VEGETABLE FARMING GUIDEBOOK

based on the study made at Rapti Model Farm
(J. A. D. P.) from 1972 to 1976

March, 1977

Agricultural Development Cooperation Department
Japan International Cooperation Agency

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Preface :

This guidebook was written for a reference of farmers and extension workers in Terai and hilly area in Nepal, especially, focused on practical techniques using pictures and figures. I hope that this booklet be helpful the Junior technicians and Junior Technical assistant who work in front of the agricultural extension.

In Nepal, maize and paddy rice are being studied at agricultural stations and some leaflets of cultivation guidances are also distributed to extension offices, therefore this booklet was compiled centering on vegetable cultivation.

The contents show an accumulated short experiences of vegetable cultivation tests in Nepal for 3 years and 5 months which have been contributed by young farm staffs. However, I afraid there might be still short comings, so I am also expecting your suggestions, if any.

I am grateful to Mr. A.N. YADAV, farm-manager of Rapti Model Farm, for his kind cooperation and valued contribution for farm management.

I am also highly obliged to Mr. T. HIDAKA, JOCV for his valued contribution for providing data and cultivation practices of vegetables and so did Mr. F. OTA, JOCV for field crops and Mr. Y. TOKUDA, JOCV for agricultural machinery in this booklet.

In the last, I am grateful to Dr. S. SHINOHARA, farmer director of UIATC, JICA for giving me his valuable suggestions and corrections in this booklet.

Uchihara, Japan
January 1977

S. YAZAWA

I Cultivation Conditions

I-1 Climate at Yagyapuri where the Rapti Model Farm is Located

(1) As seen is Fig. 1 (Table 1 as well), the biggest characteristics of climate at Yagyapuri is very clear difference of two seasons, rainy and dry.

The figure of area made up by heavey line above the curve of monthly average maximum temperature shows the grade of excess moisture in the period of June to September, while the figures of areas made up by oblique lines below the curve of monthly average minimum temperature shows the grade of excess dryness in the period of October to May.

It can be understood that the more the difference between maximum or minimum temperature curves and precipitation curve is, the severe the conditions of moisture or dryness become.

(2) The low temperature condition below 10°C of minimum temperature curve from December to February shows unfavorable condition for the growth of fruit vegetable strengthened by dryness as well.

(3) Sign of hailstone in May should be also noticed as it caused heavy damage for plants especially for fruit vegetables.

(4) Due to no irrigation facilities available, seed sowing is difficult to operate during dry season until the first monsoon comes in May (Vaishakha).

(5) When air temperature goes up 37°C, the soil temperature also rises up 38°C around at 5-10 cm depth of the field. Under such condition, germination of vegetable seeds and plant growth at early stage perform very poor.

Grass mulching may be very effective to improve high temperature condition in those days.

(6) Due to frequent hailstone falls, May (Vaishakha) has a big risk for harvesting any crops, in other words, production of any crops in May in a gamble.

For example, watermelon.

Since the price of watermelon and sweetmelon are very high in May due to still lacking season of mango, farmers wish to produce them but they must understand it is a kind of gamble.

(7) Judgement of the first monsoon called Makai Ko Pani (rain of maize) is difficult. If 40 mm of rainfall comes in 4-5 days, it can be said Makai Ko Pani and ready to sow maize.

The performance may be unsuccessful when the rate of rainfall is not sufficient, therefore, one must keep in mind that even germinating, the seedlings are very easy killed with wilting by dryness of soil after rain.

(8) Raising seedling for rain fed paddy field starts from the end of June (Ashadha) to the beginning of July (Ashadha) and Transplanting cam be done 20 days after sowing. Even there is rain at the end of July (shrvana), sometimes it is still insufficient for reserving water in the paddy field ready for transplanting.

(9) It must be taken into account that heavy rain of 140-160 mm comes usually in September and October (Ashvina) which suggests the end of monsoon season and the start of raising seedlings of winter vegetables.

Rain shed must the provided for the raising seedlings of winter vegetables during this season, otherwise, heavy disease damage will be caused by heavy rain beating on the nursery.

(10) In November (Kartika), the temperature comes down about 20°C and morning dew comes on the plant, which is the most suitable condition for the occurence of late blight of Tomato and Potato. Careful field management is desired.

(11) Growth rate of the fruit vegetable becomes very much down from the end of November (Margashirsha) to the middle of February (end of Magha due to the minimum temperature goes down less than 10°C and severe drought of the soil comes.

(12) Cruciferae crops are vernalized by the low temperature in the month of January and February (Pausha and Magha). Broad leaf mustard (Chinese ray) gets flowering time on the middle of February (the beginning of Phalguna) and Mino wase radish has the flowering time on the middle of March (the end of Phalguna), which means the end of harvesting times of these leaf and root vegetables.

1. Cultivation circumstance

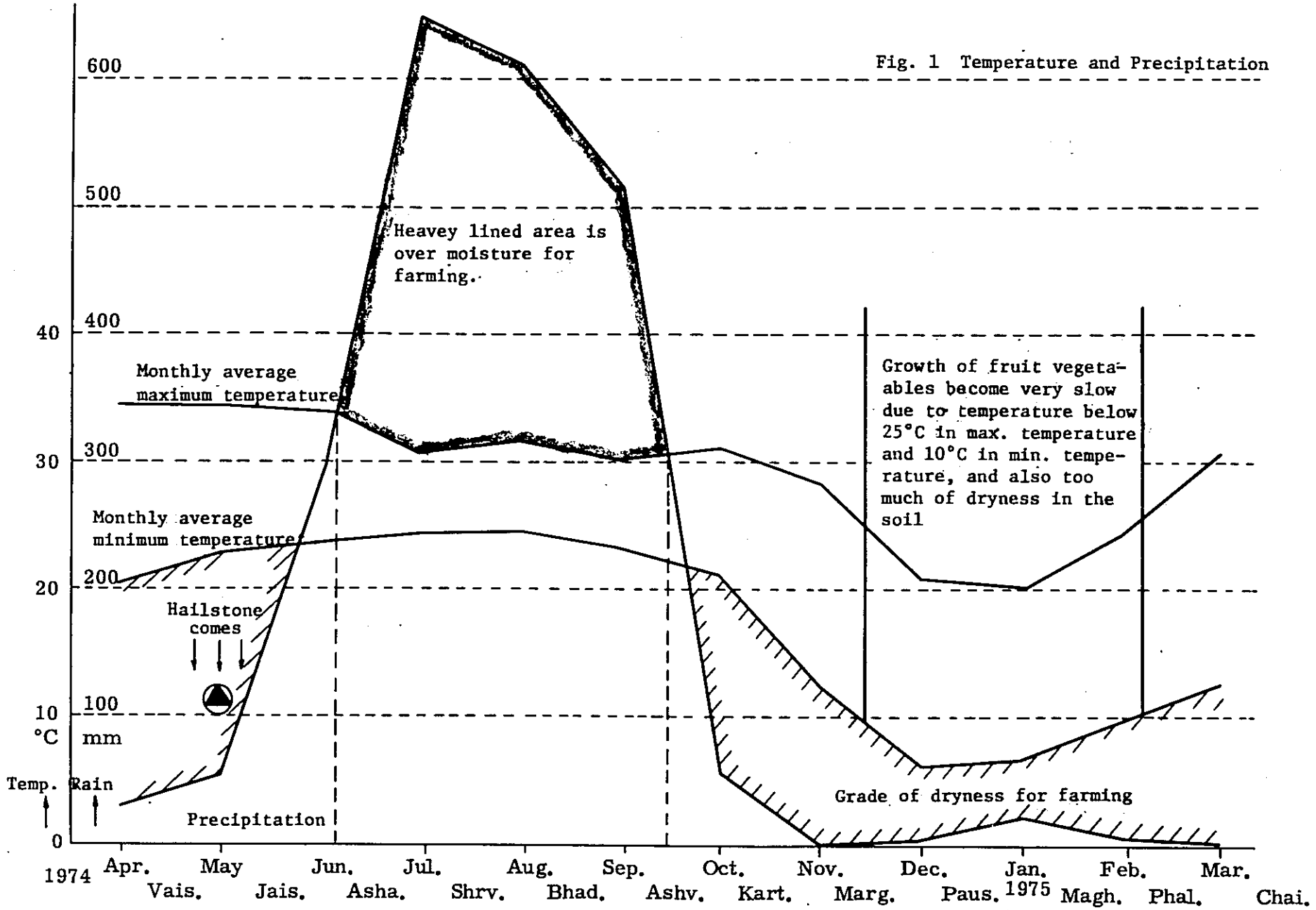
1 - 1. Climate at Yagyapuri where the Rapti Model Farm located.

Table 1. Weather table at the Rapti Modal Farm, 1974 (Unit: Temperature is degree centigrade Precipitation is mm.)

Items \ Month	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
	Vais.	Jais.	Asha.	Shrv.	Bhad.	Ashv.	Kart.	Marg.	Paus.	Magh.	Phal.	Chai.
Absolute Max. Temp. in each month	39.7	38.5	37.8	34.0	35.5	34.5	33.1	31.2	24.6	24.4	29.9	35.6
Monthly Average Maximum Temp.	35.2	34.8	34.1	31.0	31.9	30.0	31.4	28.5	21.4	20.5	24.5	31.0
Absolute Min. Temp. in each month	14.9	18.6	20.5	21.4	23.3	20.1	15.0	8.4	4.0	3.4	6.0	9.4
Mon. Ave. Min. Temp.	20.5	22.8	23.8	24.4	24.5	23.5	21.5	12.4	6.1	7.1	10.1	13.1
Mon. Ave. Mean Temp.	27.8	28.8	29.0	27.7	28.2	26.9	26.4	20.4	13.8	13.8	17.2	22.0
Monthly precipitation	35.5	54.5	285.0	649.5	616.0	518.0	59.5	0.0	4.0	21.0	8.0	3.0

Total annual precipitation is 2,254 mm.

Fig. 1 Temperature and Precipitation



I-2 Soil

Soil management is as important in the high temperature and heavy rain area for the maintenance of fertility.

Some fertilizers are recommended to supply but chemical fertilizers are usually too expensive to utilize by the farmers here, and it is also difficult for the farmers to get suitable fertilizers at desired amount and an time for their vegetable cultivations.

Moreover, simple chemical fertilizer causes very frequently degradation of soil by unbalanced chemical composition.

Accordingly, it is recommendable to depend mainly an organic self supply fertilizer. Organic fertilizer, for example, compost is not only containing necessary elements for the plant but also improves the physical condition of the soil such as keeping water capacity and aeration.

So that, it is said that compost is the most suitable fertilizer for the farmers.

According to the soil survey at Bharatpur and Narayanighat in the western ChiTwan, surface soil depth is 15-25 cm and its character is loam to sandy loam. Humus is 1 - 3% (poor). PH is 5.5 - 6.5 (light acid) and N centent is generally poor.

Soil maintenance for such soil as mentioned the above are as follows.

(1) Consider the use of green manure crops and do not keep the field un-planted, which prevents running off of the surface soil or erosion.

Application of organic fertilizer is also important.

(2) Present main rotation system in the area is maize → finger mellet (Kodo) or maize → oil seed mustard (Tori), or maize → wheat.

et should be better to introduce pulse cropping in this rotation system.

Table 2 Soil analysis around the Farm (By : Fukushima, November, 1973)

Name of the place	Houz-on	PH		NH_4-N mg/100 g	P_2O_5 mg/100 g	P. Absorb. coeffic.	K_2O mg/100 g	Ex. Ca mg/100 g	Ex.Mg mg/100 g	Humus	Ex.MnO mg/100 g	Al mg/100 g	Bulk density g/100 cc	Max. water capacity	Soil Texture
		H_2O	KCl												
Narayanghat	I	6.6	5.6	2.5	2.5	400	15.0	89.6	14.0	1.3	1.8	8	111	52.5	Silt C
	II	6.5	5.4	1.5	5.0	450	15.0	112.0	8.0	1.1	0.0	8-10	109	58.8	Silt C
Rank	I	6.2	5.6	1.8	2.5	700	3.0	126.0	42.0	4.5	1.0	20	110	54.3	SL
	II	5.7	5.3	-	2.5	900	3.0	84.0	20.0	2.6	0.3	20	100	60.6	SL
Ramnagar	I	5.7	5.0	2.5	-	500	15.0	89.6	34.0	2.5	2.0	30	108	55.7	Silt C
	II	6.4	5.0	5.0	-	1,000	20.0	39.2	46.0	0.9	2.0	30	107	55.5	SL
Gondran	I	4.9	4.6	-	-	400	8.0	103.6	20.0	2.4	1.0	18	108	56.2	CL
	II	5.7	4.6	-	-	500	8.0	42.0	20.0	1.6	0	15	110	55.8	CL
Krishnapur	I	6.2	4.7	1.0	-	700	15.0	131.6	18.0	3.0	1.0	3	110	52.5	L
	II	6.6	4.8	-	2.5	450	15.0	70.0	18.0	1.7	0	5	107	58.1	L
The Farm	I	5.8	4.3	2.5	5.0	1,250	3.0	100.8	32	4.0	1.0	10-12	109	62.0	L
	II	5.5	4.0	2.5	5.0	1,250	3.0	109.2	8	2.4	1.0	10-12	99	69.8	L

(3) Erosion in slop field should be prevented by continuous planting, withoug any vacance.

(4) There are many fields having hard pan at 15-20 can of depth which disturbs the root development.

Breaking of hard pan (furrow bottom) is quite important by deeper plowing or deeper hand digging in order to promote the development of the root.

From the view point of soil improvement, following two points are important.

I-2-1 Application of Compost

1.5 ton/10 a/year is requested as follows.

Generally, soil humus is considered to be consumed 2% per year. In the case of a soil containing 3% of humus, consumption of humus per 10 a (1,000 m^2) for 20 cm depth (a range of plant root development) can be estimated as follows.

a) Volume of soil : 1,000 m^2 x 0.2 m = 200 ton
(As specific gravity of soil is 1)

b) Consumption of humus : 200 ton x 0.03 x 0.02 = 0.12 ton

It is also considered that compost usually produces humus at a rate of 10.8% of the volume by decomposition. Then, the requirement of compost for supplementing 0.12 ton of humus consumption can be

0.12 ton ÷ 0.018 = 1.1 ton ... Required compost quantity

1.5 tons of compost supply per year is recommended to increase the soil humus content up to 5% which means ideal figure of fertile soil for vegetable cultivation.

I-2-2 Application of Lime

100 - 200 kg/10 a/year.

Although lime supply is necessary for fields here, it is hard to recommend farmers to use lime since cheap agricultural lime is at present not available here. Of course, lime is available for construction projects but it is not economical for agriculture use.

One must keep in his mind that, when the soil comes to be acidity, such undesirable phenomena frequently occur as defficiencies of Mg and Ca or slow decomposition of organic matters in the soil when cheaper lime comes someday, 100 - 200 kg of lime application is desired.

Soil analysis around the Rapti Model Farm is shown in Table 2.

The unit of Table 2 is easily understood if the unit (mg/100g) is considered as follows.

For example 2mg/100g of NH_4-N

1,000 m^2 x 0.2 m (depth) = 200 ton (soil quantity)

(As specific gravity of soil is 1)

200 ton x 2/100,000 = 4 kg (NH_4-N)

Only 4 kg of NH_4-N is available in 10 a. 20cm depth of worked soil. Actually N in the soil can not be utilized completely, so these data show that these soils are shortage with nitrogen in NH_4 type.

II Preparation for Cultivation

II-1 Seed and Germination

Seed will germinate when adequate moisture, temperature, and oxygen are given, providing the seed is well matured and no trouble of dormancy. However, sometimes seed may show poor germination in the field if the condition is insufficient, which cause difficulty in farm-management and poor yield.

Conditions of poor germination, no germination or uneven germination (germination time is not simultaneous) are as follows:

II-1-1 Seed Quality which Cause Poor Germination

(1) Seeds are aged and having no germination obility (seeds more than 3 years old)

(2) The condition of seed storage is inadequate which reduce the vital power of germination (high moisture and high temperature)

(3) Seed was harvested when it was still not ripen (un-matured seed)

(4) Hard seed coat disturb the germination (gold mohr, triploid watermelon)

(5) Dormant seed. For example, seed potato and cabbage.

II-1-2 Condition for Germination

(1) No moisture in soil (seed is sown on extremely dry soil). When seed has not absorb moisture, carbohydrate and fat present in endosperm is not activated. It means that an engine for germination does not start.

(2) Too low or too high temperature for germination, certain adequate temperature is required for germination. Under optimum temperature condition seed germinate when moisture and oxygen are given (Table 3).

Table 3 Maximum, minimum and optimum temperature for seed germination

Name of the crop	Min. temp.	Adeq. temp.	Max. temp.
Paddy rice	10°C	34°C	42 ∿ 44°C
Wheat	0 ∿ 2	26	40 ∿ 42
Maize	6 ∿ 8	34 ∿ 38	44 ∿ 46
Soyabeam	2 ∿ 4	34 ∿ 36	42 ∿ 44
Garden pea	0 ∿ 4.8	25 ∿ 31	31 ∿ 37
Melon	15.6 ∿ 18.5	31 ∿ 37	44 ∿ 50
Squash	10.5 ∿ 15.6	37 ∿ 44	44 ∿ 50
Cucumber	15.6 ∿ 18.9	31 ∿ 37	44 ∿ 50
Red pine	9	21 ∿ 25	35 ∿ 36

(From Nogaku Daijiten)

However, it does not mean that the seed may die below minimum temperature and above maximum temperature in Table 3.

Higher than optimum temperature make germination earlier and lower temperature make germination slow, but it has a tendency that lower temperature shows good germination ratio.

(3) Shortage of oxygen

Much oxygen is required for germination since seed respirates very much at germination. (Germination is disturbed by water saturation of soil after heavy rain or irrigation)

(4) In the case of no germination in the field even satisfying the above conditions, following cases which cause no germination may be considered.

ⓐ Thick soil covering of seed may cause to shortage of oxygen or disturb the shoot growing with a clod above the seed.

ⓑ Attacked by soil born disease such as Pisium, Rizoctonia (damping-off) and Fusarium, which spoil germinated seeds.

ⓒ Attacked by insects in the soil.
Larvae of seed-corn maggot eat seeds when germination start

ⓓ Attacked by birds.

II-1-3 Genetical Problems

As germination problems were explained, seed quality which is also important will be explained next.

Genetical degeneration :

(1) No good seed produced by natural selection to wrong direction. For example, if seeds such as radish, cabbage, carrot which request low temperature for bolting are produced in the area where have not take low temperature (2-5°C), seeds are generally collected from plants which easily bolted and flowered may produce un-expected stalking in next generation.

(2) No good seeds produced by natural crossing in cross pollinated crops.

For example, turnip and Chinese ray, different varieties of egg-plant and radish.

(3) Seeds (spirled) with virus. This is a common problem in all the crops and cause extreme reduction of the yield.

It is quite necessary that the seed must be bought from a reliable farm or a shop.

II-2 Importance of Compost

II-2-1 Evaluation of Compost

The effect of compost on yield which applied continuously can be understood from the experiments shown in Table 4.

Table 4 Effect of compost at the field (per 10 a.)

Name of place	Kind of soil	Compost quantity per year	Name of crop	Continued year	Yield Ⓐ No compost	Yield Ⓑ compost	B/A
		kg		yrs	kg	kg	%
Hokaido	Valcanic ash	1.120	Potato	19	630	1.013	161
Kikyogahara	"	1.120	Maize	18	573	850	148
Kanto Tosan	"	1.500	Wheat	5	269	364	135

As seen in Table 4, compost manuring contributed 61% of yield increase in potato so did 48% in maize cultivation, that is, an example of benefit of compost.

Therefore, in the area where chemical fertilizers are so expensive as seen in Table 5, one has to consider use of compost first as fertilizer instead of chemical fertilizers.

