equipped with various control levers to start and stop the power tiller, and change its speed.

5. Brake unit

Tiller is equipped with a brake unit for the safe run.

6. Working unit

Working unit is made of 2 ploughing unit of rotary or screw type, traction unit for hauling the working unit, and a device extracting the power required when other working machine is driven by the power of power tiller.

IV. Equipments for the Operation

1. Main clutch handle and main clutch

When the main clutch handle is put forward to the position "In", power is transmitted by gears to start the power tiller. When the clutch handle is restored to the position "Off", power is cut to stop the power tiller. Clutch is a very important part, which is operative not only for the start and stop of tiller, but also for the disconnection between the engine and the change gear at the change of speed. As for the clutch, there are many systems. In general, however, disc clutch and V-belt clutch are used. Disc clutch can transmit and interrupt the power exactly and very smoothly. In principle, the receiving disc is pressed against the turning disc to receive the turning effort required. In order to cut the power, discs should be kept off each other. These operations are controlled by the clutch handle. In case of the V-belt clutch, clutch handle is controlled to operate the tension pulley so that the tense belt may transmit the power. When the clutch handle is placed on the position "Off", the belt becomes lax not to transmit any power. Because of its simple mechanism, it cannot display a performance of clutch, unless it is fully adjusted.

2. Main speed change lever and the transmission gear

There is a speed appropriate to the quality of each work, in accordance with the working condition, meanwhile, it is necessary to reduce the speed properly so that the turning effort large enough to overcome the load may be given to the wheels. When the power tiller is backed, furthermore, the revolution reverse to the turning direction at the forward motion must be given to the wheels. It is a transmission gear, which is used for such a purpose as mentioned above. Transmission gear is a combination of several sets of gears, through which running speeds of several stages can be obtained. The number of stages, and the running speed are shown in the instruction manual. There are generally 3 - 6 stages for the forward motion, and 1 - 2 stages for the backward. This change of speed is controlled by means of speed change lever. In changing the speed, clutch must be switched off.

3. Direction clutch lever and the steering gear

When the power tiller changes its running direction, the wheel of the curving side must turn at a speed lower than that of the other. The steering gear of power tiller is a gearing of clutch system, in which a pair of clutches are engaged with each other by virtue of spring before the final reduction gear. When the direction clutch lever of the right side is grasped, the right-side clutch is disengaged, the left-side wheel runs faster than the right-side, and the tiller turns to the right side.

4. Brake unit

Brake unit of the power tiller is generally used only for stopping and parking the tiller. In most power tillers, brake unit of outer contraction system, or inner expansion system is fitted on the intermediate shaft from the change gear to the wheel shaft. Many brake levers are also used as the clutch handle, when the clutch handle is further pulled from the "Off" position, the brake becomes operative.

5. Speed control lever

Speed control lever, which is fitted on the handle, controls the revolution of engine. It is used for giving a revolution suitable for each operation, and controlling the speed at the revolution of power tiller. Its control is possible at the root of handle.

6. Handle

Power tiller handle holds the tiller body. During the work, meanwhile, a small curve could be corrected, by shaking the handle, not using the clutch.

V. Maintenance before working

Maintenance work before the starting and after the end of the operation of power tiller is very important to use the power tiller safely, smoothly and economically. However careful the operation of power tiller during the work may be, it cannot display its perfect performance so fully as not to achieve a good work record, and would be out of order midway

to frustrate the schedule of work, if it is not in a good state of repair. In some case, the damaged parts would inflict a serious injury on the operator.

In connection with the above, the proper operation refers not only to that during the run of power tiller, but also the repair before its run, and the custody after the work. Operator, who cannot handle the power tiller properly before and after its run, could not be called the "decent operator". Prior to the operation, operator should observe the followings:

1. Operator's dressing

Though it does not directly relate to the maintenance before the operation, untidy dress of operator would be partly rolled into the revolving parts of power tiller. As it is very dangerous, operator should be dressed tidily.

2. Checking, and the supply of oil and fuel

i) Whether any part is broken, or out of order

Damage and trouble should be found as early as possible. They should be treated until they become serious. Parts shall be checked to find whether bolts and nuts are loosened, or not. Lax points should be more tightened. Above all, set bolts and nuts of the engine, wheels, ploughing claws, etc. shall be exactly checked, because they would be easily relaxed.

ii) Whether the belt is tensed properly

When the belt is loose, it slips not to transmit the power satisfactorily. When it is too tense, however, it would be seriously abraded. When the belt waves, or makes a great noise during the run, it comes from its looseness. When the belt is beated, or seriously worn, it comes from its too much tension. In tensing the belt properly, it should be first fixed so that the center line of the engine and the power tiller pulley may be straight. Its proper tension should be so much that the middle of belt would drop by 0.5 - 1 inch, when it is pushed by the tip of finger.

iii) Whether the main clutch functions properly

If the clutch is not fully disengaged, even when the main clutch handle is placed on the "Off" position, it is very dangerous, because the power tiller is not yet stopped. At the gear change, meanwhile, improper operation of the clutch would damage the gears, and subsequently affect other portions greatly. In order to check whether the clutch works properly, or not, speed change lever shall be first placed on any optional position to turn the engine manually on trial. If nothing is wrong, power tiller ought to be inoperative, when the clutch handle is on the "Off" position. When it is on the "In" position, the power tiller would start its run.

In case of the V-belt clutch, the length of main clutch wire, and the setting of tension pulley shall be so adjusted that the tension pulley may rise much enough to tense the V-belt, when the clutch is switched "In", and that the V-belt may loose perfectly, when the clutch is switched "Off". If it does not go well, even when the above adjustment is given, the setting position of engine shall be adjusted.

In case of the disc clutch, the length of clutch wire shall be adjusted. When the clutch is not well operated, it shall be reduced. When the clutch slides, it shall be increased. In case this adjustment cannot put the clutch into order, adjustment shall be given by means of spring adjusting screw. If the screw is screwed in, the spring powerfully acts upon the disc. If the screw is loosened, the spring action is reduced. When the clutch is found slipping, therefore, the screw should be tightend.

iv) Whether the tiller is smoothly steered

The point of checking is to try to push the power tiller, by gripping the direction clutch levers, left and right. In this case, the tiller shall move slightly. When the hands are taken off the levers, the tiller shall not move easily. When the direction clutch is not well operative, the clutch wire shall be adjusted, by reducing its length.

v) Checking of the air pressure of tires

When the air pressure is different between the tires, left and right, the power tiller does not go straight ahead. It cannot be operated, because the handle is taken to the tire side of less air. In this connection, the specified air pressure (16.5 lbs per 1 inch²) should be given equally to the left and right tires each.

vi) Checking and the supply of engine oil

Under any circumstances, checking and supply of engine must not be neglected. When the oil is found running short at the checking by oil level gauge, it shall be additionally supplied. If the oil runs short, the engine is seriously stained, or the improper oil is used, piston, piston rings, bearings would be burnt or worn out.

1) Function of the engine oil

When the metals of the machinery comes into direct contact with each other to make a friction, the resistance becomes large, and subsequently their friction surface is seriously abraded. There is also a danger of the metal surface being melted and burnt by heat. Oil makes a film on the friction surface, which prevents the metals from coming direct contact with each other. When this film is formed, the friction is reduced, the machine is slightly run, and the abrasion of friction surface is curtailed. Therefore, oil is used for every friction part of the machinery. Especially in case of engine, which turns at high speed, temperature and pressure, the function of lubricating oil is very important. The effects of engine lubricating oil shall be enumerated hereunder:

- (1) Friction and abrasion can be reduced
- (2) Film between the piston and the cylinder prevents the gas from venting to give the gas tightness.

- (3) Carbon soot formed in the cylinder head, metallic dust in friction parts and other foreign matter are dissolved and taken away in the oil. Thus the oil has a purging effect upon all the parts of the machine.
- (4) Oil has the function of cooling the highly heated inside of engine.
- (5) Oil prevents the metals from rusting.

As mentioned above, oil has many important functions. If the lubrication is worsened, therefore, the running condition is immediately affected to cause a fatal fault in the engine. In this connection, the engine oil shall be checked and supplied before the use of tiller so that the oil may not run short during the run. All the stained engine oil shall be discharged and changed with the new every 40 - 50 working hours, by taking off the oil drain plug.

2) Choice of the engine oil

Selection of the lubricating oil would greatly affect the durability and maintenance of engine. Oil to be used shall be chosen on the basis of viscosity and quality. As the maker specifies in the instruction manual the oil in accordance with the expected temperature, operator shall observe this specification. In relation to the oil classification based upon the viscosity, the S.A.E. number prescribed by the U.S.A. Society of Automotive Engineering is internationally used. As for the viscosity index of the S.A.E., oil is classified in terms of viscosity alone. It does not indicate the quality and performance of oil. In the instruction manual, the maker specifies the S.A.E. number of the oil to be used in accordance with the temperature. Typical S.A.E. number shall be shown hereunder.

90°F and over	32° - 90°F	Below 32°F
SAE - 40	SAE - 30	SAE - 20

- (2) In respect to the oil classification based upon the quality, the A.P.I. standard made by the American Petroleum Institute has been most widely used (Table 1). Service classification mark, M in the Table 1 refers to the oil for the gasoline or kerosene engine, while the D to the oil for the Diesel engine.

Table 1: Classification of the engine oil according to the API Prescription

Service Classification	Definition	Additive %
ML	Jump-spark ignition engine of small size, which is fueled with gasoline or petroleum, and engaged in a very slight work	0
MM	Jump-spark ignition engine, which is engaged in a medium-grade work	0.5 - 0.2
MS	Jump-spark ignition engine, which is often stopped, moved or engaged in a heavy work	2.0 - 4.0
DG	Compressive ignition engine such as the Diesel, which is engaged in a general work	2.0 - 4.0
DM	Compressive ignition engine, which is engaged in a medium-grade work	
DS	Compressive ignition engine, for which the fuel of poor quality is used, or the engine equipped with supercharger, which is engaged in a heavy work	

We should like to recommend the MS-grade oil for the gasoline or kerosene engine fitted in the power tiller. It is, meanwhile, desirable to use the DM or DS-grade oil for the Diesel engine fitted in the power tiller. In making choice of the engine lubricating oil, proper oil shall be carefully selected according to the above S.A.E. number indicating the viscosity, and the A.P.I. standard showing the quality and performance of oil.

vii) In checking and supplying the lubricating oil

For the main body of power tiller, too, the oiling points, sort of oil and the oil quantity specified in the instruction manual shall be strictly observed. As the specially important points are equipped with oil level gauges for checking, they shall be checked. If the oil is found short, it shall be additionally supplied. Though the points to be oiled and checked vary with the sort of tillers, the main gear box and the ploughing chain case shall be charged with gear oil.

When the new power tiller is used for 30 hr. for the first time, all the oil shall be renewed. After that, the oil shall be exchanged periodically once a year. Metal of the ploughing shaft shall be greased.

viii) Checking and supply of the fuel

Fuel shall be checked, as the engine would not run without fuel. Quality and purity of the fuel to be used would greatly affect the duration and efficiency of engine. The storage of fuel is a major item relating to the maintenance of engine. Especially in the Diesel engine, the mixing of water and small dust into the fuel would often put the fuel pump and nozzle out of order.

-- Fig. 6 Example of the fuel tank

The Fig. 6 shows an instance of the fuel tank, which could be simply made of a drum. Fuel discharging cock shall be laid on a position, approx. 6 inches above the bottom. If so, fresh fuel can be extracted, because the dust and water mixed into the fuel deposit on the bottom. Drain cock shall be opened once a year to discharge the deposits and the water-mixed fuel to clean the inside. Discharged fuel can be used as the washing oil at the repair of engine and power tiller. Container of oil and the hopper shall be kept in the locker, or covered to retain its cleanness.

ix) Checking and the supply of cooling water

If the tiller is driven, the cooling water being left short, the engine temperature would become approx. 1200° - 1600° each explosion. Subsequently the lubricating oil would not function, and the piston and cylinder would be burnt for a small time. Cooling water shall be as fresh as possible, and be all discharged from the drain cock once three days, and exchanged for the new. Prior to the use of power tiller, it shall be constantly checked whether the cooling water runs short during the use, or not.

x) Preparation of tools

A minimum number of tools required on the farms shall be prepared without fail.

VI. Operation of the Engine

1. Jump-spark ignition engine

Jump-spark ignition engine has the following two types: gasoline engine, for which the gasoline is chiefly used, and the kerosene engine for which the kerosene is chiefly used.

i) Gasoline engine

1) Main clutch of the power tiller shall be disengaged. It shall be then confirmed that the speed change lever is positioned neutral. When the clutch is left engaged, the engine cannot be started easily.

2) Cock of the fuel filter shall be opened. There is a fuel filter midway, when the fuel is sent from the fuel tank to the carburetor. Filter cock shall be opened to send the fuel to the carburetor. Fuel filter is a device, which filters the dust is fuel, and feeds the fresh fuel to the carburetor. If any sediment is found in the filter, it shall be taken off, flushed with fuel neatly and set in.

- 3) Choke lever of the carburetor shall be pulled.

Choke lever is operated at the starting to limit the air flowing into the carburetor, increase the concentration of mixed gas and make easy the starting. When the engine is warm, the choke lever operation is not needed. If the engine is started and a little warmed, choke lever shall be returned as early as possible.

- 4) Throttle lever shall be placed on a position, approx. $1/3 - 1/2$.

Throttle valve is a valve, which adjusts the quantity of mixed gas flowing into the combustion chamber. When the throttle valve is opened to increase the suction quantity of mixed gas, the revolution of engine is raised.