Table 5 Price of fertilizers at AIC, Bharatpur. (as of Nov. 1975)

Name of fertilizer	Element quantity	Weight per bag	Price per bag	Element quantity per 100 kg	Price of 1 kg of component	Remarks
	%	Kg	Rs	Kg	Rs/kg	
Urea	45	100	305	45	6.78	N
Ammo. sulfate	21	100	220	21	10.48	N
Muriate Potash	60	100	185	60	3.08	K
Cal. Sup. Phosphate	18	100	88.57	18	4.92	P
Tripple S. phos.	34	100	225	34	6.61	P
Comp. Fertilizer	20-20-0	100	267	N =20 P =20	N+P=13.75	N+P
Comp. fertilizer	15-15-15	100	260	N =15 P =15 K =15	N+P+K=17.33	N+P+N

Table 6 Element quantity of compost and stable manure and their estimated cost (per 1 ton)

	Element quantity ratio	Element quantity per 1 ton	Estimated (1) cost/1 ton	Remarks
	N : P : K			
Compost	0.5 - 0.2 - 0.5	N = 5 kg P = 2 K = 5	77.7 Rs	2.25 ton of compost contains 1 kg of B, and also contain Mg, Mn,Ca,Mo,Si and so on.
Stable manure	0.5 - 0.3 - 0.6 0.7 - 0.4 - 0.8	N = 5 - 7 P = 3 - 4 K = 6 - 8	93.2 Rs	(1) Cost was estimated by equivalent of chemical fertilizer of 20-20-0 and 15-15-15.

As understandable from Table 6, compost contains nearly 1/30 of actual quantity of elements of chemical fertilizer and also rich in minor elements which chemical fertilizers do not contain. Another importance of compost is the ability of improving soil physical condition mentioned later.

II-2-2 Production of Compost per One Farmer

Reasonable amount of compost produced by one farmer per year can be calculated as follows:

Providing that one farmer keep a pair of work cattles and two milk cows and each of them produces 6 tons of stable manure per year, the result is:

4 heads x 6 ton/year = 24 ton/year

as monetary,

Rs. 93.2/ton x 24 ton = Rs. 2,237/year.

Thus one farmer can produce 24 tons of compost per year, that is equivalent to Rs. 2,237

II-2-3 Classification of Compost

(1) Stable manure : So called compost in text book means usually compost (a narrow sense), since it is the most ideal one. This is usually produce from stable manure steped and mixed the bedding straws with dunys and urine by cattle.

(2) Natural compost : Simple piled fallen leaves, dried weeds, and straw etc, without putting any fermenteries and fermented naturally with rain water. Its production takes a long time and has usually poor content of N, if exposed in rain during fermentation.

(3) Quick compost : Using similar materials to the above, the materials are piled under roof and fermented adding Nitrogen source such as ammonium sulphate or night soil and lime to accelerate farmentation. It contains richer nitrogen than the above though its production takes only a few weeks.

Farmiing in Nepal is based on cattles and cows and the farmers keep a log of them. Utilize more those valued dung and urine for making food compost.

II-2-4 Benefit of Compost

(1) Improvement of physical properties of soil.
Giving water holding capacity and nutrient holding capacity for sandy soil and giving aeration increasing crumb structure for clay soil.

It is quite effective for slope fields as increase of water holding capacity restrain run off or erosion.

(2) Improvement of chemical properties of soil.

Compost comes into humus in the soil which play such roles as : (a) produces valued plant nutritions of its elemental contents by decomposing into organic acids and gasses, (b) prevents acidification of the soil from supplying acid fertilizers, and (c) acts as a buffer of nutritions unbalance of the soil or antagonism among chemical elements and reduces fertilizer troubles.

(3) Supply of nutrients

Many kind of elements are supplied as mentioned on Table 6. Phosphorous and potash are quick acting like superphosphate and muriate potash, but nitrogen is slack effective.

(4) Increasement of micro-organism in the soil.

Nitrification bacteria is increased and promote soil fertility, changing NH_4 type nitrogen to NH_3 type.

Summarizing the above items, use of compost means that it widens safety cultivation under any condition which disturbs the cultivation such as heavy rain, drought, over dump, shortage of fertilizer and unbalanced fertilizer supply, and reduce damage of root knot nematodes and some kinds of virus diseases.

II-3 How to make compost

For making compost, if following 3 items are understood, you can save waste of making compost.

(1) C/N ratio of materials

Some of carbon in organic materials are oxidized to carbon dioxide gas to be the source of energy but some of this become a body of micro-organism.

Convertible ratio of carbon in organic materials to micro-organism can be considered as 30% under the condition of making compost. And weight ratio of carbon and nitrogen of micro-organism are considered as 10:1.

So, Nitrogen 3 is used by micro-organism for carbon 100.

$$C/N = 100/3 = 33$$

If N is contained more than this, it becomes inorganic compound and N is lost by volatilized into ammonia.

If N is contained less than this, activity of bacteria become dull and decomposition of organic matter become slow that means difficult to be compost.

So, when rice straw is piled for compost, it is better to add Nitrogen to make compost quickly as C/N ratio of rice straw is

61 as mentioned in Table 8. C/N ratio of stable manure is less than 30 and decomposition is fast. No need to add any nitrogen and you should be careful about loss of Nitrogen.

Table 8 C/N ratio of compost materials

(from Sosai no hibai)

	C	N	C/N	N per 100 kg to be C/N = 30
Saw dust	54.0%	0.20%	270	1.60 Kg
Rice straw	54.0	0.74	61	0.88
Wheat straw	46.5	0.65	72	0.90
Maize stem	43.3	1.67	26	-
Fallen leaves (pine)	42.0	1.42	30	0
Green soyabean	45.0	2.54	16.0	
Rice bran	37.0	1.74	22.0	
Rape cake	16.0	5.00	3.2	

(2) Water

There are aerobic bacteria and aerophobic bacteria which decompost organic matters, getting oxygen and water for their activities.

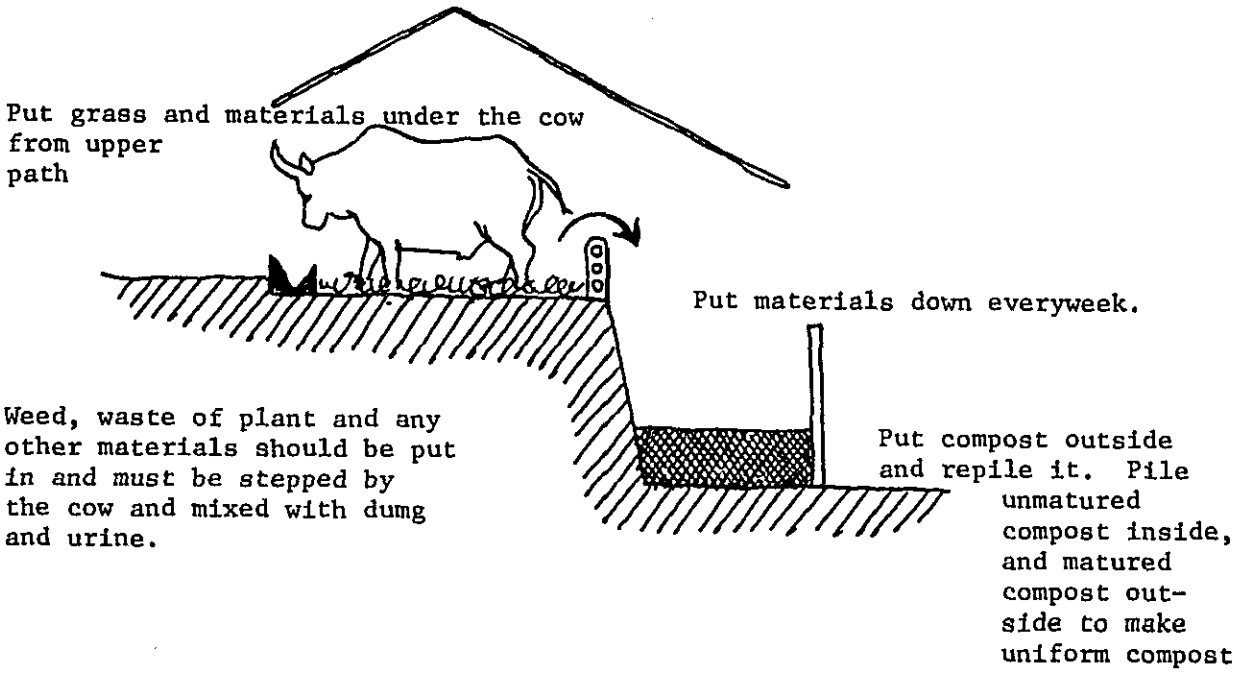
When it is good aeration, aerobic bacteria become active and decomposition of the material go smoothly, but loss of N may happen sometime.

When it is bad aeration (swampy condition), aerophobic bacteria become active and decomposition become slow. Actually the compost is made by action of both bacteria.

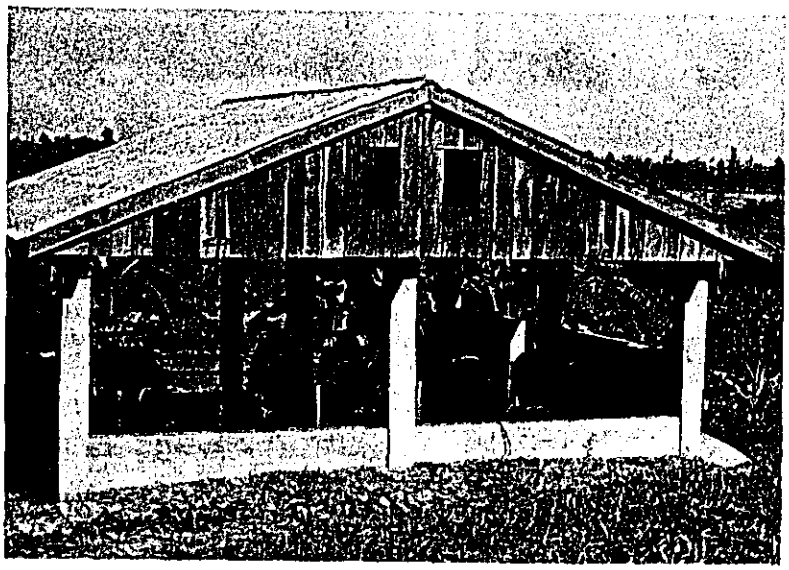
(3) As other factors, it is desirable that reaction of materials are natural for activity of bacteria.

In case of stable manure, it is neutral and no problem but for rice straw it is effective to add a little lime to make neutral. See fig. 2 as practical method.

Fig. 2 Cow and compost shed utilizing slope area

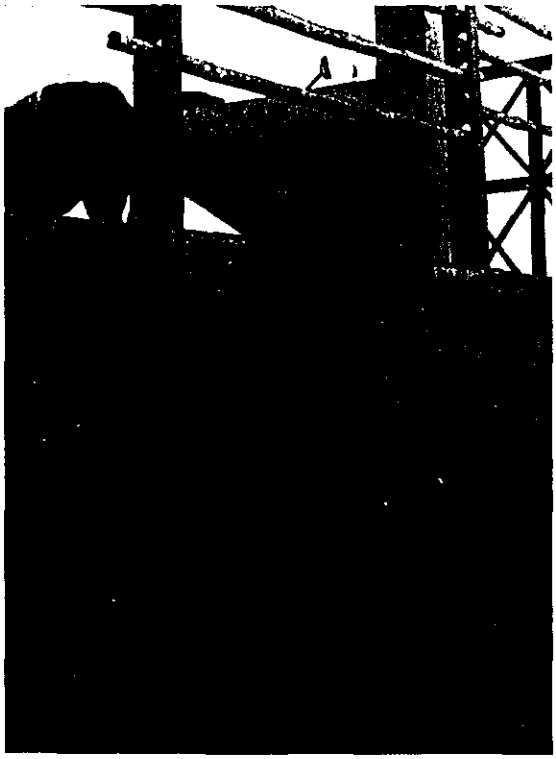


An example of the cow and compost shed of the Farm



A full view of the shed. The upstairs is utilized for storage of hay and straw.

Grass and straw are stepped and mixed with dung and urine. After a week, those are put down and piled.



Compost is piled down.

Removing compost to outside.

II-3-1 Points of Compost Making

(1) Obtain compost materials as much as possible and put them in the cow shed. As the materials, weed, straw, stem of maize, waste of vegetable and fallen leaves, etc can be utilized.

(2) Make fermentation easy and quick by mixing with duny and better stepped by cows.

(3) Urine contains nitrogen 2 times of dung. Prevent loss of Nitrogen by putting grass and straw a bedding. (Urine contains 0.6% of nitrogen dung contains 0.3% of nitrogen)

(4) When volatilization of ammonia happens (when small is strong), put straw mats on the compst to prevent the loss of nitrogen.

(5) Roof is necessary since elements is easily run off by rain.

(6) If the temperature does not rise in the compost pile, it is usually caused by shortage or excess of water. Control of water and make easy fermentation of materials.

(7) It is said that compost production per cow a year is 5-10 ton. It depends on how much one can put materials in the cow shed.

II-3-2 Points of compost use

(1) When compost become dry, denitrification may happen by nitrification. Put compost in the soil before it dry.

(2) If soil humus is less than 3-4%, compost in important as a buffer mentioned at II-2-4 (2). If that is more than 3-4%, compost increase its value in soil improvement.

Keeping soil humus at least 3% by adding 1.5 ton of compost annually is recommended.

(3) For crops like fruit vegetables which develop root broadly, apply compost in deep ditch. So that the root develops deeper and wider and the plant can stand for drought in dry season. Root (is used to) grows where compost is located.

(4) Use compost mixed with chemical fertilizers so that the run off of fertilizer by the rain can be minimized.

(5) Sometimes yield is reduced by supplying compost. It is generally caused by the use of un-matured compost.

The reasons are as follows:

(a) Un-matured compost contain more carbon and less nitrogen, while un-matured compost is discomposed in soil, it takes off nitrogen from soil which cause momentary nitrogen difficiency.

(b) While un-mature compost is decomposing, gas such as methans, hydrogen and carbon-dioxide gas are occured and which harm the root directly.

In the case of poor aeration field, the growth of root is checked by the shortage of oxygen.

(c) Pathogenic fungi, weed seeds and insects are killed by high temperature (70°C) of fermentation of the compost.

In the case of un-matured compost, the fermentation is not done well, so that those noxious fungi is not killed.

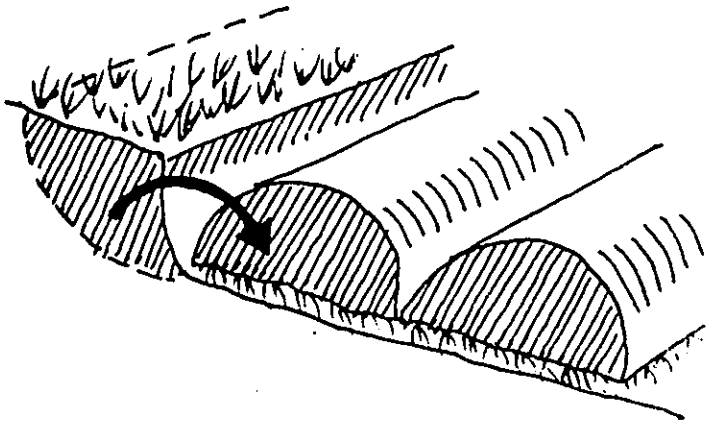
II-4 Plowing

Plowing is basic and important work for the cultivation, which helps easy planting and sowing with increase of aeration, water holding capacity and make soil structure into soft,

Plowing in this area done by a couple of cowp. It is better to plow deeper and turning out as fig. 3.

It is adviseble to use an improved plow which is recommended by agricultural development office.

Fig. Condition on turning out :



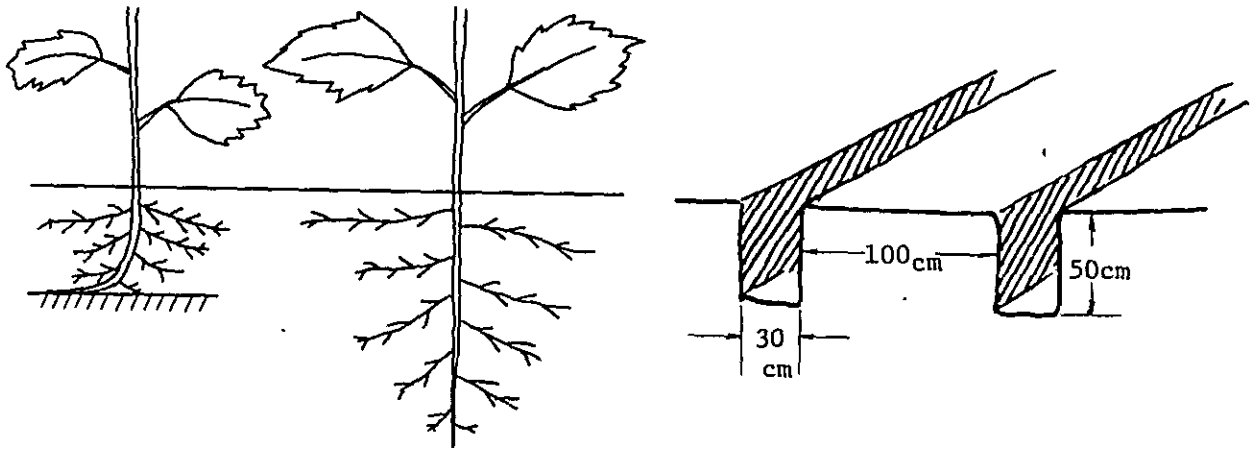
Success of failure of the cultivation depend on how much root develope in the soil, especially the area where dry season and rainy season are completely divided. Deep plowing or deep digging is recommended. At lease once a year.

In the case of vegetable cultivation, shallow plowing is not recommended. If deep plowing is difficult to do, follow the deep digging method and put compost in the ditch as fig. 4.

The compost at the deeper ditch in the soil induces deeper root development. Even when the plant is wilted at the other field, you may keep your plants fresh due to broad deep root development.

Even you plow nicely by the plow headed by a pair of cattles, 10 - 12 cm is average. Deeper digging is required at least once per two years.

Fig. 4



Root can not grow deeper due to soil hard pan also the root may not absorb moisture in deeper portion while it is a dry season.

Though a bit tractor can be seen in this area, if the tractor is attached with a plow, it is quite helpful.

But if the attachment is a disk harrow which can do only 8-12 cm depth so that it is not effective.

II-5 Importance of Bed Soil and Method of Bed Soil Making for Vegetable.

II-5-1 Conditions for Bed Soil

For vegetable cultivation, if direct sowing method can be taken, it is butter to sow seed directly on the field which is more similar to natural condition and develop the roots deeply. But, sometimes transplanting method has to be taken by following reasons, or benifit of raising seedlings.

(1) When sowing time is still rainy season and small plant just after germination is beaten by the heavy rain (cabbage on August and September (Bhadra, Ashvina) sown).

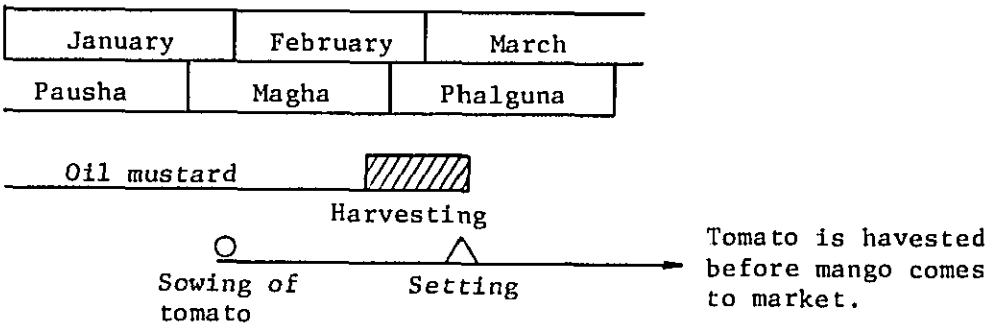
(2) When the soil is completely dry in the dry season without any irrigation facility and making germination is difficult and oftenly come irregular (Tomato on January and February (Magha, Phalguna) sown).

(3) In the case of control of noxious insects and diseases, small plants under the seedling bed are easily protected from those insects and diseases. (Cucurbit beetle for watermelon and cucmber, damping off for almost all vegetables.)

(4) When intensive plant management is required as the plant is very small and weak. (Celery)

(5) When the field utilization must be brought up and young stage of plant have to stay in a nursery bed.

In the case of planting tomato after oil mustard(Tori) cultivation.



(6) When seeds must be economized. (1/5 of seed in direct sowing is enough for transplanting in cucumber cultivation)

For the case of item (6) mentioned the above, field management such as watering, controling of noxious insects and diseases, thining are easily done intensively in the nursery bed, and high yield is expected.