- 5) Starting rope shall be wound on the starting pulley and drawn vigorously

Starting rope shall be tightly wound, and drawn first from the compression position. If the rope is not drawn from the compression position, the strength would not be sufficient to obtain a high revolution, and consequently the engine could not easily be started. If this operation is repeated 3 - 4 times, engine would generally be started. If it is not started, something is wrong with the engine. Operation shall be stopped to find the fault as early as possible. If the operation is continued, the engine would suck too much gasoline to start easily. In case it sucks too much gasoline, choke valve shall be fully opened.

- 6) Warming the engine

If the engine is started, as mentioned above, choke lever shall be returned, throttle valve be closed a little, and the engine shall be run at low speed for 3 - 4 min. Revolution shall not be increased, and the power tiller shall not be moved until the engine is warmed up enough. When the engine is cool, oil is so high in viscosity

as not to flow easily and distribute fully to the parts to be lubricated. If the engine is then run at high speed, or loaded, it would be seriously worn out to reduce its life remarkably. Engine shall be, therefore, driven at low speed to be warmed until it reaches the running temperature. The performance of engine during its warming run shall be then checked. If nothing is found wrong, the following operation shall be started.

7) Cooling the engine

When the engine is stopped, too, like in case of the starting, it shall be stopped after its low-speed run for 2 - 3 min. If the engine is stopped at high temperature, the oil would be dried by heat, and the engine would run for a while in a status of no oil at the next starting. In this connection, the engine shall be run at low speed for 2 - 3 min. to decrease the temperature slowly so that the oil may go round fully. Such a run is called the cooling run, and very important to maintain the life of engine for a long time. When the cooling run is finished, the stop button shall be pushed to stop the revolution.

ii) Kerosene engine

Gasoline is generally used to start the kerosene engine. If the engine is started, the gasoline is replaced by the main fuel, kerosene. Fundamental operation for the starting and stopping is the same as that in case of the gasoline engine.

2. Diesel engine

Diesel engine is an engine, in which the air in the cylinder is compressed powerfully, the fuel is jetted therein, and exploded by spontaneous ignition.

i) Preheating run

Fuel lever shall be placed on the "non-injection" position, the compression be released by the reducing lever, and the non-loaded run be given 10 - 20 times by means of starting handle. When this operation is

given, oil goes round to each part, and the perfect lubrication is possible at the starting. As the Diesel engine is especially in need of high compressive force, it cannot be easily started due to the gas leakage, unless the lubricating oil fully permeates between the pistonrings and the cylinder. Therefore, this preheating run is a very important operation.

ii) Starting

When the preheating run is finished, the cock of fuel tank shall be opened, throttle lever be placed on the $1/3 - 1/2$ position, and the starting handle be turned to check the injection of fuel. If the fuel is injected, when the starting handle is turned, injection noise can be heard. When any abnormal noise is then heard, air shall be vented, because there is air in the fuel system. When the engine is in need of gasoline for its starting, small quantity of gasoline shall be injected into the inlet hole of air cleaner. When the ignition paper is used, it shall be tightly inserted into the ignition paper holder. When the engine is started again immediately after its stopping, neither gasoline nor ignition paper is required. Starting handle shall be turned as quickly as possible, being gripped by hand. When the engine is equipped with a decompression lever, compression shall be released by this lever, and then the handle shall be turned. When the engine is run by inertia, decompression lever shall be taken off the hand. When the handle is further turned rapidly, overcoming the compressive force, the engine is started. If nothing is wrong with the run, power tiller shall be moved to start the work after the warming run for 2 - 3 min.

iii) Stopping method

Stopping method is the same as that in case of gasoline engine. When the throttle lever is placed on the "stop" position after the warming run for 3 - 4 min. fuel would not be injected to stop the engine.

VII. Fundamental Operation for the Run of Power Tiller

Though the operation for running the power tiller is somewhat different among the sorts of works, fundamental operation shall be first mastered.

1. Start

It shall be confirmed that the clutch is disengaged. If the speed change lever is positioned neutral, even when the clutch is engaged, power tiller is at a standstill. If the speed change lever is operated, even though the clutch is engaged, the gears would come into collision with each other, and make noise the moment they are engaged. If such an error is made in operation, the gears would be worn out early. At the worst, the gears would be broken. Clutch shall be exactly disengaged, and the speed change lever shall be placed on the required position. In case of the motorcar, etc., the speed is accelerated from the first, second and third gears to the high. When the power tiller is to be run at high speed, the lever should be first placed on the required position. Thus the tiller can start its run at the high-speed gear position. If the clutch is then suddenly engaged, however, the engine would stop, or the power tiller would dash. Clutch shall be, therefore, gradually engaged very carefully. At higher running speed, engine would be loaded more greatly. If the tiller is run at high speed for such a heavy work as the ploughing, accordingly, it would stop, emitting black smoke. Checking the condition of engine, operator should use the power tiller at a proper gear position. If the tiller is run too fast in the sowing, etc., meanwhile, no good result cannot be obtained. If the speed change lever is placed on a proper position, throttle lever shall be drawn to increase the engine speed, and then the clutch shall be quietly engaged. After such an operation, the power tiller shall start its run.

2. Stopping

Clutch shall be disengaged. In case the tiller does not stop by virtue of inertia, even if the clutch is disengaged, brake shall be further applied. At the same time when the clutch is disengaged, throttle lever shall be restored to decrease the revolution of engine. Speed change lever shall be positioned neutral. When the

operator goes off the power tiller, he must always brake it.

3. Turning

As it is dangerous to turn at high speed, throttle valve shall be returned to decrease the revolution of engine, and then the turning action shall be conducted at safe speed. If the working unit is lifted, and the clutch of the turning side is disengaged at the same time when the throttle lever is returned, the power tiller would turn.

Operator shall be well trained in three actions of switching off the throttle lever, lifting the working unit and disengaging the steering clutch. If the turning comes to an end, steering clutch shall be returned, and the throttle lever shall be drawn to increase the revolution of engine.

4. Backing

After confirming that the clutch is disengaged, speed change lever shall be switched into the back gear position. Unless special care is taken, the handle would rise by reaction force in case of backing. Handle shall be tightly held so that the clutch may be disengaged at any time.

5. Straight run

Straight run without curving is a fundamental of the driving operation. When the power tiller does not run straight on the farms, good result cannot be expected therefrom. In order to move the power tiller straight forwards, care shall be taken about the following points:

- i) Regardless of the motion of power tiller, operator shall drive it with his face turned upwards to the target carefully.
- ii) Strength of the shoulder shall be weakened, and handle shall be held lightly. In an easy posture, operator shall drive the tiller. If the operator presses the handle too strong, the tiller would wind.

- iii) If the power tiller begins to turn aside, it shall be corrected by handle so much as it turns. If operator tries to correct the tiller by switching off the steering clutch, it would often make the tiller wind.
- iv) If the air pressure is unequal between the power tiller wheels, left and right, or the tail wheel does not turn smoothly, the tiller would not go straight. Prior to the run, therefore, perfect maintenance shall be given.

6. Crossing over the hills and obstacles

Unless the tiller is carefully driven in passing over the hills of paddy fields, and the obstacles, it would be not only damaged by impact, but also the operator would be swung around. This is very dangerous. In passing over these obstacles, the speed change lever shall be first put on the "first gear" position to run the tiller on to the hill of paddy field quietly. In this case, tiller shall be braked, stopped once, and then descend quietly after the clutch is engaged. If the crossing is felt dangerous, plank shall be laid over so that the tiller may cross over safely.

7. Run on the ascent

When the power tiller ascends the slope, the speed change lever shall be switched into the low before the ascent. Lest the speed should be changed midway on the upward slope, because the large force is required for the ascent. If the clutch is disengaged confusedly to operate the speed change gear, as the engine is likely to stop midway on the ascent, the power tiller would change its run by the self-weight, and be suddenly drawn back, as the power of engine is cut off. When the speed is to be changed inevitably midway on the upward slope, clutch shall be disengaged, brake be fully applied at the same time, and the speed change lever be quickly switched over. If the steering clutch is disengaged on the ascent, the power tiller would turn aside suddenly to cause a great danger. On the ascent, therefore, care shall be taken about the steering operation.

8. Run on the descent

Run on the descent is more dangerous than that on the ascent. Therefore, special attention should be paid to the drive. According to the grade, speed change lever shall be first placed a proper position so that the tiller may descend at as safe a speed as possible. As for the engine revolution, the engine shall be run at low speed by operating the throttle lever. Engine brake shall be then applied so that the tiller may descend at moderate speed.

Engine brakage is a sort of braking effect made by the engine: When the power tiller runs down a steep slope, its motion is curbed by the compression of the low-speed running engine, and the friction resistance of parts. As the engine brake is more effective at lower speed, gears shall be changed into the low speed on a steep descent. Tiller shall then descend quietly, clutch being engaged. In case the slope is very steep, the slope is rugged even though it is gentle, or the road ground is soft, it would be safe, if the tiller runs down, the backgear and the engine brake being applied.

9. Run in the muddy water

In East Pakistan, the power tiller must be used in the muddy water to make the grounds for the transplanted AMAN and AUS, and BORO rice plants. If the steering clutch is gripped for a long time for the sideway turning, when the tiller is driven in the muddy water, only the wheel of one side would be loaded, it causes the wheel submerged into the paddy field. In this connection, steering clutch shall be operated intermittently.

When the power tiller is driven in the muddy water, part of the tiller would be submerged in the muddy water, and further often splash mud. When the power tiller is not well repaired, muddy water would infiltrate into the inside of machine to cause the trouble. Prior to the drive, loosened bolts and nuts shall be fully tightened. Above all, it shall be checked whether the oil leaks into the chain case, or not. If any oil leakage is found, there is a danger of the muddy water infiltrating therefrom.

After the work, tiller shall be well washed, and the drain plugs of chain and transmission cases shall be

taken off to drain a little oil. It shall be then checked whether the muddy water is mixed into this oil, or not. If the muddy water is mixed, the oil is stained whitish. In this case, treatment is required after checking from where the muddy water comes in. Oil shall be, needless to say, renewed.

As the run in the muddy water imposes a severe load upon the machine, operator shall repair it carefully before and after the run.

10. When the power tiller is used in a very dusty place.

When dust rises very much in the ploughing operation, etc., or the tiller is used as a motor for the threshing operation, all coupling sections from the air cleaner to the air inlet pipe shall be checked, and locked so tightly as not to be loosened. When the work comes to an end, air cleaner shall be checked without fail, its inside be washed, and the soiled oil shall be renewed.

VIII. Handling after the Run, and the Cares about the Keeping in the Shed.

During the time from the end of daily work to the keeping of power tiller in the shed, the followings shall be strictly observed:

i) Engine shall not be stopped immediately.

Engine shall not immediately be stopped, but after the non-load run at low speed for 3 - 4 min. When the engine is stopped at high temperature, oil sticking to the piston, cylinder, piston pin, crankshaft, etc. would be dried to make difficult the starting on the following day. Therefore, the engine shall be turned quietly before the stop. It shall be stopped after the temperature decreases gradually.

ii) Washing and checking of the power tiller

If the run is finished, the power tiller shall be washed and cleaned without fail. This operation does not only cleans the machine, but also is useful for finding the looseness of bolts and nuts, breakage of parts, oil leak and other faults at early stages. It is, therefore,

important for the operator to make a habit of cleaning the machine, however busy he may be.

iii) Indoor keeping of the machine

As the power tiller is a costly machine, and has many exposed parts, it would gather rust easily, when it is exposed to the wind and rain. At any cost, therefore, it shall be kept indoors.

iv) Treatment of the clutch

If the disclutch is left disengaged, clutch spring would remain contracted for a long time to hasten the fatigue of spring. If the driving plate is kept off the pressure plate, meanwhile, dust would come into the clearance to cause the slipping.

v) Confirmation of oil supply and tools

All oiling points shall be lubricated. It shall be confirmed whether all the tools, which had been carried to the farms, are complete, or not.

IX. Sorts and Characteristics of Various Operation Units Attached to the Power Tiller

1. Tiller

There are three types of tillers: rotary, crank and screw types. It is the rotary type, which is used most at present. The tiller of rotary type conducts the ploughing and soil crushing operations at the same time, when its ploughing shaft equipped with the claws turns at the revolution of 150 - 200 per sec. The magnitude of soil stamping can be controlled over a considerably wide range, when the revolution of ploughing claws, advancing speed, sort and the number of claws, etc. are changed. The rotary type is simple in construction, and inexpensive, as it can be made easily. It can be used for the puddling and intertillage. Its application is very wide.

2. Hilling unit

In case the farms are ill-drained, and the crops are

subject to the damp like the vegetable crops in rainy season in East Pakistan, it is necessary to raise the seeding bed. If the crops are sown on the flat ground, meanwhile, this unit can be used as the furrowing unit. When the hilling unit is fitted on the rear of the rotary unit, ploughing and hilling operations are given at the same time. Hilling unit is so devised that the height of hill may be changed to some extent.

3. Puddling unit, paddy field wheel and the plank harrow

When the puddling is given by the rotary unit, auxiliary rotaries are fitted on both sides of the rotary to enlarge the corking width in some case wheels are replaced by paddy field wheels, and the puddling is conducted, by turning the rotary. Simple plank hallow is trailed to roll the ground evenly. Plank harrow is also used for the ground making for the dried fields. Plank harrow has the some function as that of the "ladder" used by farmers in East Pakistan.