However, principle of vegetable cultivation is direct sowing which do not harm the root, providing the points mentioned above are avoidable.

II-5-2 Method of Bed Soil Making

If transplanting method is taken, bed soil is required.
The bed soil must be satisfied following conditions, otherwise good seedling can not be raisen.

(1) Contain enough nourishment (adding compost and fertilizers)

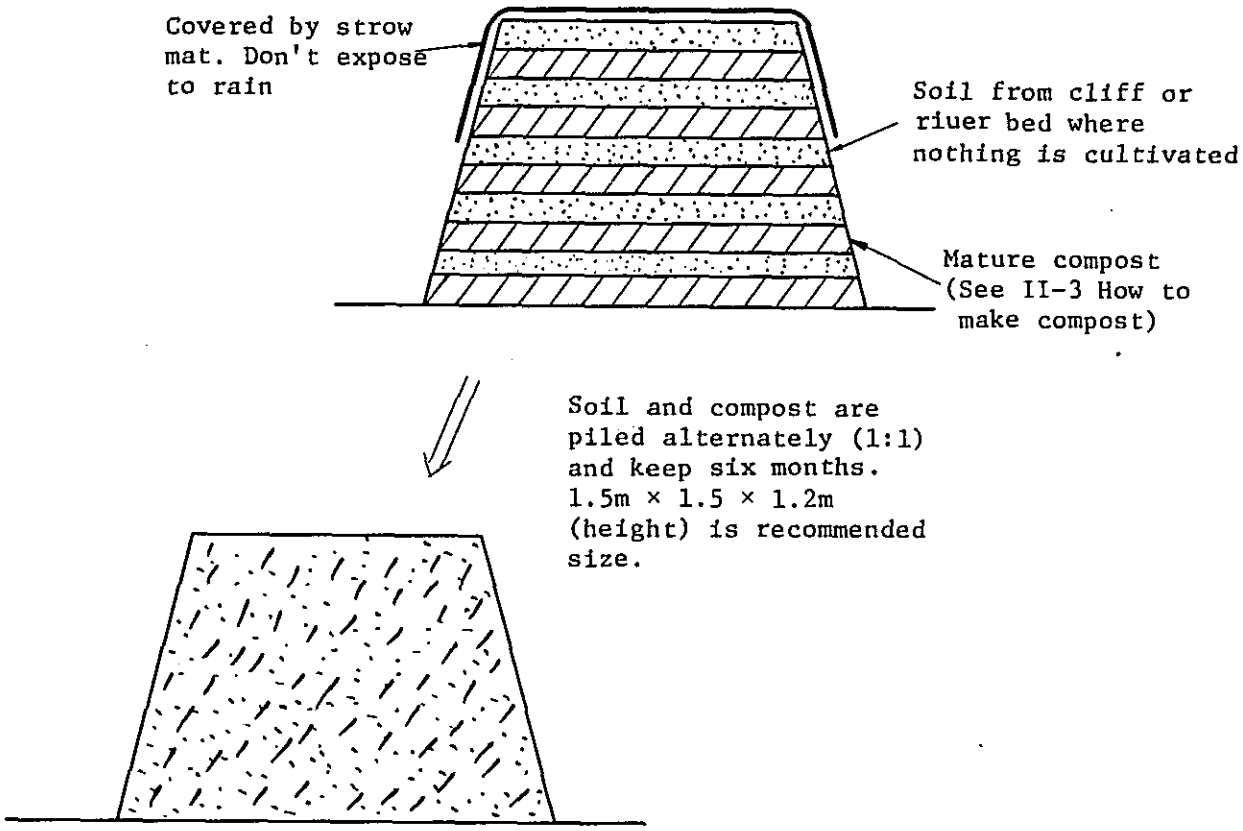
(2) Free from noxious insect and pathogenic fungi (use soil from vergin area like mountain soil or river bed soil).

(3) Good aeration and water holding capacity (adding organic matters.)

(4) Soil pH is adequate (adding ash when acidity is high)

Practical way of bed soil making is explained on Fig. 5

Fig. 5 How to make bed soil



After 6 months, break the pile by a hoe and repile them mixing soil and compost together.

If the bed soil is well drained and easy to be dried, add some more compost and clay soil, so that water holding capacity is increased.

On the contrary, if aeration and drainage are like having crack in the bed, add some compost and sand.

Regarding to nourishment, elements which are contained in compost can do. However, if some of chemical fertilizer are available, it is better to add fertilizer as much as the amount reffered on Table 9.

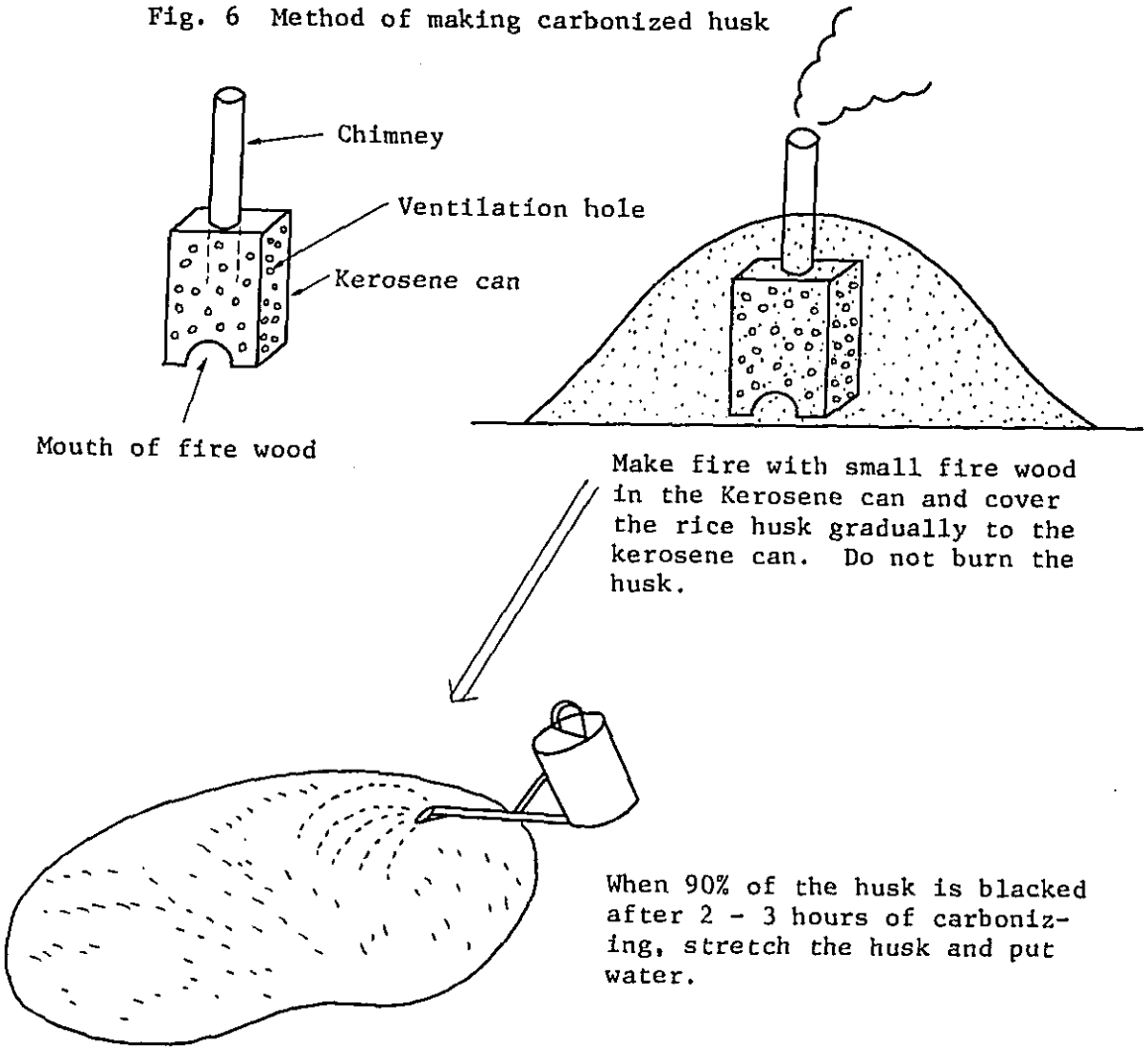
Table 9. Fertilizer amount for 1 m^3 of bed soil

Element		Fertilizer	
Nitrogen	130 g	Urea	325 g
Phosphrous	130	Cal. Super Phosphate	650
Potash	130	Muriate Potash	216

If a method of Fig. 5 is taken, it needs usually one year to be good bed soil after piling compost and soil.

In the case of urgency, bed soil using carbonized husk is convenient. Rice busk is easily gained where paddy rice is planted. And making carbonized husk is quite simple as Fig. 6.

Fig. 6 Method of making carbonized husk



If watering is not enough, the stretched carbonized husk turn to ash from the bottom. If watering is too much, the carbonized husk get damp and hard to use.

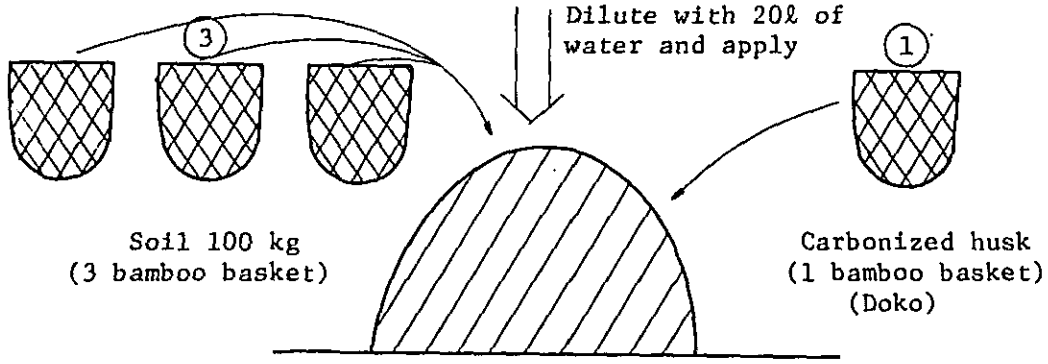
It needs to watch 2-3 hours after stretching carbonized husk and when the temperature of the husk get down, the work is completed.

When the carbonized husk turn to white ash by burning, it becomes alcaline, but nothing is harmful that even those ash are used with soil. It collect soil acidity also.

Bed soil with carbonized husk can be made as follows.

Fig. 7 Method of making bed soil using carbonized husk.

Urea	32 g (2 table spoon)
S. phosphate	65 g (4 table spoon)
M. potash	21 g (1.5 table spoon)



Mix soil and carbonized husk with diluted fertilizer.
This bed soil can be used immediately

III Cultivation Practice in General

III-1 Sowing Time

Adequate sowing time has to be selected according to the differences of places, crops, and varieties. This adequate sowing time should be set up considering with, (1) to get better, easy plant management, (2) to get better quality and high yield, (3) to get good harvesting time at higher price (beneficial marketing time).

The adequate sowing time may change with temperature, day length, rainfall, soil moisture, hailstone, and marketing.

As those conditions are different in different area, it is necessary to set up the sowing time in each area.

As a standard, the planting calender at the Rapti Model Farm is mentioned an next page.

TEMPERAIURE & PRECIPITATION AT PAPT MODEL FARM 1974 — 1975

°C TEMPERATURE

mm PRECIPITATION

(VAISHAKHA) (JAISHTHA) (ASHADHA) (SHRVANA) (BHADRA) (ASHVINA) (KARTIK

APR. 1974 MAY. JUN. JUL. AUG. SEP OCT.

4/25 5/5 MAIZE

6/15 6/30 SOYABEAN

6/25 7/5 PADDY RICE

7/5 RADISH

5/1 OKRA

5/1 BITTER GOURD

4/25 5/5 CUCUMBER

7/20 8/1 CUAUMBER

8/15 8/20

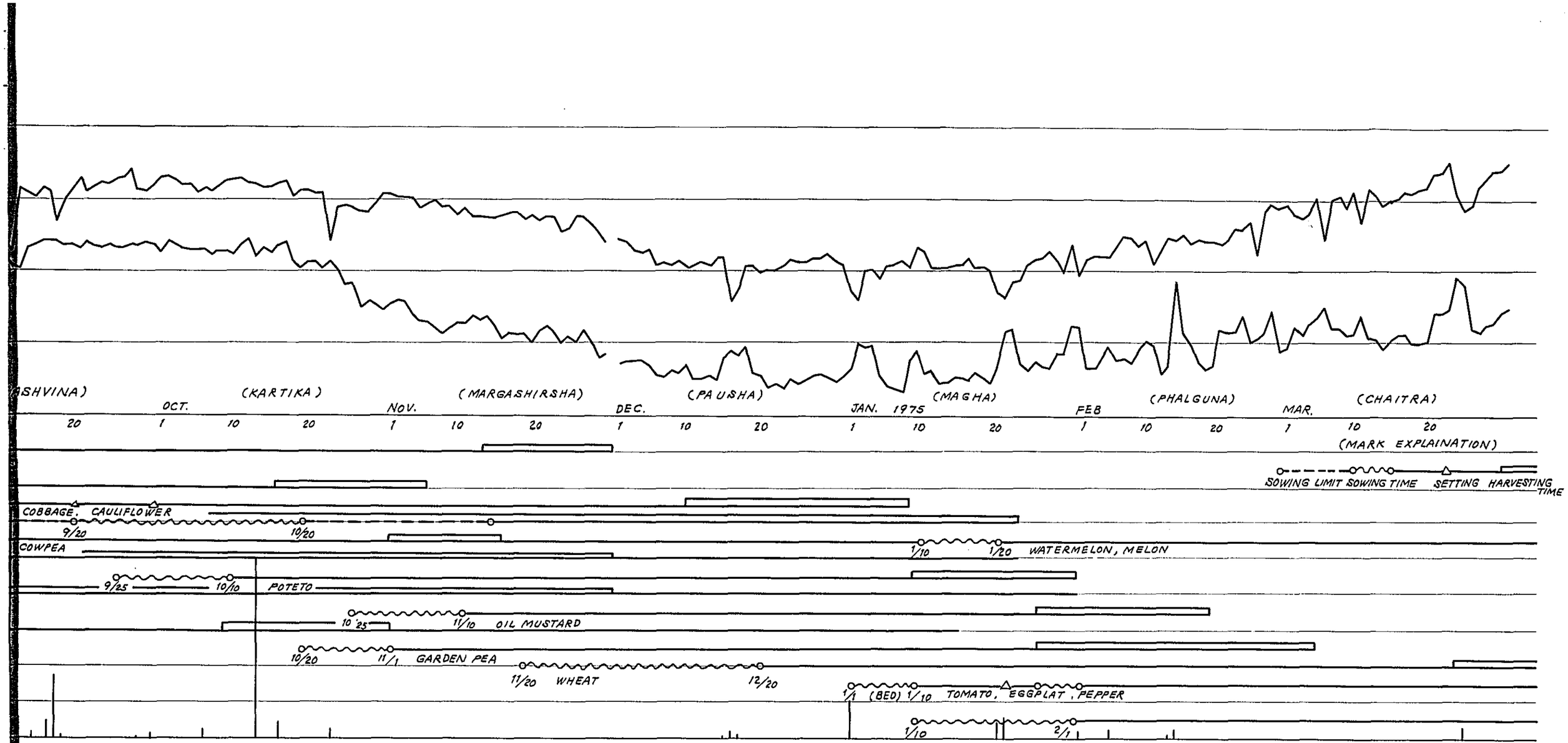
8/1

9/1 (BED) 9/10 COBBAGE. CAULIFLOWER

9/20

9/1 COWPEA

9/25 10/10 POTE


(ASHVINA)
(KARTIKA)
(MARGASHIRSHA)
(PAUSHA)
(MAGHA)
(PHALGUNA)
(CHAITRA)
OCT.
NOV.
DEC.
JAN. 1975
FEB
MAR.
20 1 10 20 1 10 20 1 10 20 1 10 20 1 10 20 1 10 20
(MARK EXPLAINATION)
SOWING LIMIT SOWING TIME SETTING HARVESTING TIME
COBBAGE, CAULIFLOWER
9/20
10/20
COWPEA
1/10
1/20 WATERMELON, MELON
9/25
10/10 POTETO
10/25
11/10 OIL MUSTARD
10/20
11/1 GARDEN PEA
11/20 WHEAT
12/20
1/1 (BED) 1/10 TOMATO, EGGPLAT, PEPPER
1/10
2/1

An example which sowing time is changed by field condition is shown below.

Sowing time of oil mustard (Tori) is usually considered at the end of October to the beginning of November (Kartika) in Chitwan district. Generally, this period can be said adequate indeed. However, if the soil moisture in the field is sufficient, oil mustard can be planted as late as by the end of November (middle of Margashirsha) and able to obtain general yield.

Thus, in the rotation of paddy rice, oil mustard cultivation can be introduced after harvest of paddy rice at the middle of November (beginning of Margashirsha), that is, sowing oil mustard at the end of November (middle of Margashirsha)

Utilization of paddy field can be increased.

One must examine field condition and improve field management as economic as possible.

III-2 Planting Density and Seed Sowing Method.

When one designs planting density for a vegetable crop in the tropical area like Terai, one must firstly consider how much and how big can the plants grow under the said condition, that is, severe in rainy hot season while rather mild in dry moderate season.

For example, in radish :

In rainy season; since radish can not be expected to grow big root due to heavy rain and hot weather, recommendable spacing is 2 line sowing on 90 cm row (60 cm width bed with 30 cm path), that is, 7,400 plants per 10a. By this design, 3,700 kg per 10a. of yield can be expected if the growth is completely smooth though one radish may be as small as 0.5 kg, in the other words, when big growth can not be expected, a yield increase can be expected only by means of dense planting.

While in dry season, since growing condition is moderate and good

gwoth rate of 1 Kg per one radish can be expected, recommendable spacing is single line sowing on 70 cm row (30 cm width bed with 30 cm path).

By this design, 5,500 Kg/10a of yield can be expected counting 5,500 radishes as the maximum.

More or less the similar idea to radish can be applied to design planting density of cabbage, tomate, cucumber, and other vegetable crops too. In general, planting density be changeble in the same crops with planting times, field fertility, varieties as well as the ability of farmers.

Following points can be counted for dense spacing;

Merit :
a) High yield can be expected in early stage.
b) Check weed growth due to covering soil by plants
c) Prevent drying of soil
d) Less sun-burn on the fruits

Demerit :
a) Plants be easily elongated and spoiled by diseases
b) Roots, bulbs and fruits become small
c) Difficult to enter into the field therefore hard to manage the field owing to crowded leaves and stems.