4. Fertilizing and sowing unit

Most of the power tillers can be equipped with fertilizing and sowing units. In this unit, the feeder and the hopper for the fertilizer and seed are fitted on the front of handle, the furrowing unit on the rear of the rotary, and both units are coupled through the pipe. When the seed delivery roll is replaced, the unit can be used for sowing rice, wheat, barley, pulse and regetables, etc. As for the sowing system, broadcast and drill sowings, either of them, are possible. Fertilizing and sowing quantity, and the sowing depth can be adjusted over a wide range. As for the covering soil, soil, which is finely crushed by the rotary, is used. As the ground is then stamped by the roller, the germination is excellent.

5. Water pump

In East Pakistan, irrigation is required for the crops on the farms and the BORO rice in dry season. Thus the function of water pump is very important. In the Pakistan-Japan Agricultural Extension Training Institute, a water pump is fitted on the front of power tiller so that the pump may be driven by the engine of power tiller (Fig. 3). Such a system is very economical, because no time is required for setting the pump, and the power

tiller engine can be utilized.

6. Trailer

When the ploughing unit on the rear of power tiller is removed, and the working unit setting device is equipped with a trailer, the tiller can be used for the conveyance (Fig. 8)

--- Fig. 7 Water pump directly coupled with the power tiller

-- Fig. 8 Trailor fitted in the power tiller

X. Ploughing and Harrowing by Means of Power Tiller, and its Working Capacity

1. Characteristics of the ploughing by means of power tiller

Objective of the ploughing lies in tilling the soil to the proper depth, stirring, crushing, expanding and softening the soil.

- a) to extend the growing range of roots.
- b) to make an air and moisture condition favorable for the germination of seeds.
- c) to promote the decomposition of nutrients in the soil and make even their distribution.
- d) to remove the weeds and harmful matters in the soil, etc.

In order to achieve the above objectives, it is necessary to crush a certain depth of soil into a definite size, and further roll the soil surface evenly.

Soil in East Pakistan is generally clayish. If it is dried, it is so much solidified that the ploughing work becomes very difficult. In Feb. 1964 a ploughing test in the Institute on a very much dried paddy field, where the AMAN rice had been harvested in the previous year yielded the following record (Table)

Table 1:	per acre	
	Required time (%)	Fuel consumption (%)
Dry field	160	130
Properly wet field	100	100

Operation was very difficult, on the dried field as the body of power tiller oscillated much. As the ploughing work thus becomes very difficult, when the soil is dried, the soil must be ploughed while the water remains properly in the soil after the harvest of the previous crop.

Soil crushing operation shall be given in rainy season in Mar. - Apr. Even if the soil is stamped while it is dried, it would cost much labor and have little effect. In dry season when the moisture evaporates rapidly, a ploughing device, which would make the soil retain the moisture for as long a time as possible, is required. If the surface soil is finely crushed, the surface is rapidly dried, but the soil 10 inch deeper than the surface is not so much dried. In obtaining such a sowing bed, power tiller is an ideal ploughing and harrowing machine.

2. Ploughing operation of the power tiller

When the power tiller reaches a farm.

- a) fixed pipe tightening handle shall be first loosened,
- b) depth adjusting screw guide shall be greatly lifted,
- c) guide shall be adjusted to the approximate depth,
- d) speed change lever shall be switched into the first or second gear according to the ground condition,
- e) ploughing speed gear shall be switched into the high or low, (Relation between the combination of the running speed change with the ploughing

speed change, required horsepower and the soil crushing is shown in the Table 2).

--- Table 2: Effect of the combination of the running speed change with the ploughing speed change upon the required horsepower and the soil crushing

Running speed change	Plowing speed change	Required horsepower	Soil crushing extent
First gear	Low	least	secondly fine
	High	secondly much	finest
Second gear	Low	thirdly much	finest
	High	most	thirdly fine

- f) clutch shall be engaged to start the ploughing work after switching in the speed change lever and the ploughing speed gear,
- g) and the control shall be given by the depth adjusting handle in any case the ploughing depth is smaller or higher than the required depth.

3. Ploughing method and the working capacity

i) Level ploughing

Ploughing method must be devised to meet the ground condition. General method shall be described hereunder.

In case of level ploughing, as shown in the Fig. 10, farm should be ploughed, some width remaining unploughed, and then the remaining portion should be later ploughed. In this case, the remaining

--- Fig. 9, Fig. 10 Ploughing method ---

width shall be smaller than the ploughing width so as

not to leave any non-ploughed portion. If the ploughing in a longitudinal direction is finished, both ends shall be ploughed at the end of the work. Such an adjacent reciprocal ploughing method as shown in the Fig. 9 is not favorable because the power tiller is tilted, and the ploughing ground is inconstant. When the "hatchet-shaped claws" are used, the setting direction of claws shall be as shown in the Fig. 11.

--- Fig. 11 Setting direction of the "hatchet-shaped claws" at the ploughing

As a large horsepower is required for the first ploughing, both running and ploughing shaft speed change gears shall be switched into the low position. Working capacity of the power tiller is as shown in the Table 3.

Table 3 Ploughing capacity of the power tiller
(at the first plowing)

Engine H.P.	Sort of the ploughing unit	Ploughing depth, inch	Ploughing speed Ft/Sec	Required time, min/acre	Fuel consumption gallon/acre
3.5	Rotary	5.3	1.2	524	2.2
4.5	"	5.5	1.5	400	2.5
6.0	"	4.9	1.3	344	2.4
8.0	"	5.6	1.5	264	2.4
5.0	Plow	5.6	3.0	320	2.6

ii) Soil crushing operation

In relation to the broadcast AMAN and AUS rice plants, well crushed soil would make the soil stick closely to the seeds, and promote the germination. It is, therefore, desirable to crush the surface soil into lumps of less than 1 inch diameter each. After the harvest of the previous crops, first ploughing shall be given, and then soil shall be crushed 1 - 2 times after the rainfall. In the soil crushing, the speed change gear of the ploughing shaft shall be switched into the high, while the speed change gear for the ploughing shall be placed into the second speed. In setting the ploughing claws, they shall be put in-and outward in combination as shown in the Fig. 12. Working method is the same as that

-- Fig. 12 Setting of the "hatchet-shaped claws" at the soil crushing --

of the level ploughing previously mentioned. Working efficiency of the soil crushing is almost twice as high as that at the first ploughing. Fuel consumption per acre is $\frac{1}{2}$ of the first ploughing. In other words, when the power tiller of 8 HP. capacity is used, 2 hr. and 15 min. are required per acre, and the fuel consumption is 1.8 gallon.

Crushing of the soil lumps at the crushing work varies with the moisture of soil. In any case when the soil is too wet, or too dry, it would be unfavorable for the crushing. As it is the optimum moisture condition when the soil is easily crushed by hand, crushing work shall be done during the proper period after the rainfall without fail.

iii) Hilling ploughing

--- Fig. 13 Setting of the claws, and ploughing in case of hilling ploughing --

In case of the hilling ploughing, claws shall be first put inward as shown in the Fig. 13, No. 1. Alike the level ploughing shown in the Fig. 10, ploughing shall be given every other travel. For the second place, as shown in the Fig. 13, No. 2, all the claws but one claw of both ends each shall be put inward. When the harrowing unit is then fitted as shown in the Fig. 14 to plough the remaining portion, hills can be neatly made. Working efficiency is almost the same as that in case of the first ploughing at the level ploughing (refer to the Table 3)

-- Fig. 14 Harrowing unit fitted in the power tiller--

iv) Hill breaking ploughing

In case of the hill breaking, as shown in the Fig. 15, furrows shall be first ploughed, and then the hills shall be ploughed as, if they are broken down to both sides. Except two claws of both sides, ploughing claws shall be put outward. Working efficiency is almost the same as that in case of the level ploughing.

- v) Puddling for the paddy fields, and the harrowing for the upland fields.

In the puddling work, the tiller shall be equipped with paddy field wheels, as it is put into the submerged fields. Especially in paddy fields, where the soil is soft, a power tiller of so small a capacity as approx. 4.5 HP is desirable. Meanwhile, wheels for the wet fields must be used in reference to the claw setting at the puddling, claws shall be put in-and outward as shown in the Fig. 16. In order to make even the field surface, such a simple harrow plate as shown in the Fig. 17 shall be tied to the depth adjusting screw guide, and the operator shall ride on the plate in driving the tiller. In such an order as shown in the Fig. 16, puddling work shall be given length-and crosswise. When the puddling work is given twice, approx. 120 min. are required per acre. As the puddling work aims to make the field surface evenly flat, various methods must be devised in accordance with the height of field surface regardless of the above-mentioned way. In preparing the soil of upland fields, harrow plate, which had been used for the puddling, shall be utilized. Function of this plate is almost the same as that of the MAI, which is generally used by farmers in East Pakistan. When the harrowing is given twice, approx. 100 min. are required per acre. Working method is the same as that in the puddling.

-- Fig. 16 Claw setting and working method in the puddling and ground making operations --

-- Fig. 17 Rolling work by means of harrow plank --

XI. Utilization of Fertilizing and Sowing Machines, and Their Working Efficiency

In East Pakistan, the Broadcast AMAN and AUS rice seeds are broadcast. Their area under cultivation is not small. When the fertilizing and sowing units are used for these rice plants, the efficiency of sowing operation can be not only improved, but also the weeding and harvesting labor can be saved by means of drill planting system.

In 1965 when the power tiller with fertilizing and sowing unit was tested for the broadcast AUS rice plants, good results were obtained, and the sowing operation was possible as expected. Fertilizing and sowing unit can be used not only for the rice but also for the wheat, barley, pulse, vegetable, etc. In East Pakistan, it is a working machine which shall be widely useful. In this connection, its details shall be described in this paragraph.

1. Kind of the direct sowing machine

Fertilizing and sowing machine is divided into the following types: drive sowing and traction sowing types. As shown in the Fig. 18, the drive sowing type unit can conduct ploughing, stamping, manuring, sowing, covering and tamping works in a process. It is very efficient. In case of the broadcast AMAN and AUS rice plants, ploughing and stamping operation must be almost twice given, because the weed grows, unless the ploughing work is given by the sowing period. This type can be fitted in the power tiller, which can conduct a drive ploughing operation. In the meantime, the traction type is an unit, in which the fertilizing and sowing unit is hauled by the power tiller as shown in the Fig. 19. Before the sowing, therefore, ploughing, soil stamping and preparation must be given.

-- Fig. 19 Traction-type sowing machine --

-- Fig. 20 Drive-type manuring and sowing machine --

As the type of fertilizing and sowing unit to be fitted is dependent upon the sort of power tiller, special care shall be taken, when it is purchased.

2. Construction and action of the fertilizing and sowing machine

Fertilizing and sowing machine consists of power transmission gear, fertilizer and seed delivery unit, grounding unit, etc.

i) Power transmission gear

Unit, which transmits the power from its source to the fertilizer and seed delivery unit, is called the "power

transmission gear". In many types, seed and fertilizer are generally delivered, when the delivery roll is turned. This revolution is usually approx. 30 - 100 r.p.m. because it is limited by the property of seeds and fertilizer. As the revolution of delivery shaft is thus low, tilling shaft or power tiller shaft is used as a power extracting shaft. As for the order of power transmission, almost as shown in the Fig. 20, sprocket is fixed to the power extraction shaft, and chained, and the power is transmitted in order of intermediate shaft, fertilizing unit shaft and sowing unit shaft.

-- Fig. 20 Power transmission mechanism of the fertilizing and sowing machine

In the fertilizing and sowing machine of traction type, grounding wheel makes a power source of the delivery unit.

ii) Delivery unit

Delivery unit is the major section of fertilizing and sowing machine, which delivers evenly a definite amount of seed or fertilizer to each drill without damaging it. Though there are various types of seed delivery units, such a horizontal roll type as shown in the Fig. 21 is most in number.

-- Fig. 21 Seed delivery unit

Delivery unit of this type consists of hopper containing the seed, delivery roller giving a revolution, brush cutting the seed, receiver getting the delivered seed, and the control mechanism adjusting the delivery. Delivery quantity is controlled, when the roll is shifted to the left or right to adjust the working width of delivery slit. As for the

fertilizer delivery, there are various systems. Roll type or turning bottom system is generally used.

iii) Grounding unit

Grounding unit is an unit coming into contact with the ground. Its function has the largest effect upon the germination and growth of seed. As shown in the Fig. 22, prounding unit of the drive sowing type machine consists of ploughing unit, fertilizing and sowing pipes, and tamping roller. In case of drill planting, it shall be set as shown in the Fig. 22. In case of direct sowing, however, fertilizing and sowing pipes shall be set in front of the ploughing claws, fertilizer and seed be dropped, and mixed with the soil by claws, and the soil be tamped by roller. In case of drill planting, sowing depth shall be controlled by virtue of plough depth based upon the lifting of roller. Row spacing shall be controlled, when the setting position of fertilizing and sowing pipes is adjusted.

3. Preparation for the sowing

Fertilizing and sowing unit shall be so completely set as not to be loosened or dislocated during the work. Set fertilizing and sowing unit shall be well checked, fertilizer and seed delivery unit be taken off and its turning portions be lubricated. Seed to be used shall be perfectly freed from dust, straw, stone, etc. Above all, fertilizer shall be well crushed and sieved.

4. Adjustment before the sowing

When the adjustment opening for the delivery of fertilizer and seed is gradually enlarged, the delivery is gradually increased. For instance, test records of the KUBOTA-made KMB-200 model power tiller equipped with the fertilizing and sowing unit, model FR-3 (experiment place: Agricultural Extension Training Institute, Tejgan) are shown in the Figs. 23 and 24.