Table 10 Planting density and sowing rate

Plant	Variety	Spacing	Number of plant/10a.	Seed sowing	rate	Remarks
Paddy rice	IR-20,22	25 x 20 cm	20,000	5ℓ	2.5 kg	70g/m^2,unhusked
Wheat	RR-21	25 cm row	-	15ℓ	12 Kg	Sown after cattle plow.
Maize	Khumal Yellow	80 x 30	4,160	6.7ℓ	5 Kg	
Oil mustard	Local	Broadcast	-	2.7ℓ	1.8 Kg	5 Mana/10a
Cucumber	Local	120 x 90	920	4 dl	200 g	spread culture
Bitter gourd	Local	150 x 120	550	1.4 dl	500 g	supporting culture
Watermelon	Shin-Yamato	180 x 120	460	4.5 dl	200 g	5 seed per a hill
Melon	Nara #2	180 x 100	550	2.2 dl	100 g	
Tomato	Local	130 x 60	1.280	T60 ml	20 g	90cm bed 40cm path
				D120ml	40 g	spread culture
Eggplant	L.R. Purple	160 x 50	2.500	T 65ml	45 g	120 cm bed
				D130ml	90 g	2 lines planting
Okra	Local	90 x 50	2.220	1.3ℓ	700 g	4-5 seeds
Cabbage	Indian var.	120 x 45	3.700	85 m	60 g	90 cm bed
Radish	Mino Wase	90 x 30	7.400	1.8ℓ	1.200g	60cm bed 5 seeds 2 lines planting
Turnip	Shogoin	100cm row	-		1.000g	3 lines planling
Potato	Local	70 x 30	4.760	-	150 kg	30g/a piece of seed potato
Asp. bean	Kuro 3 shaku	80 x 45	2.770	2.1ℓ	1.5 kg	70-90-70 cm method 3 seeds a hill
Garden pea	Alaska	80 x 20	6.250	5.4ℓ	3.9 kg	70-90-70cm method 3 seed a hill

Notice :

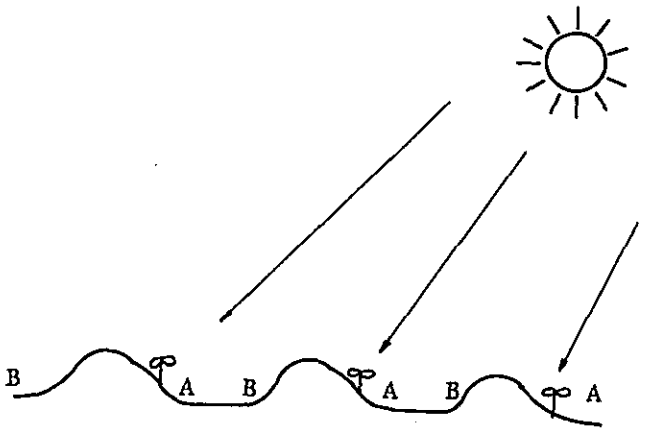
Seed sowing rate is different a little with persons and varieties. Even one tries to sow 5-6 seeds per a hill, actually 7-8 seeds are fallen. Therefore, seed rates of table 10 are mentioned as a little bit more than moderate seed rates as safety cultivation.

How to make rows :

Usually planting rows are ridged by easiest way.
If the field is on slope, make rowa horizontally parallel and if the field is on hilly place, make rows by contour ridgying in order to prevent running off of the surface soil. Furrow irrigation can be also introduced if the rows are made horizontally.

As particular case of making rows, when sowing time is still too cold to sow the seed, rows are recommended to be made directly east to west in order to get sun-shine and at this time the seed is sown at the southern side of rows.

Fig. 8 Rows to get high soil temperature.

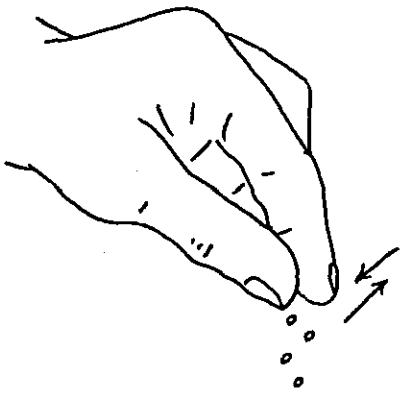


It is effective from November (Margashirsha) to February (Phalguna) when the angle of solar radiation is low. (The sunshine leans the south)

When the seed is sown in dry season, give some tamping to soil to be able to utilize capillary water. If the seed is given thick covering, nourishment of embryo is consumed before the cotyledon appear, or even the cotyledons come up, it is small and weak which affect in future growing.

When the seed is sown in hot and heavy season, put rice straw or dried grass on the rows as mulching to protect from heavy rain heating, strong sunshine, and as well as sudden drought after rain.

In this case, the thickness of hay mulching is also a problem, that is, if it is very thick thinking of sufficient protection , the seedling may be elongated by the mulch, therefore, if so, the mulching should be half removed for making adequate condition.



Seed should be sown as thin as possible. Small seeds such as cabbage, turnip, tomato and etc., are sown nicely by twisting of two fingers like the left figure.

As a standard idea of seed covering, the depth of covering soil is likely to be as thin as 3 times of the seed thickness.

III-3 Fertilizer Application

Plant absorbs its nutritions from soil through the roots. Even if the soil is considered as fertile at the beginning, the fertility of soil would be exhausted step by step with plant absorption if the farmer does not supplement its fertility or without fertilizer supply, and eventually plant growth become poor. This is the meaning of fertilizer application.

Of course, the fertility of soil may be supplemented naturally at

any rate with getting river water silts, fallen leaves and sometimes eroding silts from upper land.

Yet, fertilizer application is necessary for high yielding and maintenance of field fertility.

III-3-1 Three Steps in Agriculture

There are following three steps in agriculture in this respect:

Shifting agriculture - mountain areas
Flooding agriculture - river side lowlands
Manuring agriculture - developed agricultural area.

a. Shifting agriculture A forming that, (i) open the field by means of cutting and burning the trees and shrubs of forest or savanna, (ii) plant crops several times and (iii) when the land fertility is exhausted, stop the cropping and leave the land again into the former status of forest or savanna. This is the most primitive way of agriculture managing small area, and poor production depending on the nourishments existed at the beginning and no fertilizer supply.

b. Flooding agriculture A farming with getting nourishments of plants from river water silts. This is also a primitive agriculture generally without fertilizer supply but sometimes this is developed for very big area is river basin of big river. This status is remained in many places along lower stream of big river, for example, River Ganges and Indus etc, in the developing countries.

River basin is usually fertile land of alluvial soil and the fertility of land can be supplemented by river water silting of yearly flood especially in the case of paddy field. Most of rice planting areas in South East Asian countries have been developed in this way.

However, the flooding means at the same time instability of production and limitted yields due to unstable amount of water year by year (sometimes excess and sometimes shortened) and only one season cropping. Therefore,

to set up stable production and to get more yield by means of multi-cropping, control method of river water by construction of dams and canals become now the first project in these areas in many countries.

After controlling flood water which means stop of river water silting, artificial fertilizer supply become eseential matter for farming. That is, a step of manuring agriculture as mentioned the below.

c. Manuaring agriculture This can be said constructive agriculture comparing with natural or less artificial farmings of former two step.

When one wants to produce more amount of crops beyond those produced depended on only natural supply of nourishments in the soil (former two steps), one must supply fertilizers to obtain more yield and to maintain alnd fertility of the field, supplementing the spended nourishments by plant growth and leaching.

In upland field, this step has been developed from earlier stage than river basin paddy field since natural supply of nourishments is much less than the latter and very quickly exhaust it. This trend is specially clear in vegetable culture since most of vegetable crops are quickly growing plants and produce much amount of production. Therefore, vegetable cultivation is supported by manuring farming in every country from ancient stage.

III-3-2 Kinds of Fertilizers

a. Self-supplying organic fertilizers : Compost, animal manures, ckicken dropping, ground bones, fallen leaves and green manure.

Although these manures content low percentage of the 3 elements of N, P, K, they are rather important for plant growth containing various important minor elements which are apt to cause serious difficiencies for plants just like vitamines and minerals for human beings, as mentioned in II-2. Demerit of using composts is needs of a lot of amount, time and labors for making and handling of them (II-2)

b. Commercial chemical fertilizers : Urea, ammonia sulplate, calcium superphosphate, muriate potash, compound fertilizer 20-20-0.

The merit of chemical fertilizers is high percentage of elements, quick effect, and easy to handle.

The demerit is firstly their high prices and secondly, since chemical fertilizers contain only limited major elements, if one continuously depends on them only, the soil may get acidity and become lacking of important elements, the plants grown may get susceptive to many diseases.

As understood from the above explanation, fertilizer application is important to have good yield. Fertilizer application in this area should be given first priority an use of self-supplying organic fertilizers and use chemical fertilizers as supplementary.

Standard of fertilizer application is given on Table II.
On this table, mainly compost is used and ammonium sulphate, superphosphate and muriate potash is used as supplementary.

One bamboo basket (Doko) of compost contains 25 - 30 Kg. (25 Kg. at dry condition and 30 Kg. at wet)

Table 11 Standard of fertilizer application by crops

Crops	Fertilizer per 10 a. (1,000 m^2)		per Bigha (67.7a)	per Ropani (5.1a)
(1) Paddy rice	Compost only			
Ver. Local	Seedling bed :	Compost 2 kg/m^2		
	Paddy field :	Compost 1.5 ton 10a	10 ton	0.7 ton
IR-20	Seedling bed :	Compost 2 kg/m^2		1,020 kg
	N = 8 g/m^2	A. sulphate 38 g/m^2		19.4 "
	P = 8 g/m^2	S. phosphate 44 g/m^2		22.4 "
	K = 6 g/m^2	M. potash 10 g/m^2		5.1 "
	Paddy field	Compost 1.5 ton/10a	10.2 ton	0.8 ton
	N = 3 kg/10a	A. suphate 14 kg/10a	94.8 kg	7.1 kg
	P = 3 kg	S. phosphate 17 kg/10a	115.1 kg	8.7 kg
	K = 3 kg	M. potash 5 kg/10a	33.9 kg	2.6 kg
	1/2 of N must be applied in basic and other half is applied on heading period. (7 kg of A. sulphate).			
(2) Wheat		Compost 1.5 ton	10.2 ton	0.8 ton
RR-21	N = 5 kg	A. sulphate 24 kg	162.5 kg	12.2 kg
	P = 5 kg	S. phosphate 28 kg	189.6 kg	14.3 kg
	K = 3 kg	M. potash 5 kg	33.9 kg	17.3 kg
(3) Maize		Compost 2 ton	13.5 ton	1 ton
Khumal yellow	N = 5 kg	A. sulphate 24 kg	162.5 kg	12.2 kg
	P = 5 kg	S. phosphate 28 kg	189.6 kg	14.3 kg
	K = 3 kg	M. potash 5 kg	33.9 kg	2.5 kg

continuation

Crops	Fertilizer per 10 a (1,000 m^2)	per Bigha	Per Ropani
(4) Oil mustard	Compost 1.5 ton	10.2 ton	0.8 ton
	N = 3 kg A. sulphate 14 kg	142 kg	7.1 kg
	P = 0		
	K = 0		
(5) Potato	Compost 2 ton	13.5 ton	1 ton
	N 7 + 3 = 10 kg Urea 22 kg	148.9 kg	11.2 kg
	P = 8 kg S. phosphate 44 kg	297.9 kg	22.4 kg
	K 6 + 3 = 9 kg M. potash 15 kg	101.6 kg	7.7 kg
	For N and K, give 3 Kg of each component as top dressing.		
(6) Vegetables Fluit Veg. Tomato Eggplant watermelon	(Basic) (Top 1) (Top 2) (Total) N 7 + 1.5 + 1.5 = 10 kg P 8 = 8 kg K 6 + 1.5 + 1.5 = 9 kg		
	Compost 2 ton = 2 ton Urea 16 kg + 3.5 kg + 3.5 kg= 23 kg S. phosphate 44 kg = 44 kg M. potash 10 kg + 2.5 kg+2.5 kg = 15 kg	13.5 ton 108+24 24=156 kg 298 kg 68+17+17= 102 kg	1 ton 8 + 2 + 2 = 12 kg 22 kg 5+1.2+1.2 = 7.4 kg
Leaf Veg. Cabbage Cauliflower Petsai	N 8 + 1.5 + 1.5 = 11 kg P 8 = 8 kg K 6 + 1.5 + 1.5 = 9 kg		
	Compost 2 ton Urea 18 + 3.5 + 3.5 = 25 kg S. phosphate 44 = 44 kg M. potash 10 + 2.5 + 2.5 = 15 kg	13.5 ton 121+23+23=167 kg 297.9 kg 68+17+17=102 kg	1 ton 9 + 2 + 2 = 13 kg 22 kg 5+1.2+1.2 = 7.4 kg

Crops	Fertilizer per 10 a (1,000 m^2)					Per Bigha	Per Ropani
Root Veg.		(Basic)	+	(Top 1)	= (Total)		
	N	5	+	1.5	= 6.5 kg		
	P	5			= 5.0 kg		
	K	4	+	1.5	= 5.5 kg		
	Urea 11.1		+	3.3	= 14.4 kg	75+22=97 kg	5.7+1.7=7.4 kg
	S. phosphate	28			= 28 kg	190 kg	14 kg
	M. potash	6.6	+	2.5	= 9.1 kg	47+17=62 kg	3.4+1.2=4.6 kg
(7) Beans							
Asp. bean	Compost 1 ton					6.8 ton	500 kg
String bean	Ash 20 kg					135 kg	10 kg
Garden pea							

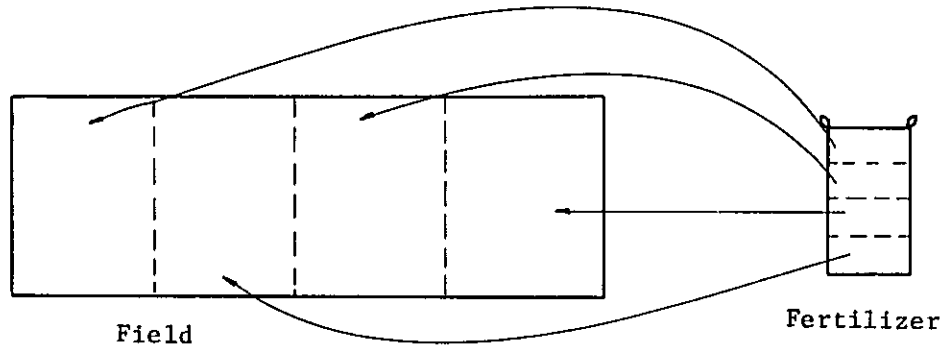
The amount of fertilizers in Table II show a standard and not always show essential amounts. Especially in hilly area where chemical fertilizers are not available, only compost is suggested to be supplied as much as mentioned in Table II.

And when the farmer has surplus money, it is better to supplement commercial fertilizer as close as possible to the amount shown in Table II.

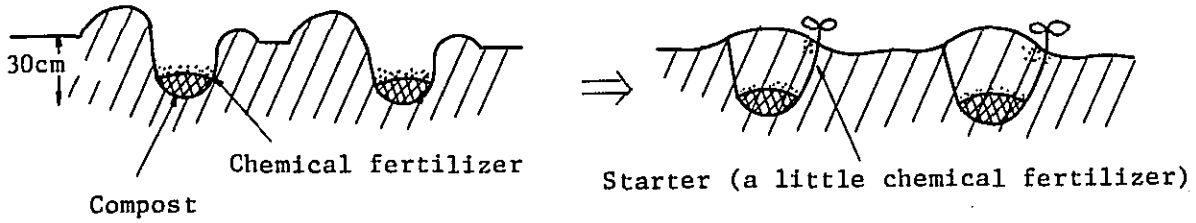
III-3-4 Method of Fertilizer Application

As the method of fertilizer application for paddy rice, wheat, oil mustard, maize, bean, and root vegetables, broadcasting after plowing is recommended for farmer's practice.

In the case of wide field, it is better to divide the field and fertilizer into the same numbers and broadcast each fertilizer in each field, in order to prevent uneven broadcasting.



Fertilizer for fruit vegetable and leaf vegetable are applied centering on compost supplementing some rate of chemical fertilizers. Those chemical fertilizers should be applied mixing with compost to prevent running off (loss) of elements.



Before planting

After planting
Avoid to plant just above compost as the soil gets easily dry.

III-4 Raising Seedling Method ---
How to Make Soil Block

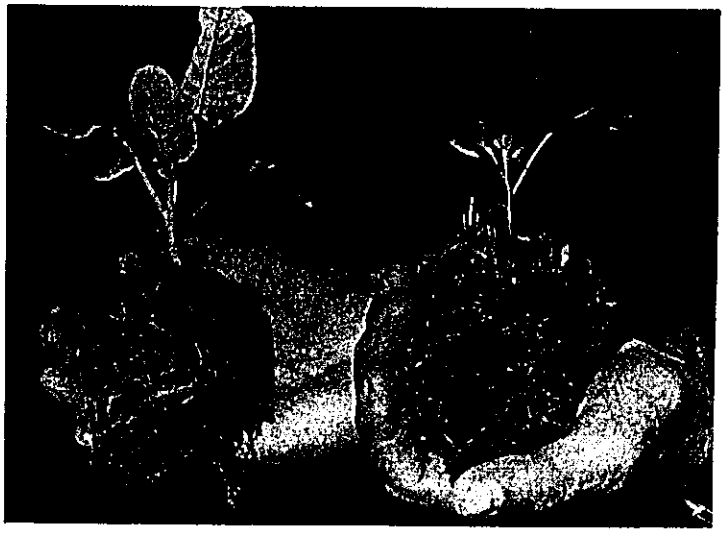
Direct sowing seems to be the most natural way of planting method. Transplantation of plant means more or less cutting off of its roots but plant roots are corresponding to mouth of animal which absorb water and nutritions, that is, transplantation is as if a kind of operation of animal body.

So, if the roots are cut severely, the plant growth is stoped for a long time until recovery of roots, this causes falling of leaves and severe delaying of growth or dying of plants, that is, eventually cause yield decrease.

However, transplanting culture or raising seedlings is necessary as explained in II-5, it should be done very carefully keeping least damage on the roots.

Picking seedlings from nursery bed without soil is poor practice. Especially hairly root which absorb water and nourishments is weak for sunshine, therefore, handling should be done carefully with soil and not expose the hairly root into sunshine.

When seedlings are raised, it is important to consider how to transplant the seedlings with soil. See the photograph below.



Cabbage seedling

Left is good, right is poor seedling which grown in shade

Generally raising seedling is done near the residence where water is available and convenient to manage nursery bed. And the seedlings are transplanted from the nursery bed (better condition for the plant) to the field (severe condition for the plant comparing with the nursery bed) with cutting off of the roots. This is a heavy task for the crop as the auther mentioned several time.

To avoid such injury, there is a nice method of raising seedling of "Soil block", which is laborious but, the soil block seedlings can be transplanted to the field without watering and less damage.

III-4-1 How to Make Soil Block Seedling

a. Materials

1) Frame boards which are 10 cm width.

For example, cabbage seedling for 10 a.
3.700 seedlings are required for 10 a.
1.2 m x 33 m - size of the bed
(1.2 m + 33) x 2 = 68.4 m 69 m
So, totaly 69 m of 10 cm width of frame boards are required.

2) Prepare matured compost, the same volume as field soil (1:1)

When the soil is heavy and sticky, add sandy soil

b. Practice

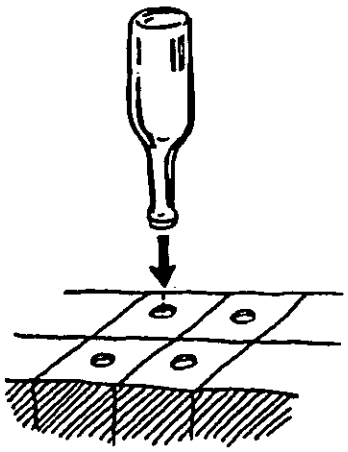
1) Make the outline of bed by enclosing with the flame boards sizing 1.0 - 1.2m width, 10 cm height (the width of board) and convenient length (may be fixed by the length of bed site). Level and harden the bottom soil of bed. Spread rice straw or sand thinly on the bottom before the bed soil is spreaded so that the seedlings raised can be easily taken from the bed at the time of transplantation.

2) Mix soil and compost before putting water.

3) Kneading like children play. After mixing soil and compost, firstly put water from a corner with rough Kneading by a grab hoe and secondly knead well by hands.
Too long time kneading results in breaking down of porosity of bed soil and causes poor aeration in the soil.

Knead in the bed, or outside of the bed then put it in the bed. Level the surface of bed soil after kneading.

4) Bed soil cutting



Cutting of kneaded bed soil is done at the time of half drying. The waiting time may be a half day, if in fine day. On the other way, doing kneading in the evening and cutting in the next early morning.

Cut the hardened bed soil by a knife along two pieces of boards as scales so that can cut the straight and right angle and also avoid attaching soil on the knife.

10 cm x 10 cm or 12 cm x 12 cm are commonly used.

5) Make a sowing hole with mouth of bottle (see figure) Some 2 cm diameter and 0.5 cm depth.

6) Sowing. Sow seeds in holes and put covering soil which in the same but filtered as unkneaded bed soil.

Spread rice straw thinly after sowing.

7) Shading is required to prevent drying and rising of soil temperature.

Note : Poor growth of root and cracking of the bed soil happens easily if bed dries quickly when the soil and compost have not been mixed enough.

Watering should be managed carefully. Once a soil block is dried, the bed soil does not absorb water well. Thinning should be done earlier.

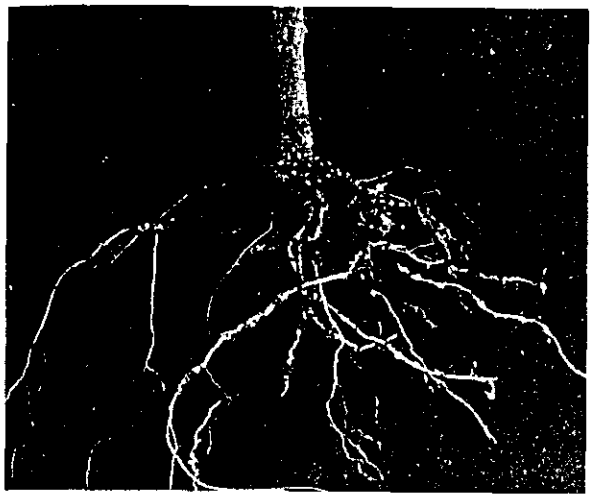
III-5 Protection From Pests and Diseases

For human health, it is recommended firstly to maintain health by healthy life and too much depending on medicines is never recommendable. In the case of plant health maintenance, the same idea is recommendable, that is, an idea to recover plant diseases only by means of chemical spraying is never the basic solution of the disease problem.

At present, many efforts for protection of pests and diseases are being done such as plant breeding of resistant variety, rotation, at Experimental Stations. But sometime, use of high yielding variety and heavy fertilizer application are taken in order to get high yield and big fruits which lead the farming into susceptive to pests and diseases.

Most of plant diseases do not appear by simple invasion of the pathogenes, that is, usually the troubles have such back ground as:

a) When the plants are not grown smooth, they become susceptive to diseases. For example, when the root of tomato are attacked



by root nematodes, the tomato plants become very susceptive to late blight and anthracnose. When any plant get some physiological troubles such as some elemental defficiencies, the plant become very susceptive to various virus diseases.

Okra infected by Nematode

b) When field soil becomes degraded, high acidity, lacking of some miner elements, the plant grown there become mulnutrition (miner element defficiency) and very susceptive to various diseases.

Therefore, the fundamental countermeasure of plant disease trouble is to overcome the above two points.

Especially in vegetable cultivation, foriegn varieties are weak for pests and diseases when those are planted in tropical area.

The important point in plant protection can be said that don't believe too much chemical spraying but care of more to grow healthy plants as mentioned the above.

III-5-1 Notice to Avoid Pests and Diseases.

Following items are common practice to avoid pests and diseases:

1) Use resistant variety and recognize a merit of local variety. Local variety of tomato in Chitwan district is resistant to late blight (phytophthora infestans) but, it is small fruit.

2) Sowing time must be at the proper time

Early sowing of radish (August, shrvana) invite bacterial soft

rot (Erwinia aroideae), late sowing of turnip invite gray leaf spot (Alternaria brassicae).

As pests and diseases have their own optimum temperature for occurence, planting time should be avoided from such a period.

Notice for cultivation in the field

1) Excess dense spacing causes failure.

Don't grow plants in crowded condition which causes insufficient sunlight radiation and poor ventilation between the plants and results in elongated and weak plant growth. For example, when tomato is grown in crowded standing and without training of branch buds, the leaves can not enjoy sunshine sufficiently which results in heavy late blight infection.

2) Reduce density of pests and diseases in the field

Successive cropping of same or relative vegetables for long time causes accumulation of diseases and pests, therefore, adequate rotation system is essential for vegetable field. The best way in this respect is use of second cropping of paddy field, or the field is converted into paddy field once in a few years.

Nematodes and Fusarium and bacterial wilt can be almost avoidable in this way because the pathgenes are killed by submerged condition of soil in paddy rice cropping.

3) Plant at proper spacing and an proper time

Unreasonable cultivation make plants weak and get pests and diseases. Following A.D.O's guidance is important.

4) Do not leave diseased and infected fruits and leaves in the field after cultivation which accumulate the pathogenes.
Those remainders as well as weeds must be removed. Cleaning the field after every cropping is necessary.

5) Harvest of fruits must be done on proper time, otherwise big old fruits give heavy burden to the plants which result in poor growth and yields.

6) The most terrible noxious insects are cucurbit beetle, cabbage armyworm, common cabbage worm and other larvae of lepidoptera. When one sees any of adults and larvae, catch them immediately by hand.

   As cabbage worm has a habit to stay under grean leaves on the ground in the morning, catch them by turning leaves utilizing this havit.

By means of cultivating vegetables following the above mentioned notice, diseases and pests can be reduced in some extent.

However, when pests and diseases still occur, the agricultural chemicals must be utilized. There are many kinds of chenicals and their usage are different in each other. The most effective chemical should be taken when chemicals are used.

III-5-2 Classification of Agricultural Chemicals

Table 12 Classification of Agricultural Chemicals

Kind of chemicals	Name of chemicals	Remarks
Ⓐ Fungicides		
① Preventor	Dithane Zineb Bordeaux mixture Triazine Karathane	Those chemicals make thin coat on surface of the plant and prevent invasion of pathoges. If it is not spray on before occurrence or early stage of occurrence, the effect is poor. Dilute sufficiently and spray more times. Spray not only surface of leaves also back of leaves where pathogenes exist. Most of fungicides in the market belong to this group.
② Direct controller	Formaline Usplun Streptomycin	Those chemicals sterilize pathogene directly. Spray when fungi adhere the plant or early stage of occurrence. Thicker dilution is more effective. As those are mainly organic mercury compound or antibiotics, Try to use in very limmited case, or for the last case, Many contries are already prohibited then to use in agricultural purpose.
Ⓑ Insecticides		
① Stomach poison	Lead arsenate Arsenic compound	When insects eat the plant which sprayed by those insecticides, they get stomach poison. Use those chemicals like Ⓐ - ① preventor fungicides. Not commanly use at present.
② Contact poison	② - 1, Organic Chrolide Endrin Aldrin BHC DDT Chlorodin	Sticking on the insect bodies, those chemicals kill them. However, organic chrolide suchas Endrin, Aldrin, BHC, and DDT have long, strong residual toxicity which is effective for insect control

Kind of chemicals	Name of chemicals	Remarks
		but also very dangerous to human being. As those chemicals kill insects also harm human body too, therefore, avoid to use them as far as possible. Many contries already prohibited to us those chemicals.
	② - 2, Organic phostate Dipterex Diazinon Malathion (Parathion)	These chemicals except parathion are decomposed quickly and low residual toxicity, therefore, it is comparatively safe for human being. As those chemicals are quick effect, spray directly to insects on early stage of occurrence. Those are the most common insecticide.
③ Systemic insecticide	Estox Metasystox Ekatin Anthio	Plant absorbs those compound from leaves or root by foliage spraying or dropping of the granulor on soil. And when insects eat or suck the plant, they are killed. Those are specially good effect for aphids. As some of them have very long residual toxicity about 50 days, do not use before harvest. Some of them have systemic and contact poison.
Ⓒ Nematocide & soil sterilization chemicals (Fumigant)	Chloropicrin Metyl bromide D.D.	When these are injected to soil, the liquid turn to gas and fumigate nematodes, pathogenic fungi, and insects. It is quite effective but expensive and a little dangerous for unexperienced person to use. It is good also for sterilization of store room.

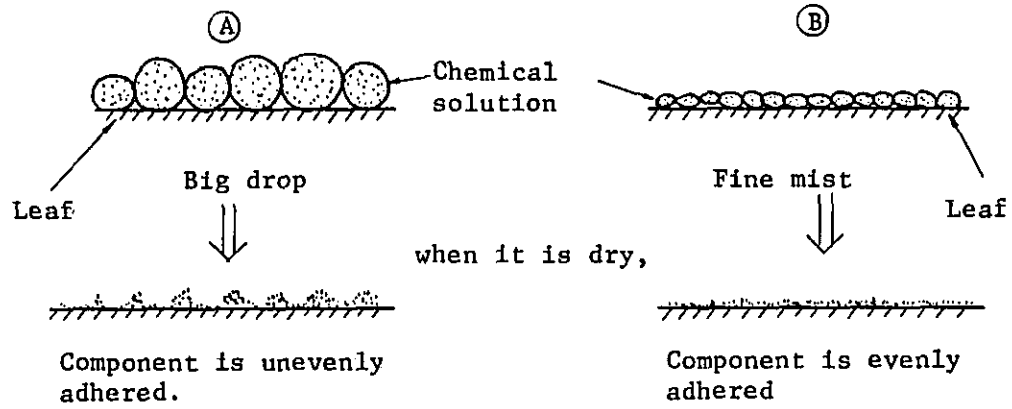
III-5-3 Method of Spraying

Non-spraying cultivation is the most desirable one, but if spraying must be done, keep in mind the following notices.

① In the case of disease, spray just before occurence or early stage of occurence as most of fungicides are preventor. It is considered that it is quite difficult to control after the disease spread.

② In the case of noxious insects, most of insecticide are not so effective for adult insect, they may easily escape from sprayed plants. Spraying on early stage of occurrence and a joint prevention in which spray covers wide area simultaneously are quite effective, so that even adjult can not escape from the area.

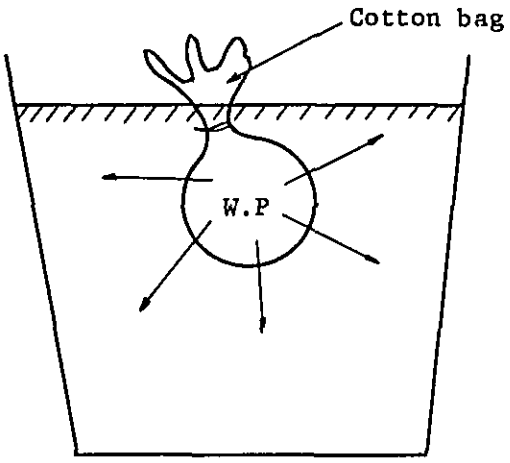
③ When it is spray, use high pressure to make fine mist which cause good effect and less chemical expend



When chemicals are sprayed like rain Ⓐ , it is not only loss of chemicals also it makes chemical injury sometimes due to unevenly adhered component.

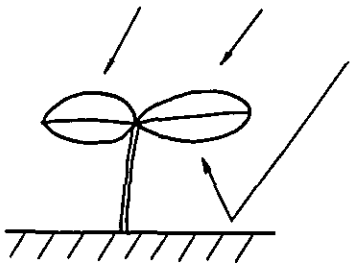
Spraying must be done like mist Ⓑ

④ When wettable powder is diluted, dissolve power like below picture to be fine solution

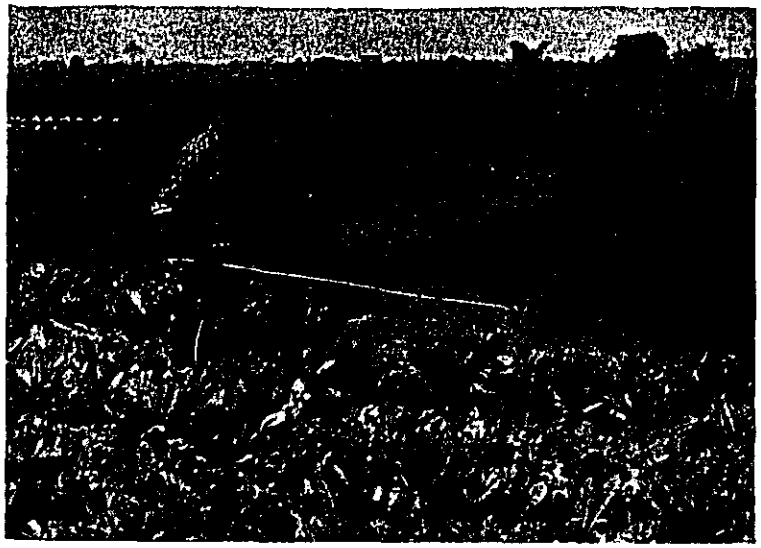


Put wettable power in a cotton bag and clap in water.
Wettable power is dissolve through the cotton bag.
Power is diluted finely and some dust in power is removed, which prevent nozzle problem.

⑤ Pathogenic fungi are used to invade from back of leaves.
Spray with high pressure mist so that the back of leaves are also sprayed by rebound mist.



Mist rebound to back of leaves.



Spraying vegetables

⑥ As to the spray just before harvest, follow strictly what an explanation of chemicals mentioned, especially period before harvest. Even quick decomposition chemicals,spraying must be finish one week before harvest.

⑦ Plant easily gets injury where pathogenes invade after heavy rain or storm. Spraying preventor (chemical) after heavy rain is effective.

⑧ As to the late blight and anthracnose diseases on tomato, potato, cucumber etc., the pathogenes sprout from the spare during the time of dewing on the leaves and quickly invade into leaf tissue. Therefore, the most effective method of spraying is in early morning before the dew dries or at the end of rain when the rain becomes like fog, that is called spraying in the fog.

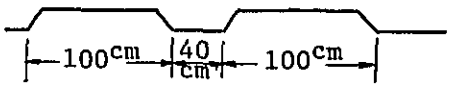
⑨ Use of mask or towel on mouth during spraying and wash hands and mouth after spraying. This is essential notice for our health.

IV Cultivation Practice

IV-1 Paddy Rice (Seedling bed)

Ⓐ Cultivation standard

Variety:
Paruwanipur-I
IR-20
IR-22
IR-26

Size of the bed 

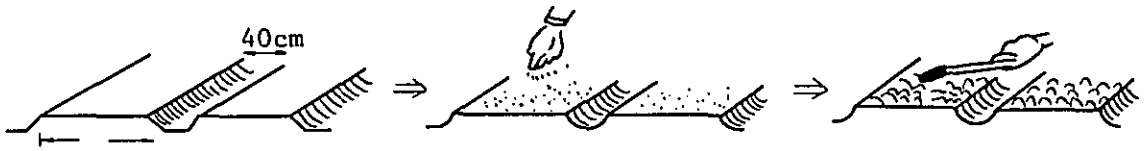
5-8 cm of the height of the bed with adequate length

Fertilizer rate	Elemental rate		Actual amount	
	N	$8g/m^2$	(Ammo. sulphate	$38g/m^2$)
	P_2O_5	$8g/m^2$	(Cal.S. Phosphate	$44g/m^2$)
	K_2O	$6g/m^2$	(M.potash	$10g/m^2$)
			Compost	$2kg/m^2$
Seed rate		$70g/m^2$	2.5 kg/10a (field)	

Ⓑ Outline of cultivation

① Keep the nursery bed woil as fertile as possible

② Put compost 2 kg/m^2 and plow 3 - 4 times

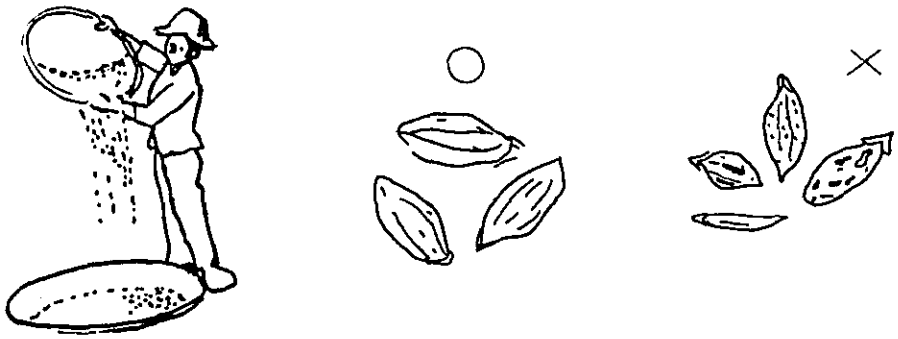


100cm

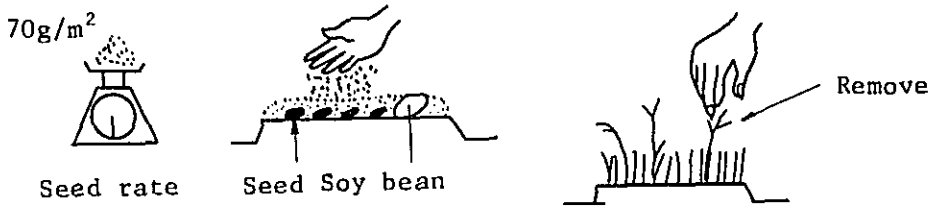
Broadcast fertilizer evenly

Mix them

③ Use seed which is free from disease and pest and select by wind

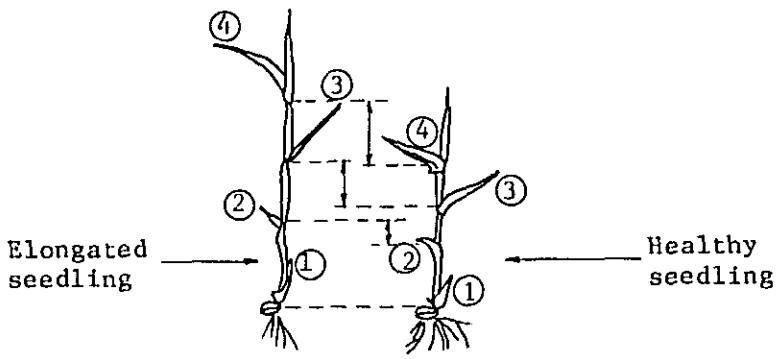


④ Seed rate is 70g/m^2 and sow evenly.
Covering soil is as thin as soyaben hidden.



⑤ Weeding and remove elongated seedling

⑥ Spray Dithane Z 78 (500 time solution, 20g, of Dithane with 10ℓ. of water) before transplanting.
Spray 40ℓ./10.)



Paddyfield

50% of yield may be promised at the seedling stage, therefore, raising healthy seedlings is quite important.

Ⓐ Cultivation standard

Planting space	25 cm x 20 cm			
Fertilizer rate	Elemental rate		Actual amount	
	N	3kg/10a	A. Sulphate	14kg/10a
	P_2O_5	3kg/10a	Cal. S. phosphate	17kg/10a
	K_2O	3kg/10a	M. Potash	5 kg/10a
			Compost	1.5ton/10a
	Use 1/2 of N for Basic fertilization			

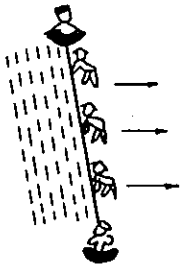
Ⓑ Planting outline

① Put compost 1.5 ton/10a and plow 3 - 4 times.

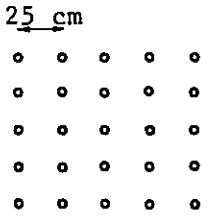
② Puddling and field preparation must be done carefully and broadcast fertilizers

7kg/10a of Ammo. sulphate
17kg/10a of Cal. S. Phosphate
5kg/10a of M. potash

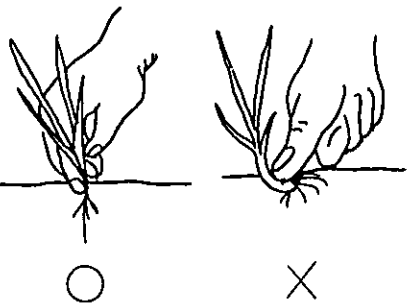
③ Transplanting is done as follows.



line planting

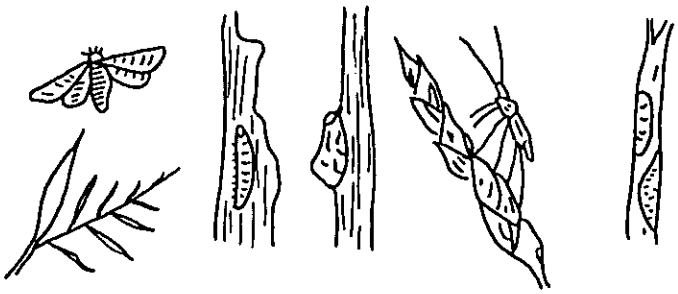


spacing



Don't plant deep
Don't break seedling

④ Early stage of plant protection is important for pests and diseases. If you find any problems, ask to J.T.A.