— Fig. 23 Characteristics curve for the seed delivery
AUS rice plant: Variety, Kataktara
(22 g. per 1,000 grains)

Number of the dropping seed grains per foot (per pipe)
Adjustment scale
Running gear, Ploughing gear
Sample machine.
Power tiller, KUBOTA KMB-200

-- Fig. 24 Characteristics curve for the fertilizer
delivery (Ammonia chloride)

The above curves are called the "Characteristics curves for the fertilizer and seed delivery. As the power for driving the delivery unit was extracted from the tilling shaft in the above sample machines, the characteristics curves for the delivery varied with the position (High or low speed) of the running speed change gear as well as the ploughing speed change gear.

Quantity of seed delivered is greatly dependent upon the size and shape of grains. Before the work, therefore, adjustment shall be given. Adjustment shall be then given again after checking whether the required number of seed grains (approx. 20 grains for the AUS rice plant) are dropped per foot, or not, when the tiller is run, the seed being not covered with soil. This is also the same with the fertilizer. The soil depth shall be a little small, when the soil is wet. When the soil is dry, meanwhile, the depth shall be large. In general, the proper soil depth is 0.5 inch. The covering soil depth shall be controlled by the ploughing, when the roller is lifted or dropped by the depth adjusting handle as mentioned above.

Sowing operation shall be given in such a way as the close ploughing method shown in the Fig. 25. When the wheel track of power tiller is 26 inches. The hill width shall be 13 inches, and the tiller shall run along the previous wheel tracks. If so, the wheel tracks would function as the markers to make the work more easier.

-- Fig. 25 Method of the sowing work --

The time required per acre is 4 hr. when the hill width is 13 inches, and the speed gear is positioned first.

It is 2 hr. and 30 min., when the speed gear is positioned second.

-- Fig. 26 Sowing work for the AUS rice plants by means of drive-type fertilizing and sowing machine.



Fig. 1 Soil crushing work by power tiller

Fig. 2 Driving type

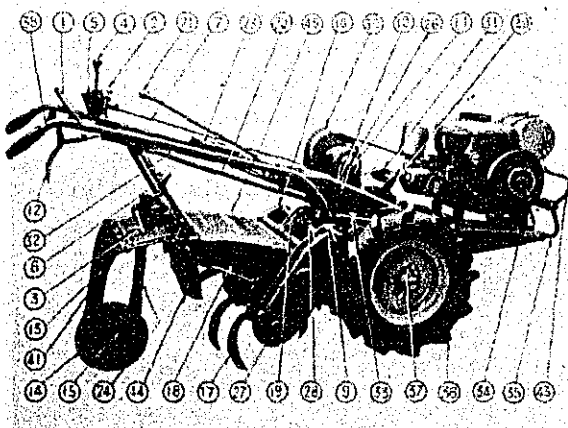


Fig. 3 Structure of power tiller



Fig. 1 Soil crushing work by power tiller

Fig. 5 Iron wheels

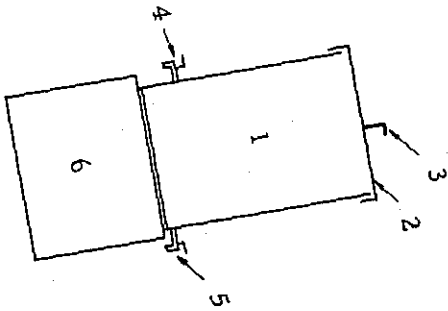
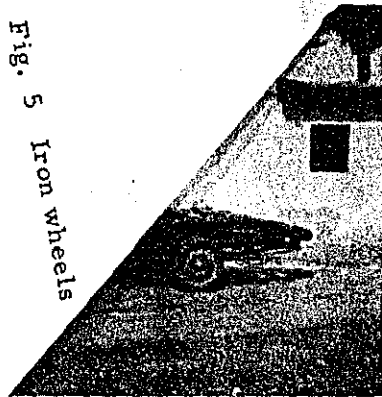
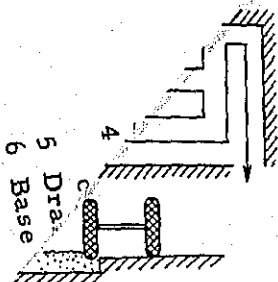


Fig.