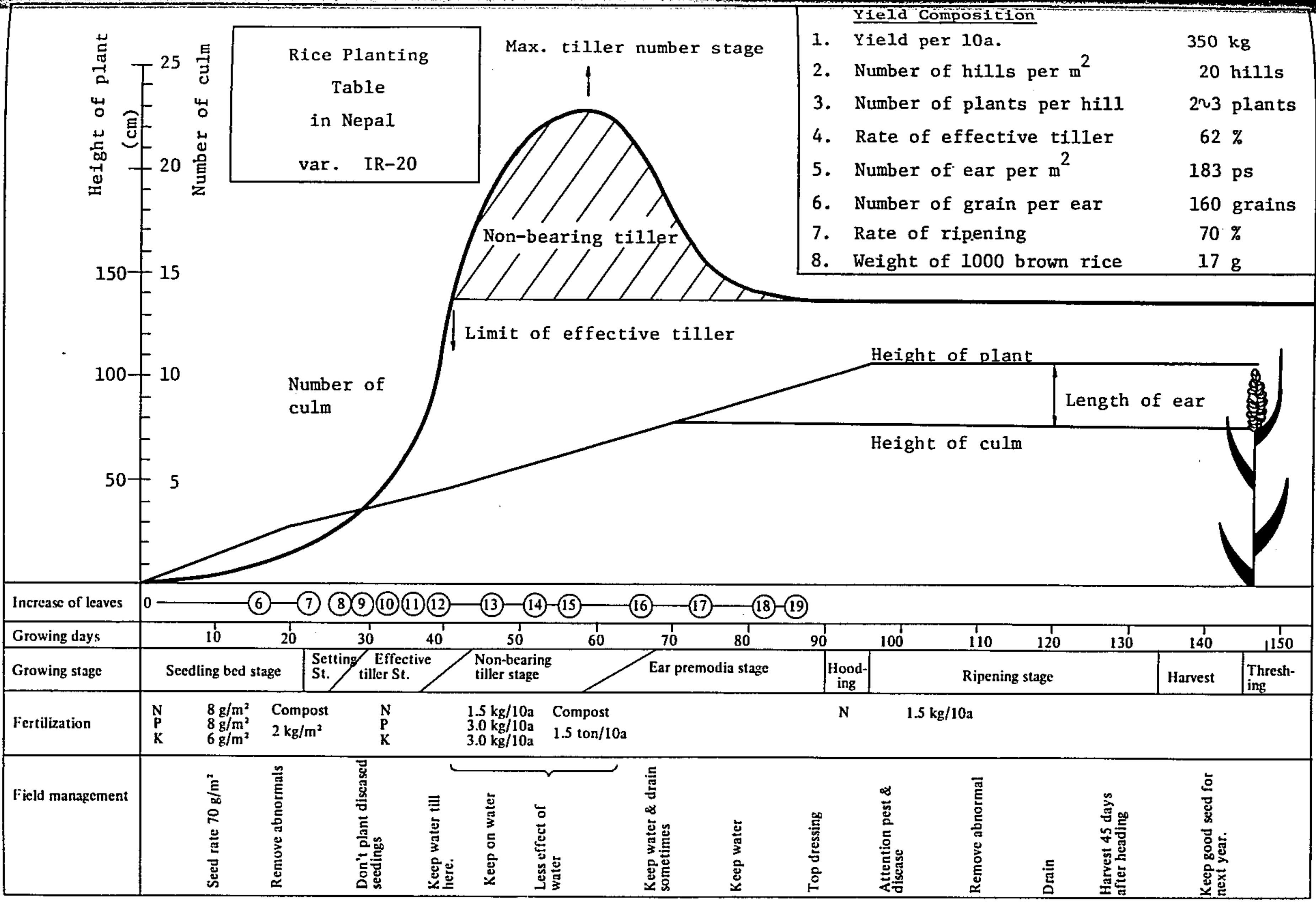
	Name of insects, disease
o	Bacteria leaf blight
o	Sheath blight
o	Blast
o	False smut
o	Rice stem borer and other borers
o	Plant hoppers
o	Rice bugs
o	Leaf hoppers

⑤ Top dressing on heading period Broadcase 1/2 of N 7 days after head emergence
(1.3 kg of N. 7 kg/10a of Amm. sulphate)

⑥ Harvesting to be done 40 ∿ 45 days after head emergence. Early harvest may results in greenish rice grains (ripening is poor), while late harvesting causes grains dropping.

⑦ Seed preservation

Remove abnormal individuals after head emergence
Keep seed dry after havesting and inspect noxious insects sometimes during storage.


Rice Planting Table in Nepal var. IR-20
Height of plant (cm)
Number of culm
Max. tiller number stage
Non-bearing tiller
Limit of effective tiller
Number of culm
Height of plant
Length of ear
Height of culm
Yield Composition
1. Yield per 10a. 350 kg
2. Number of hills per m2 20 hills
3. Number of plants per hill 2∿3 plants
4. Rate of effective tiller 62 %
5. Number of ear per m2 183 ps
6. Number of grain per ear 160 grains
7. Rate of ripening 70 %
8. Weight of 1000 brown rice 17 g
Increase of leaves 0 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Growing days 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
Growing stage: Seedling bed stage; Setting St.; Effective tiller St.; Non-bearing tiller stage; Ear premodia stage; Hood-ing; Ripening stage; Harvest; Thresh-ing
Fertilization: N 8 g/m²; P 8 g/m²; K 6 g/m²; Compost 2 kg/m²; N 1.5 kg/10a; P 3.0 kg/10a; K 3.0 kg/10a; Compost 1.5 ton/10a; N 1.5 kg/10a
Field management: Seed rate 70 g/m²; Remove abnormals; Don't plant diseased seedings; Keep water till here.; Keep on water; Less effect of water; Keep water & drain sometimes; Keep water; Top dressing; Attention pest & disease; Remove abnormal; Drain; Harvest 45 days after heading; Keep good seed for next year.

IV-2 Wheat variety RR-21

Ⓐ Cultivation standard

25 cm drilling,	12 kg/10a is seed rate		
Fertilizer rate	Elemental rate	Actual amount	
	N 5kg/10a	Amm. sulphate	24kg/10a
	P_2O_5 5kg/10a	Ca.S.Phosphate	28kg/10a
	K_2O 3kg/10a	M. Potash	5kg/10a
		Compost	1.5ton/10a

Ⓑ Outline of cultivation

① Broadcase 1.5 ton of compost to 10a. and plow 3 ∿ 4 times. Need elaborative harrowing in the case of second cropping of paddy rice .

② Broadcase fertilizers before the last plowing by a pair of cattles.

③ Sowing rate is 12kg/10a. Drill seed after the last plowing as in local method.

50 ∿ 60 DOKO is 1.5 ton of compost

④ Sowing time is the middle of Nomber to the middle of December (Margashirsha)

⑤ Rather less pests and diseases attack wheat.

⑥ Be careful to be delayed harvesting at the middle to end of April (beggining of Vaishakha) since early rain may spoil the grains with fermentation.

⑦ Remove abnormal plants and harvest good uniform plants for seed grain in next year.

IV-3 Maize Variety : Khumaltar Yellow
Rampur Yellow

Ⓐ Cultivation standard

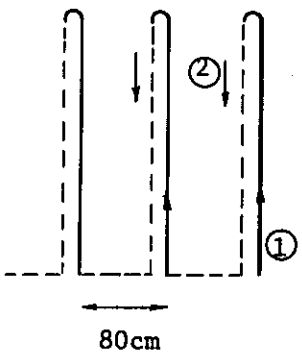
Planting distance	80cm x 30 cm, 2 ∿ 3 seed per hill.			
Seed rate	5 kg/10a.			
Sowing time :	① The end of April - beginning of May (The middle of Vaishakha)			
	② The middle of September (Beginning of Ashvina)			
Fertilizer rate	Elemental rate		Actual amount	
	N	5kg/10a	Ammo. Sulphate	24kg/10a
	P	5 "	S. Phosphate	28 "
	K	3 "	M. Potash	5 "
			Compost	2ton/10a.

Ⓑ Outline of cultivation

① Broadcase 2 ton of compost to 10 a. and plow 3 ∿ 4 times.

② Broadcase fertilizers evenly just before the last plowing.

③



Plow straight and sow seeds every 30 cm apart. And put cover soil when the plow return.

Or else take local method as you are doing.

④ Thinning

1st thinning is done at the time of 3 true leaves stage.
2nd thinning is done at the time of 5 ∿ 6 true leaves stage.
And cultivate for weeding and mulching.

But traditional method is also recommendable.

⑤ The most dangerous thing for maize is parrots when maize is matured.

⑥ Since maize plant absorbs soil nutrition strongly and usually the soil after maize cropping become wasted, therefore, must have rotation with pulse crop like soyabeen for supplementing soil fertility.

IV-4 Oil Seed Mustard Variety : Local

Ⓐ Cultivation standard

Sowing rate in broadcasting	1.8 kg/10a. (5 Mana/10a)		
Sowing time :	The end of October - the beginning of November (The middle of Kartika)		
Fertilizer rate	Elemental rate	Actual amount	
	N 3kg/10a	Ammo. Sulphate	14kg/10a
		Compost	1.5ton/10a

Ⓑ Outline of cultivation

① Follow local practice which is easy and reasonable.

② Application of N is very benifitable(beneficial)

③ Handling of harvested plants in the field should be done in the morning in order to decrease loss of seed by cracking pod.

④ Sowing time depend on soil moisture. One must settle sowing time according to soil moisture in his field.

Flowering Time

IV-5 Potato Variety Nepal Local
Indian var.

Ⓐ Cultivation standard

Sowing time : The end of Sep. - beg. of Oct. (Ashvina)
Harvest : The end of Jan. - beg. of Feb. (Magha)
Spacing : 70 cm x 30 xm (one line seeding)
Plants per 10a. : 4.700 plants (10a. 3 Katha)
Rate of seed : 150 kg/10a. (30gr. a piece)

Fertilizer application

	Total	Basic	Top 1	Top 2
N (Kg)	10	7	1.5	1.5
P (Kg)	8			
K (Kg)	9	6	1.5	1.5
Urea (Kg)	22	15.4	3.3	3.3
S. Phosphate	44	44		
M. potash	15	10	2.5	2.5
Compost (ton)	2 ton	2 ton		
Ash	60 Kg	60 Kg		

* An example of expenditure and income per 10a.

Labor charge	25 day x 2 person x Rs.5 =	Rs. 250
Seed		Rs. 150
Fertilizer		Rs. 135
Spraying		Rs. 20
	Total	Rs. 555
Estimated yield	1,500 Kg	
	1,500 Kg x Rs. 1.25/Kg =	Rs. 1,875
Income	Rs. 1.875 - Rs.555 =	Rs. 1,320

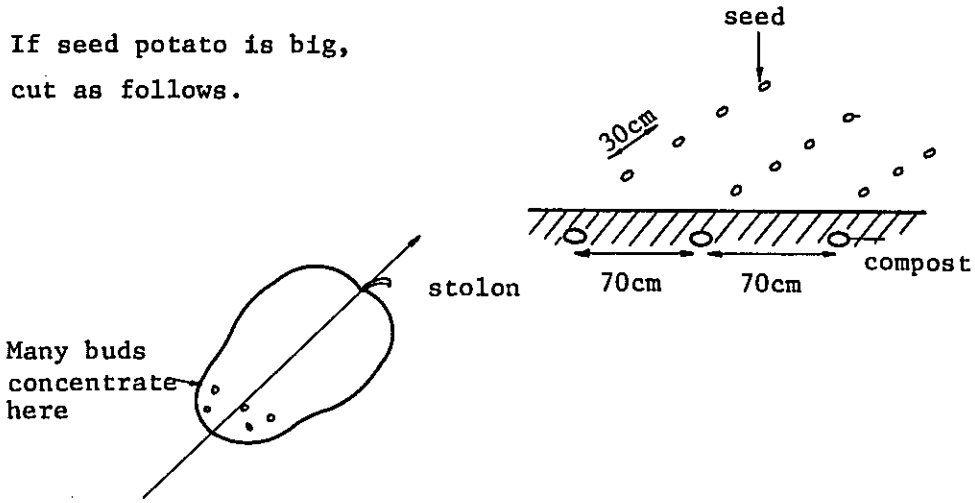
Ⓑ Outline of cultivation

① Make ditch 70cm apart and put compost in the ditch.

② Apply fertilizers on the compost and cover them thinly with soil.

③ Sow potate seed above compost.

④ If seed potato is big, cut as follows.



cut 2 pieces or 4 pieces (30 gr. each)

⑤ At the selecting of potato seed, examine not only variety but also its age. Seeds do not sprout before dormancy broken and aged potato produce many buds but thin and weak.

⑥ Cultivate the row 10 days after germination.

⑦ Give top dressing 25 days and 55 days after germination.

2 month after germination

⑧ Late blight (Phytophthora infestant), the most troublesome disease appears sevearly in November when fog comes everyday.

⑨ Harvest when leaves and stem are turned to yellow and brown. Approximately 100 ∿ 120 days.

IV-6 Cucumber Variety Nepal Local

Ⓐ Cultivation standard

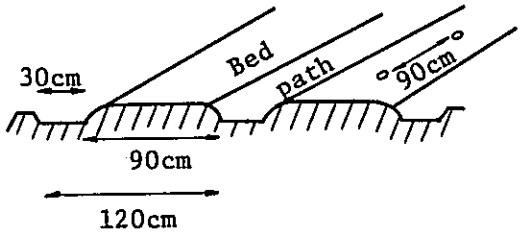
Sowing time : ① The end of Apr. - beg. of May (Vaishakha) after first monsoon (Makai Ko pani) comes

② The end of July (The middle of Shrvana)

Harvest ① The middle of July (Shrvana)

② October (Ashvina ∿ Kartika) when it is Dasai

Spacing 120 cm x 90 cm



Plants per 10a. 920 plants

Rate of seed 200 gr or 4 dl per 10a.

Fertilizer application

	Total	Basic	Top 1	Top 2
N (Kg)	10	7	1.5	1.5
P (Kg)	8	8		
K (Kg)	9	6	1.5	1.5
Urea	23	16	3.5	3.5
S. phosphate	44	44		
M. potash	15	10	2.5	2.5
Compost	2,000	2,000		
Ash	80	80		

If less fertilizer, use chemical fertilizer as top dressing only.

* An example of expenditure and income per 10a.

Labor charge	25 days x 2 men x Rs.5.0 =	Rs. 250
Seed		Rs. 5.0
Fertilizer		Rs. 135
Spraying		Rs. 20
		Rs. 410

Estimate yield 1,500 kg

Rs.0.8/Kg x 1,500 Kg = Rs.1.200

(Rs.2.0/Dharni)

Estimate income Rs.1,200 - Rs.410 = Rs. 790

Ⓑ Outline of cultivation

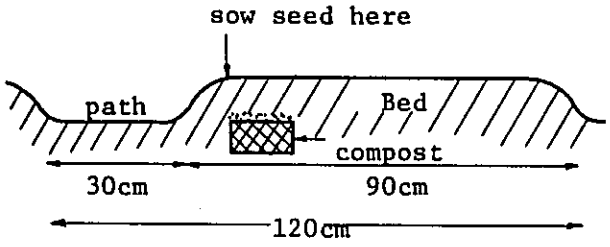
① Field preparation

Select fertile and good drain field. Scatter ash and plow well.

Make a ditch every 120 cm apart and put compost in the ditch.

Apply fertilizers on the compost and cover them thinly with soil.

And make beds as follows.

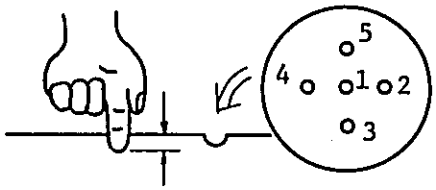


Making ditch by a hand tractor.

② Sowing

Sow after first monsoon (Makai Ko pani) comes.

90 cm apart directly.



Don't sow deep
(One knode depth)

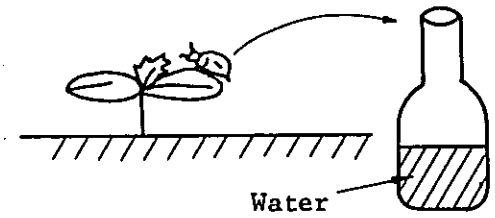
5 seeds per hill.

put rice straw or dried grass as mulching.

And water there.

③ For cucurbit beetle.

Cucurbit beetles come certainly after germination. Prepare a bottle with water and catch beetles and put them into the bottle.



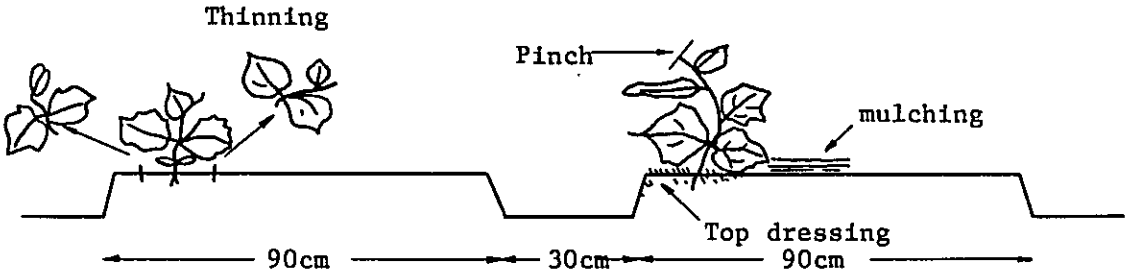
This is the most effective way to decrease beetles damage. Controlling by chemical is difficult.

④ Thinning

At the 2-3 true leaves stage, thin them to leave only one good plant per hill.

⑤ Pinching

At the 5-6 true leaves stage, pinch the tip to help development of branches. Top dressing, mulching, and watering are necessary.

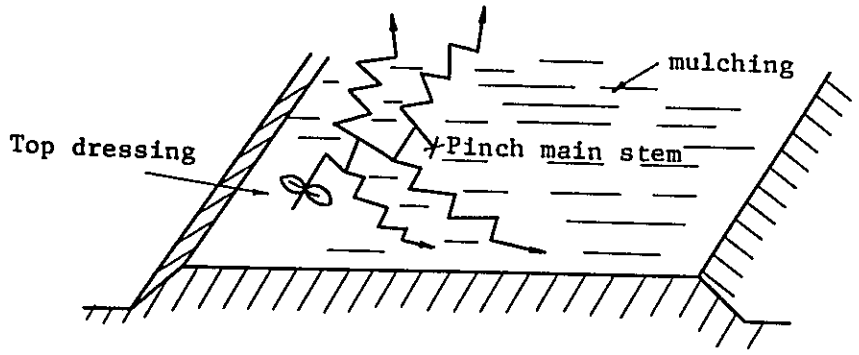


⑥ Spraying

For spraying 10 a. of cucumber, 25 litter of water (5 pathi) is required.

Dithane Z	0.15 %	(666 times)	38 gr./25ℓ
Metasistox	0.1 %	(1000 times)	25cc/25ℓ

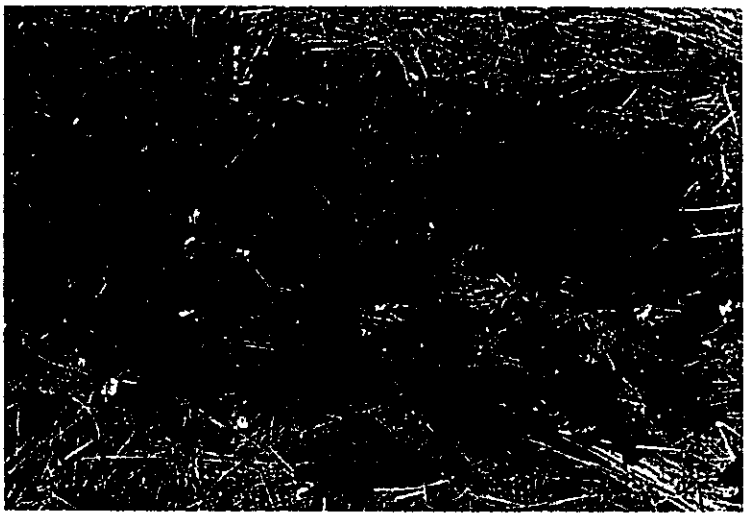
⑦



Release side stems, and let them grow nicely.

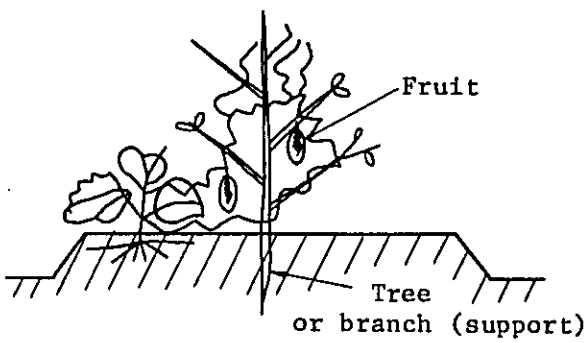
Female flowers come at the 2nd or 3rd knode on side stems.

Wheat straw mulching is effective. (For Vaishkha sowing)



⑧ When mulching straw or grass are not available, use tree branch or bamboo like right figure.

It is effective when cucumber is sown on July (Shrvana) due to too much rain.



⑨ Harvesting

Harvest first fruit earilier (10 - 12 cm).
If harvesting is late like first fruit turn to yellow brawn, the plant is burdened by big fruits, therefore, the plant can not grow smoothly.

From 2nd fruit, harvest 15 - 17 cm of fruit.
Average fruit weight 500 g.
Product from a plant 4 - 5 fruits.

⑩ Intensive management is required for cucumber cultivation. Therefore, it is better to plant in small area for first time former and increase unit yield, for example 3a 1 katha

⑪ Insects and disease are as follows

Cucurbit leaf beetle (Most dangerous)
Seed corn maggot
Cotton aphid

Downy mildew
Anthracnose
Phytophthora
Powdery mildew
Damping-off
Fusalium wilt.

IV-7 Bitter-gourd Variety Nepal Local

Ⓐ Cultivation standard

Sowing time : May ∿ July (The middle of Vaishkha ∿ middle of Shrvana)
Harvest : July ∿ the end of October (Shrvana ∿ middle of Kartika)
Spacing 150 cm x 120 cm (30 cm path)
Plants per 10 a. 550 plants
Rate of seed 500 gr.
Fertilizer application. Same as cucumber (IV-6)
Use more compost and ash.

* An example of expenditure and income per 10 a.

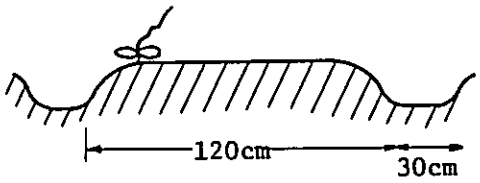
Labour charge	25 days x 2 men x Rs.5.0 =	Rs.250
Seed		Rs. 5.0
Fertilizer		Rs.135
Spraying		Rs. 20
	Total	Rs.410
Estimated yield	1.300 Kg	Rs.1.25/kg x 1.300 kg
	=	Rs. 1,625
Income Rs. 1,625 - Rs.410 =		Rs.1,215

Ⓑ Outline of cultivation

① Field preparation Same as cucumber

② Sowing Same as cucumber.

4 seeds per hill.
Sow after first monsoon
Enough watering is needed for germination



③ Management

Germination	:	5 ∿ 6 days after sowing
Thinning	:	At the stage of 3-4 true leaves, remain the best one.
Pinching	:	At the stage of 5-6 true leaves, pinch main stem and release side branches.
Top dressing	:	2 times like cucumber.
Supporting	:	If bamboo or tree branch is available, supporting culture is recommended. This is quite effective and good quality fruits can be harvested.

Bitter gourd with support.

As fruit skin of bitter gourd is soft, lifting fruit and good aeration is required.
Since fruit skin of bitter gourd is delicate, it is better, fruits to be hanged in the air.

④ Harvest

First harvest : 10 cm in length, 65 days after sowing.
From 2nd harvest: 14 ∿ 15 cm
Peak of harvest : 80 ∿ 110 days after sowing.
Product from a plant 10 ∿ 15 fruits

⑤ Insects and disease are as same as cucumber.

⑥ This is one of the recommended crops in rainy season.

IV-8 Water melon Variety Shin-yamato

Ⓐ Cultivation standard

Sowing time : Jan. 10 ∿ 20 (Pausha 25 ∿ Magha 5)
Harvest : The beginning of May ∿ beginning of June
(End of Vaishakha ∿ end of Jaishtha)
Spacing : 180 cm x 120 cm (30 cm path)
Plants per 10 a. : 460 plants
Rate of seed 200 gr. (4.5 dl.) 5 seeds a hill.
Fertilizer application Same as cucumber (IV-6)

* An example of expenditure and income per 10 a.

Labor charge 40 days x 2 men x Rs 5.0 =	Rs.400.0
Seed	Rs. 5.0
Fertilizer	Rs.135.0
Spreiying	Rs. 20.0
Materials (plastic film)	Rs.400.0
Total	Rs.960.0
Estimated yield 1,500 Kg	
Rs.1.25/kg x 1.500 kg =	Rs. 1,875
Estimated income Rs.1,875 - Rs. 960 =	Rs. 915

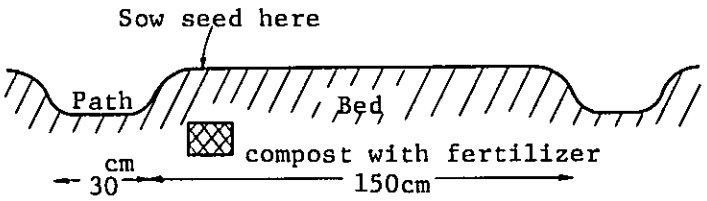
Ⓑ Outline of cultivation

① Field preparation

Select fertile field. If the field is near residence and water source, it is easy to manage intensively.

Make a ditch every 180 cm apart and put compost in the ditch.

Apply fertilizer on the compost and cover then thinly with coil. And make bed as follows.

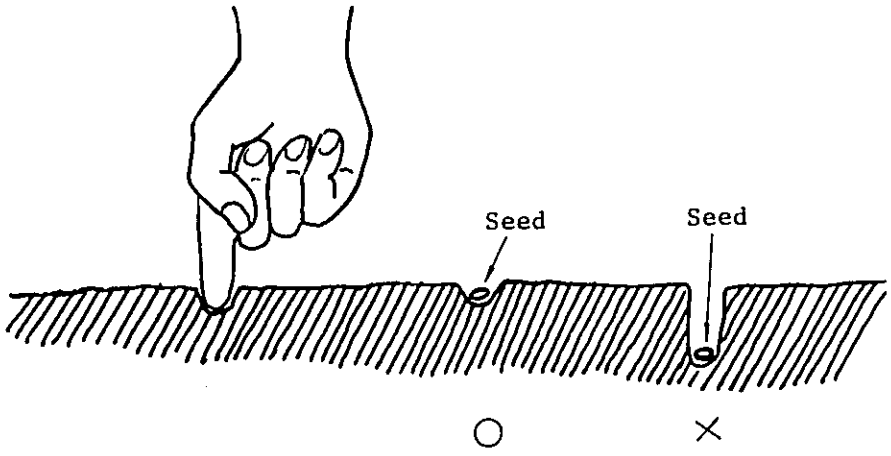


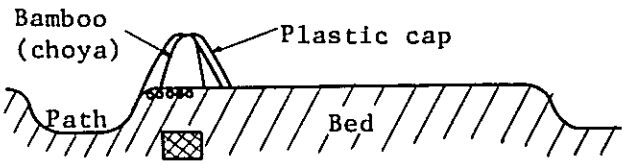
② Sowing

It is better to keep germination by use of plastic hot cap because of low temperature in sowing time (Jan.)

If wat rmelon is sown late when it is already worm, harvesting time of watermelon meet time of Mango and price of watermelon go down.

So, a point of watermelon cultivation to get high income is produce watermelon before mango come to markets.





Sow 5 seeds per hill. Don't sow deep.
Use plastic film as hot cap.

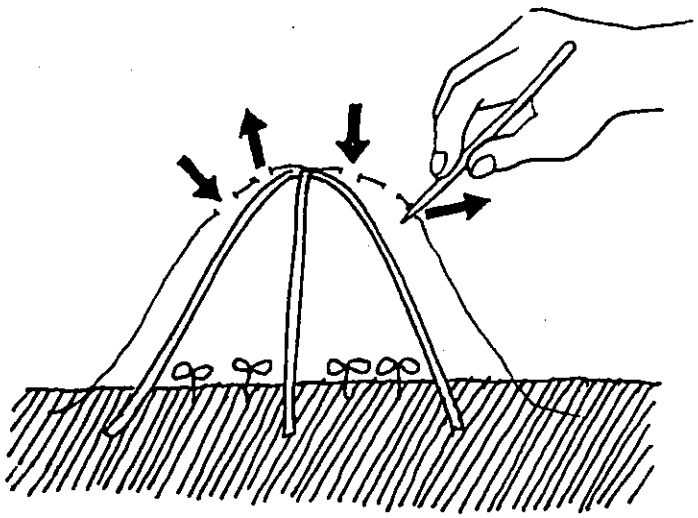
Use the path for furrow irrigation if much water is available.

③ Management

o It needs 7 ∿ 9 days for germination. 28 ∿ 30°C is required.

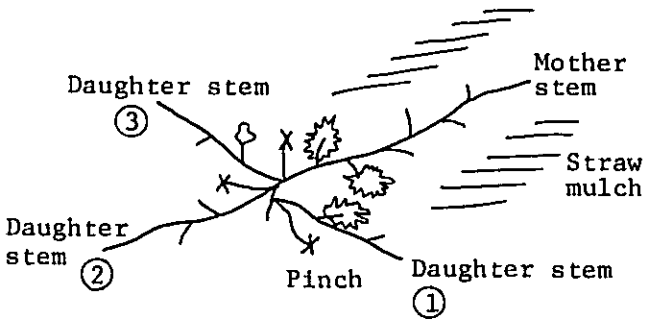
Put small holes to the cap for ventilation

o Thinning is done 10 ∿ 14 day after germination at the time of 2 ∿ 3 true leaves stage. Remain best one per hill.



o At the time of 4 ∿ 5 true leaves stage, remove the hot cap referring with the growth and temperature.

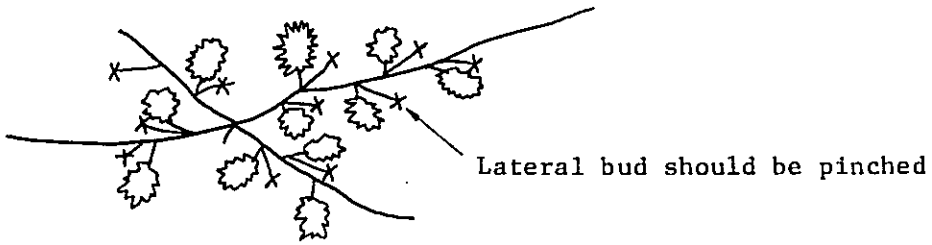
Give first top dressing and straw mulch to prevent soil drought.
Watering is important in this stage.



- o At the time of 6 ∿ 7 true leaves stage (30 days after germination), release 3 vigourous daughter stem and remove other stem.

  And put straw mulching under the stems.

- o Pinching of all further lateral bud on the released 4 stems. Do it every 2 days until first fruits set.

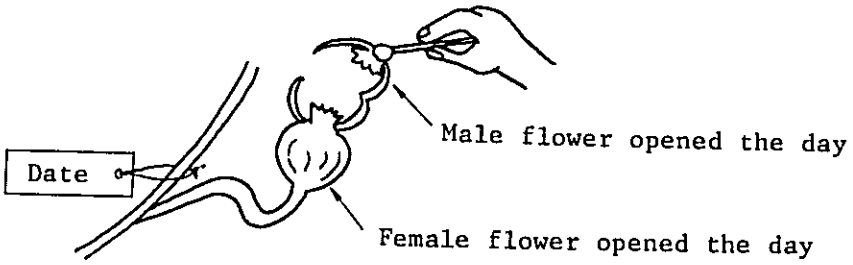


- o Top dressing (2nd times) and putting straw mulch, when first fruit set on the main stem, give top dressing.

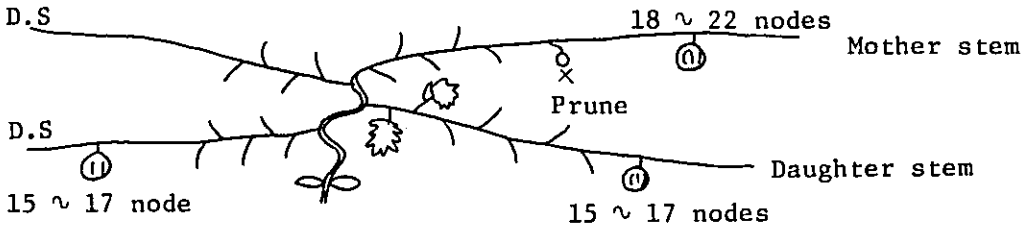
- o Hand pollination

  Natural insect pollination is also good. But the hand pollination is more reliable and we can get time of maturity by putting date of pollination.

  Hand pollination should be done between 5 ∿ 7 AM before temperature rise up.



o Position of fruit set and prunning of fruit



4 stems per a plant and set average 3 fruits per plant. Don't make to be 2 fruits per a stem, otherwise the second fruit never grow well.

Main stem the 18 ∿ 22 node
Side stem the 15 ∿ 17 node

o Correct the fruit stand arranging as follows when the fruit become big

o Harvest

35-40 days after pollination (Date of pollination).

Harvest according to the date. (or stick mark)

o Average weight
4 ∿ 5 kg.

Matured watermelon

o Disease and insects are
Same as cucumber

o Plastic hot cap can be utilized for two years.

IV- 9 Sweetmelon Variety Makuwa melon
Nara #1

Ⓐ Cultivation standard

Sowing time : Jan. 10 ∿ 20 (Pausha 25 ∿ Magha 5)
Harvest : The end of Apr. ∿ middle of May (Vaishakha)
Spacing : 180 cm x 100 cm (30 cm path)
Plants per 10 a. : 550 plants
Rate of seeding : 100 g (2.2 dl.) 5 seeds a hill
Fertilizer application Same as cucumber (IV-6)

* An example of expenditure and income per 10 a.

Labor charge	23 days x 2 men x Rs 5.0 =	Rs. 230
Seed		Rs. 3.0
Fertilizer		Rs. 135.0
Spraying		Rs. 20.0
Materials (plastic film)		Rs. 400
	Total	Rs. 788.0
Estimated Yield	Rs. 1.25/kg x 1.200 kg =	Rs. 1.500
Income	Rs. 1.500 = Rs.788 =	Rs. 712

Ⓑ Cultivation outline

① Field preparation and seed sowing method are similar to watermelon.

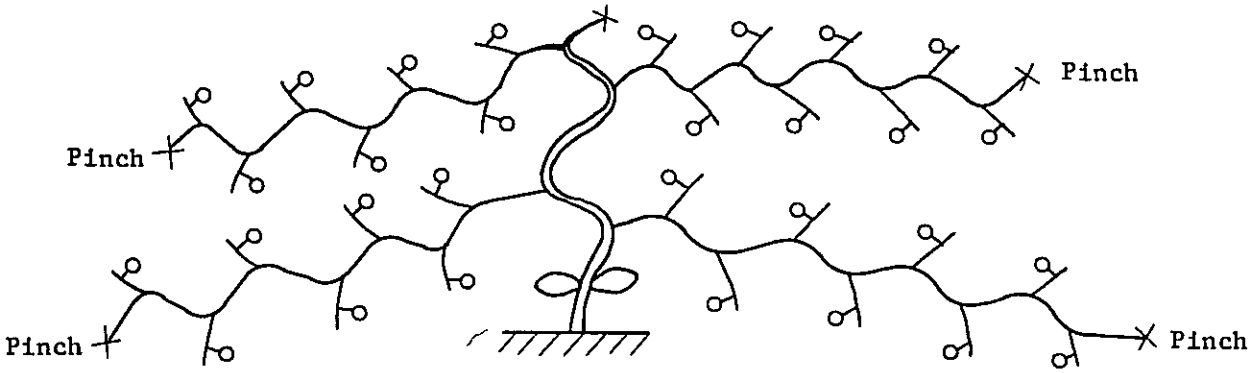
In late sowing, hot-cap is not necessary but price of melon may go down due to competition with Mango in the market.

② Fruit set is of melon much fruitful and enough by natrual pollination.

Flowering habit of Makuwa melon is somewhat different to that of watermelon. Female flowers of watermelon appear usually on main vein and first branch vein, while those of Makuwa appear mainly on

the secondary branch vein.

Therefore, it is better to pinch main vein at the time of 5-6 leaves stage and pinch again first branch vein at the time of their 7-8 leaves stage as shown in lower figure.



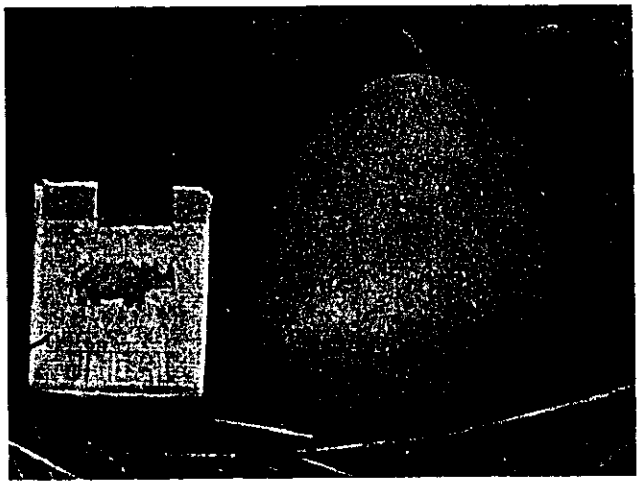
Then leave only 4 ∿ 5 fruits on every secondary veins for mature and remove others when the plant growth is good.

Straw mulching is important to prevent soil drought and fruit rotting.

③ Harvest

28 ∿ 30 days after flowering when the fruit is mature, the fruit color turn into golden yellow and has sweet flavor.

Average weight 400 g.
Number of fruits per plant 10 fruits.



④ Disease and insects — The same to cucumber

IV-10 Tomato Variety Nepal Local

Ⓐ Cultivation standard

Sowing time :

①	Rainy season May and June (The middle of Vaishakha to middle of Ashadha)	Trans-planting cultivation
②	Dry season The beginning to middle of Jan. (The middle to end of Pausha)	
	The middle to end of Jan. (beginning to middle of Magha)	Direct showing cultivation

Harvest :

① The beginning of Aug. ∿ end of Nov. (Middle of Sharvana ∿ middle of Margashirsha)

② The beginning of May ∿ end of July (The middle of Vaishakha ∿ middle of shrvana)

Spacing : 130 cm x 60 cm (40 cm path)

Plants per 10 a. : 1,280 plants

Rate of seeds : Transplanting sowing 20 g (65 ml.)
Direct sowing 40 g (130 ml.)

Fertilizer application The same to cucumber (IV-6)

* An example of expenditure and income per 10 a.

Labor charge	:	26 days x 2 men x Rs.5.0 =	Rs. 260.0
Seed	:		Rs. 2.0
Fertilizer	:		Rs. 135.0
Spraying	:		Rs. 20.0
Materials (String):			Rs. 15.0
		Total	Rs. 432.0
Estimated Yield		1.000	
		Rs.1.25/kg x 1.000 kg =	Rs.1.250
Income		1.250 - 432 =	Rs. 818

Ⓑ Outline of cultivation

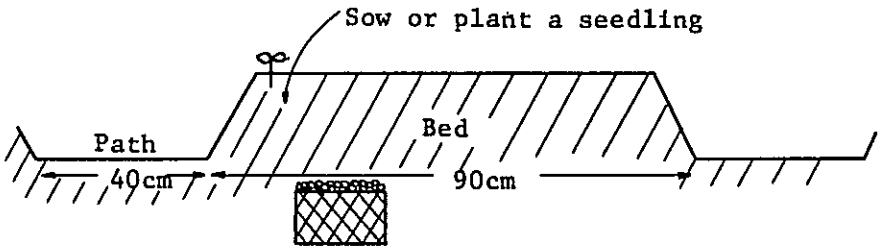
① Field preparation

For rainy season : Select fertile and good drain field
For dry season : Select fertile field and near water sourse

Broadcast ash and plow well, one month before cultivation.

Make ditches at every 130 cm apart and put compost in the ditch, which is the most important work.