9

Ploughing method I

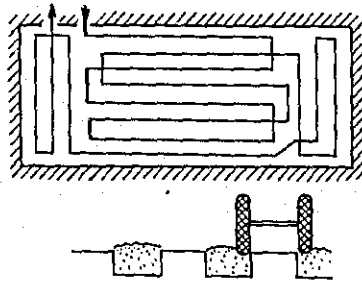


Fig. 10

Ploughing method II



Fig. 1 Soil crushing work
by power tiller

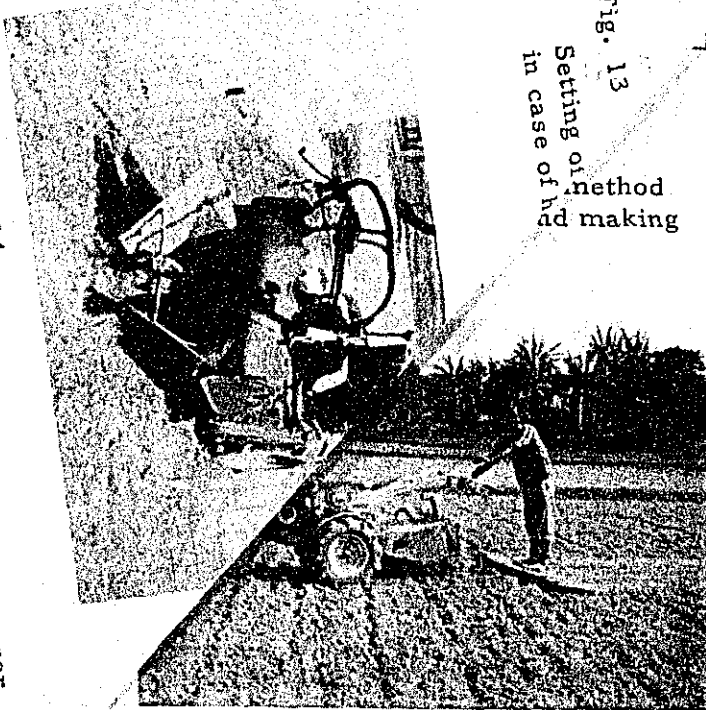


Fig. 13
Setting of method
in case of harrow making

Fig. 14
Harrowing unit fitted in the power
tiller

Fig. 17

Rolling work by harrow plate



Fig. 1 Soil crushing work by power tiller

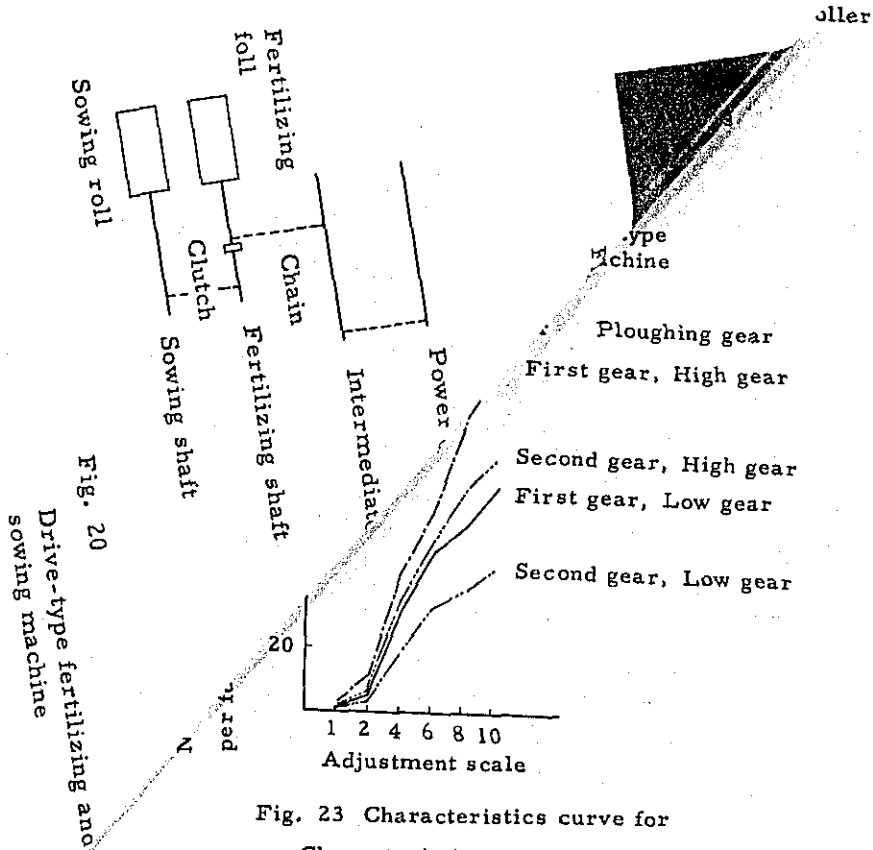




Fig. 1 Soil crushing work by power tiller

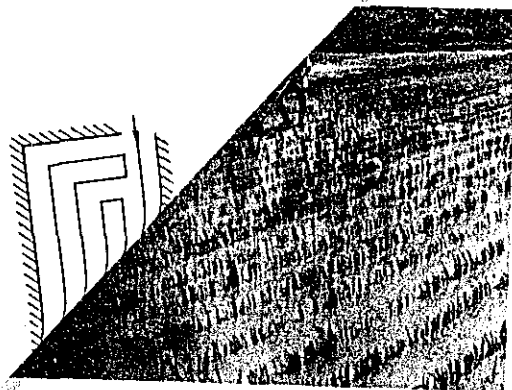


Fig. 25 Method of Sowing

Weeding of Line sowing low land Aus



Fig. 26

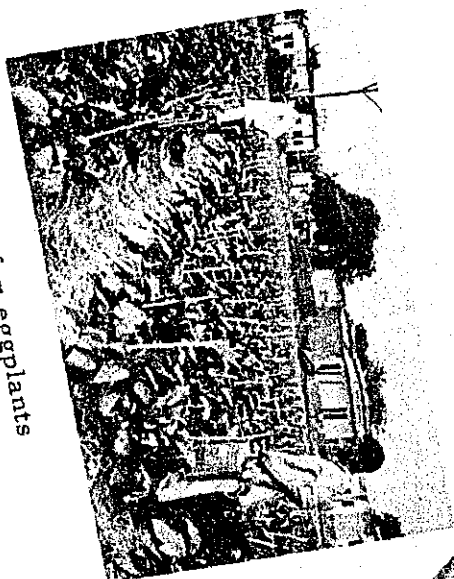
Sowing work for the Aus rice plants by drive-type fertilizing and sowing machine

Application of Ball fertilizer (T. Aman crop)

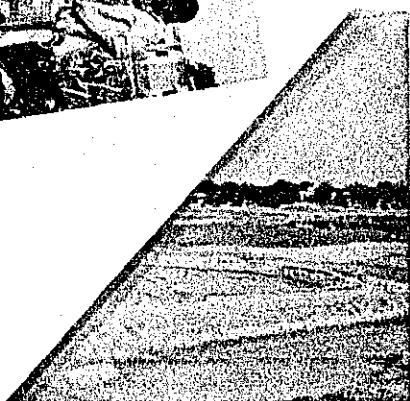
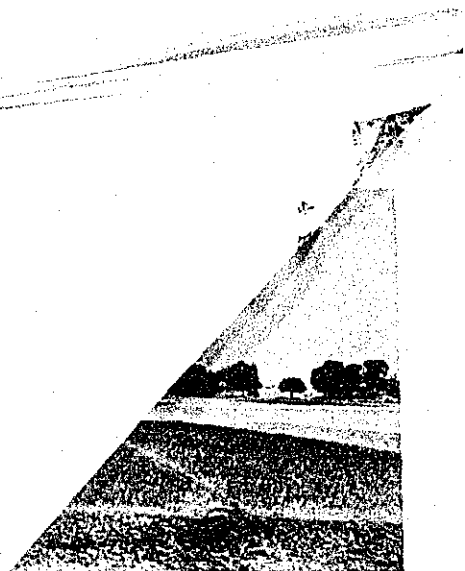


Fig. 1 Soil crushing work by power tiller

6 Spray for eggplants

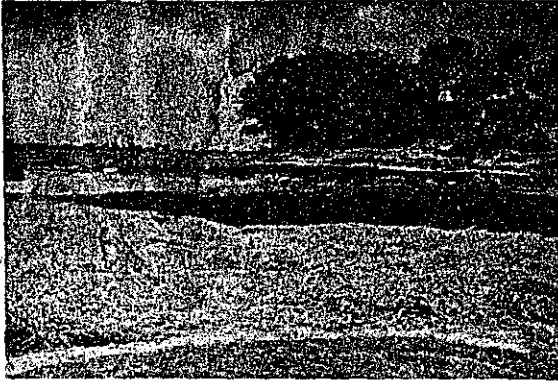


5



3 LOW LAND 1

Farmer's houses are concentrated as a group on some high land. B. Aus and Mixed crops (B. Aus and B. Aman) are main crops, and many Rohi crops are cultivated.



4 LOW LAND

Farmer's houses are concentrated as a group on high land. B. (floating Rice) is main crop in area.

5 LOW LAND 3

Farmer's houses are concentrated as a group at higher land. T. Boro is main crop in the area.