Apply fertilizer on the compost and cover them with soil.
And make bed as follows



compost with fertilizer

Successive cropping causes heavy infection of diseases

② Seed sowing

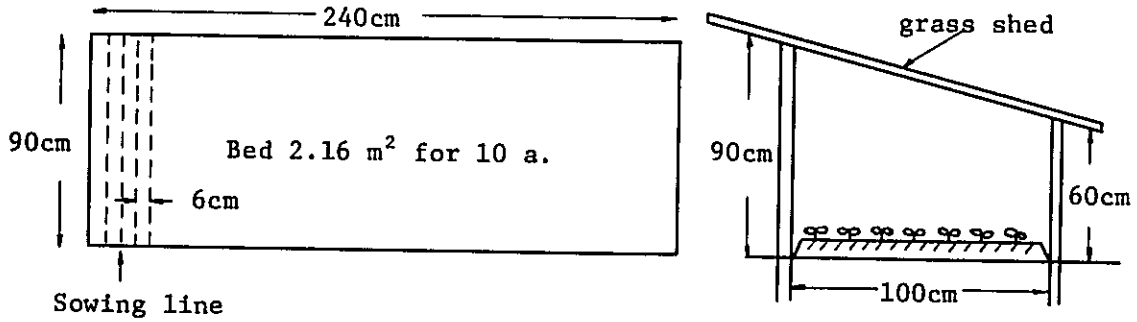
Direct sowing : Sow seeds on shoulder of bed, 5 ∿ 6 seeds per a hill, every 60 cm appart.

If tomato is sown directly in the field, the root develop deep and strong for drought, but this method has a big risk of diseases and pest infection in young seedling stage.

Transplanting (Raising seedling) : In rainy season, select good drain area for nursery bed

o Size 90 cm x 240 cm = 2.16 m^2
(Width) (Length)

Need rain-shed mode of grass.



o See II -4 / III-4 raising seedling.

o Bed soil should be made earlier mixing compost and soil.

o Don't sow seeds densely

o No shed is required in dry season.

o Don't sow seeds deeply and cover with soil thimly

o Transplant seedlings to nursery bed before setting.

9cm x 9cm in distance

(See IV-13 cabbage)

③ Thinning

Thin 2 ∿ 3 times to keep 2 cm in a plant to a plant.

Thin weak and elongated plants.

For direct sowing, thin one week after germination and leave 3 good plants per hill.

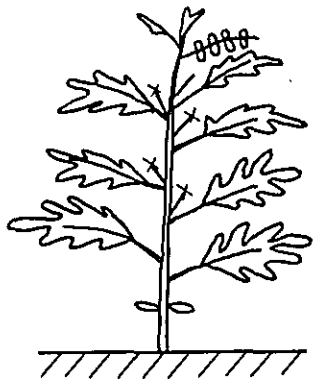
Thin again 3 weeks after germination to make only one good plant per hill. Put straw mulching.

Raising seedling of Tomato

④ Setting in the field

- o Use 25 ∿30 day seedlings
- o Give enough water on the bed one hour before setting.
- o Pick the seedling with soil and plant the seedlings with soil.
- o Plant not so deep and cover straw mulch on the soil surface.
- o Better to transplant late afternoon.

⑤ Pruning



Prun lateral buds if tomato is trained single or double stem with supports.

A lateral bud just below first cluster is usually vigorous, that cam be ultilized as a second main stem (double stem training)

⑥ Supporting

Bamboo or tree branch is available for support, supporting culture is much better than spreading.

If no support, use grass mulching as much as possible.

⑦ Harvest

Keep 9 - 10 fruits per a cluster, so that bigger fruits can be harvested. Don't keep full matured fruits on the plant.

For Japanese variety, 5-6 fruits per a cluster

Average weight 15g
12 cluster a plant,
1.5 kg from a plant

⑧ Insect & disease

- o Common cut worm
- o Cucurbit leef beatle

- o Damping off
- o Late blight (see photo)
- o Mosaic Virus
- o Bacterial wilt
- o Fusarium wilt
- o Early blight

Late blight
(Phytophtora)

IV-11 Eggplant Variety Large Round purple
Wase Shinkuro

Ⓐ Cultivation standard

Sowing time :

① Rainy season
May and June (The middle of Vaishakha) to middle of Ashadha)

② Dry season
The beginning to middle of Jan. (The middle to end of Pausha)

} Transplanting culture (30 days)

The middle to end of Jan. (beginning to middle of Magha)) Direct sowing

Harvest :

① The middle of Aug. to end of Nov. (The beginning of Bhadra to middle of Margashirsha)

② The beginning of May to end of Aug. (The middle of Vaishakha to middle of Bhadra)

Spacing : 160 cm x 50 cm (40 cm path. 2 row planting)

Plants per 10 a. : 2.500 plants

Rate of seed : Transplanting sowing 45 g (65 ml.)/10a.
Direct sowing 90 g (130ml.)/10a.

Fertilizer application : The same as cucumber (IV-6)

Since the growing period of eggplant is long, compost should be put at least 2 ton per 10.

* An example of expenditure and income per 10 a.

Labor charge	30 days x 2 men x Rs.5.0 =	Rs. 300
Seed		Rs. 1.0
Fertilizer		Rs. 135.0
Spraying		Rs. 20.0
Materials (string)		Rs. 40.0
	Total	Rs. 496.0
Exp. Yield	1 500 kg	
	Rs.1.0/kg x 1.500 kg =	Rs. 1.500
Income	1.500 - 496 =	Rs. 1.004

Ⓑ Outline of cultivation

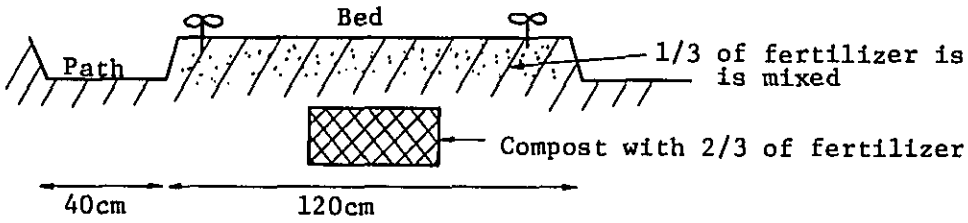
① Field preparation

For rainy season : Select fertile and good drain field
For dry season : Select fertile field near water source.

Broadcase ash and plow well one month before cultivation.

Make wide ditch every 160 cm apart and put compost in the ditch.
Apply 2/3 of fertilizer on the compost and cover them with soil.

And make a bed mixing 1/3 of fertilizer as follows.



② Sowing

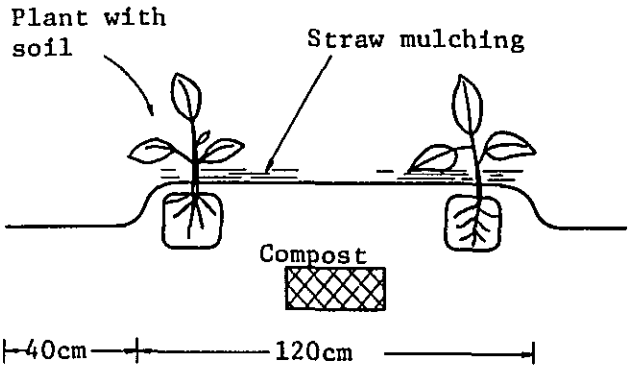
The same as tomato cultivation.
If it is transplanting method, keep nursery bed 2 times wider than tomato (4.3 m^2).

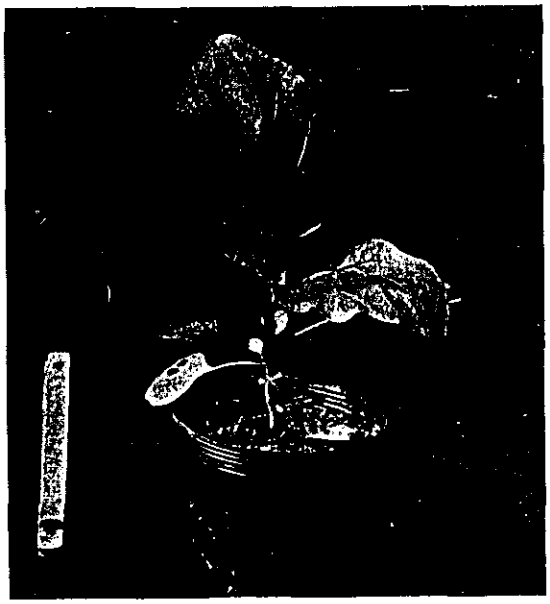
③ Thinning

The same as tomato.

④ Setting of seedling

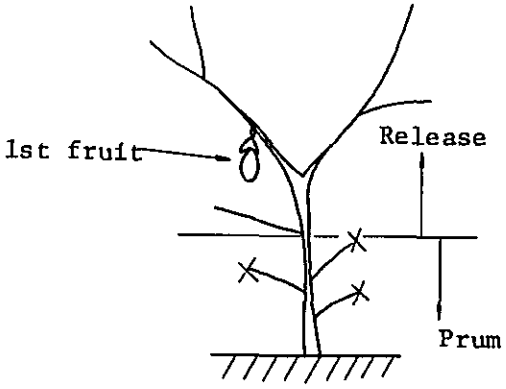
The same as tomato.





A seedling ready to set

⑤ Training



Leave 2 stem below 1st flower and prun below this. (see left fig.)

⑥ Heading back

When plant vigour come weak at the end of harvesting time, sometimes heavy pruning is done leaving some buds and cut all branches.

Fruits can be harvested again one month after cutting.

⑦ Harvest

Early var. : 18 ∿ 20 days after flowering

Mid. late var. : 25 ∿ 28 days after flowering

Average weight : 120 g.

Fruits per a plant : 20 fruits (2.4 kg)

Harvesting time

IV-12 Okra Variety Nepal Local

Ⓐ Cultivation standard

Sowing time : The beginning of May ∿ middle of Aug. (The middle of Vaishakha ∿ end of Shrvana)

Harvest : The middle of July ∿ end of Nov. (Shrvana ∿ middle of Margashirsha)

Spacing : 90 cm x 50 cm

Plants per 10 a : 2,220 plants

Rate of seed : 700 g (1.3ℓ)/100 4 ∿ 5 seeds per hill.

Fertilizer application : The same as cucumber (IV-6)

* An example of expenditure and income per 10 a.

Labor charge	20 days x 2 men x Rs.5.0 =	Rs. 200
Seed		Rs. 3.0
Fertilizer		Rs. 135.0
Spraying		Rs. 20.0
	Total	Rs. 358.0
Exp. Yield	900 kg	
	Rs.0.8/kg x 900 = Rs.720	
Income	Rs.720 - Rs.358 = Rs. 362	

Ⓑ Outline of cultivation

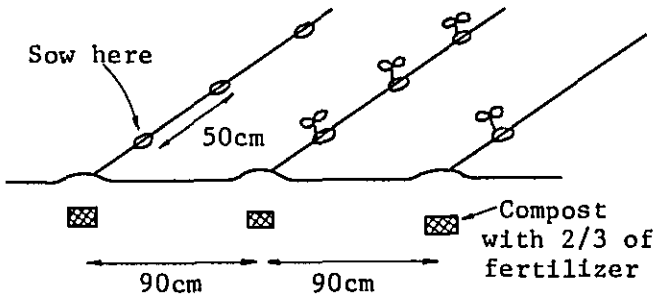
① Field preparation

Select fertile and good drain field.

Broadcast ash and plow well

Make ditch every 90 cm apart and put compost in the ditch. Apply 2/3 of fertilizer on the compost and cover them with soil.

And make ridge as follows, mixing with 1/3 of fertilizer.



② Seed sowing

Sow 4 ∿ 5 seeds per hill.

If seeds are soaked one day in water, germination become uniform.

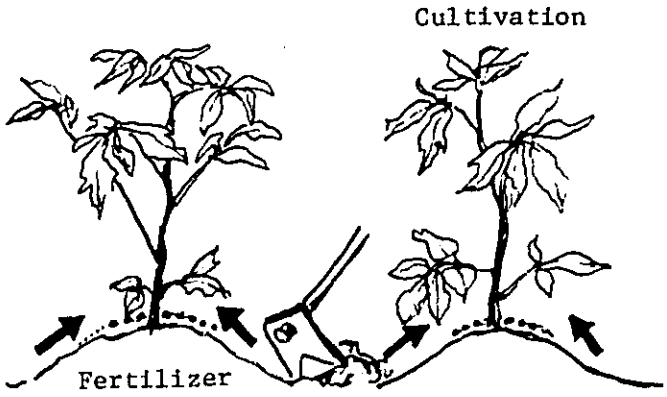
Con't put much covering soil (about 1 cm)

③ Thinning

Make plant per hill when okra grow 12 ∿ 15 cm and 4 ∿ 5 true leaves.

④ Training

Make single training, pinching all lateral buds.



⑤ Cultivation and mulching

After top dressing, give cultivation and mulching.

⑥ Harvesting

Harvest 5 ∿ 6 days after harvest.
The size of fruit is as big as fore finger (6 ∿ 7 cm).

If the fruit become big, plant vigour will be reduced.

Harvest everyday.

⑦ Insect and disease

Virus (The most dangerous)
Nematode

⑧ Okra is one of important egetables in rainy season. Easy to cultivate and yield is quite stable, since it is tolerant to hot weather and diseases and pests.

IV-13 Cabbage and cauliflower

Variety :

Cabbage : Indian early var.

Cauliflower : Nepal local

Ⓐ Cultivation standard

Sowing time : The beginning of September (The middle of Bhadra)

Harvest : The beginning of Dec. ∿ beginning of Jan. (The middle of Margashirsha ∿ middle of Pausha)

Spacing : 120 cm x 45 cm (90 cm bed, 2 row planting)

Plants per 10 a. : 3,700 plants

Rate of seed : 60 g (85 ml.)

Fertilizer application

		Total	Basic	Top 1	Top 2
Elemental rate	N (Kg)	11	8	1.5	1.5
	P (Kg)	8	8		
	K (Kg)	9	6	1.5	1.5
Actual amount	Urea	25	18	3.5	3.5
	S. phosphate	44	44		
	M. potash	15	10	2.5	2.5
	Compost	2,000			
	Ash	100			

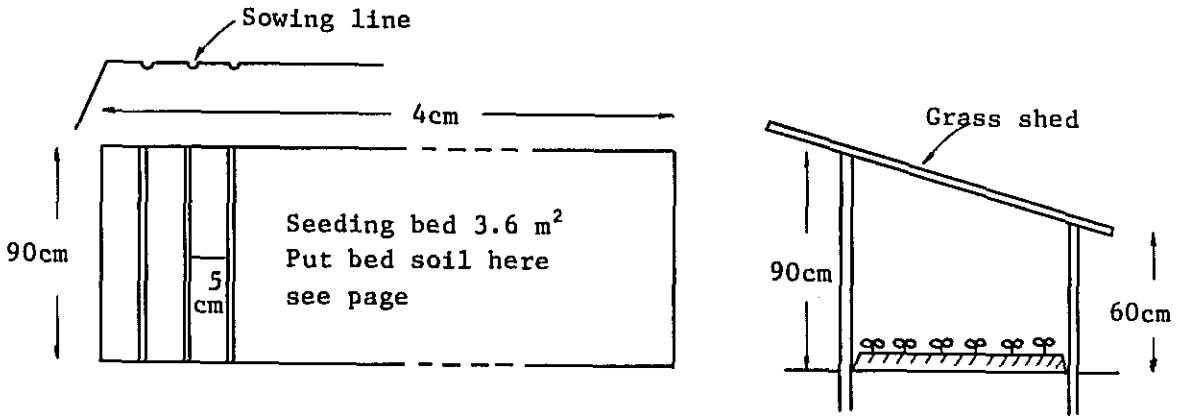
* An example of expenditure and income per 10 a.

Labor charge	25 days x 2 men x Rs.5.0 =	Rs. 250
Seed		Rs. 3.0
Fertilizer		Rs. 142.0
Spraying		Rs. 20.0
	Total	Rs. 415
Exp. yield in cabbage 2,000 kg		
	Rs. 0.75 / kg x 2,000 kg =	Rs. 1,500
Income	Rs. 1,500 = Rs. 415 =	Rs. 1,085

Ⓑ Outline of cultivation

① Nursery bed

Select the bed site that is good drain and near water sourse.

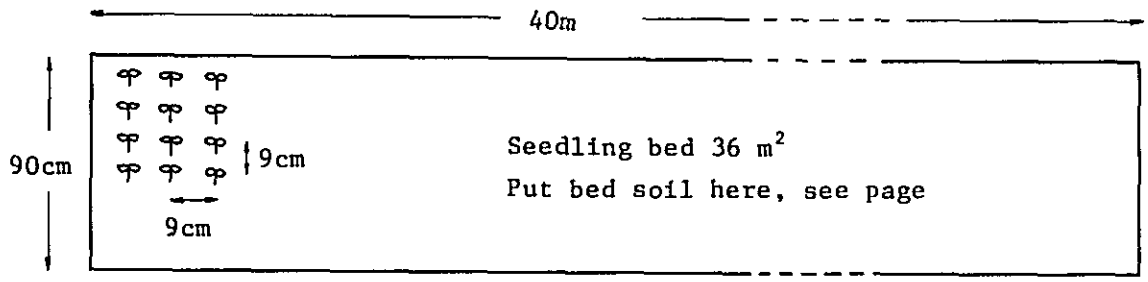


Line sowing, don't sow seeds crowdedly.
Light soil covering and put straw mulch.
Water at every morning.

② Thinning

Remove abnormal plants.
Give some space (1.5 cm) plant to plant
One must be careful about elongation of seedlings.

③ Transplanling in the nursery bed

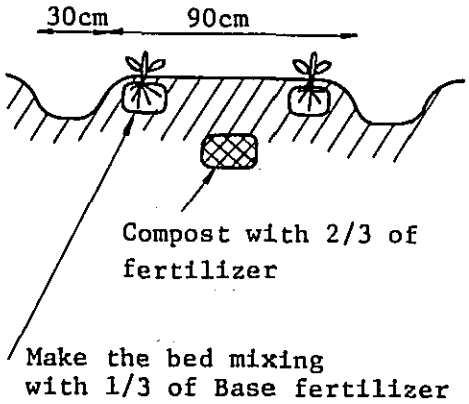


- o Give enough water to the seedling bed before transplanting
- o Transplant at the time of 2 true leaves.
- o Transplant seedling with soil

- o Transplant in the evening when it is not hot and not so windy day.
- o Give water after transplanting
- o If soil block raising seedlings are used, no need to transplant before setting (see IV-4)

③ Setting of seedling

Cabbage seedling for setting Left is good one



- o Give enough water one hour before picking
- o Set plants always with soil. See above a photo
- o Transplant in the evening
- o Give water after setting
- o Keep extra seedlings in the bed for supplemental planting
- o Don't plant deep. Below cotyledon.

④ Top dressing and cultivation

Give top dressing (1st time) at the time of 9 ∿ 10 true leaves (2 weeks after setting) and cultivate the rows.

Give 2nd top dressing at the time of cabbage has small head (tennis ball). This is important for enlargement of cabbage head.

⑤ Watering is required when head formation start.

⑥ Harvest

60 ∿ 70 days after setting
Average weight 1.2 ∿ 1.5 kg.

⑦ Insect & desease, common white, cabbage armyworm plutella are the most dangerous ones. See III-5.

IV-14 Radish Variety Mino-wase.

Ⓐ Cultivation standard

Sowing time : 1 The beginning of July ∿ middle of Sep. (The middle of Ashadha ∿ end of Bhadra) Can be sown, but difficult produce good radish.

2 The end of Sep. ∿ middle of Oct. (The Beginning of Ashivina ∿ end of Ashrina) Most suitable period, big root and good quality.

3 The middle of Oct. ∿ middle of Nov. (Kartika) Root is small, un-seasonable flowering come.

Harvest : The beginning of Sep. ∿ middle of Jan. (The middle of Bhadra ∿ end of Pausha)

Spacing : 90 cm x 30 cm (60 cm bed, 30 cm path)

Plants per 10 a. : 7,400 plants

Rate of seed : 1.2 kg (1.8ℓ)/10a. 5 ∿ 6 seeds per hill.

Fertilizer application

		Total	Basic	Topl
Elemental rate	N (Kg)	6.5	5.0	1.5
	P (Kg)	5.0	5.0	
	K (Kg)	5.5	4.0	1.5
Actual amount	Urea	14.4	11.1	3.3
	S. phosphate	28.0	28.0	
	M. Potash	9.1	6.6	2.5

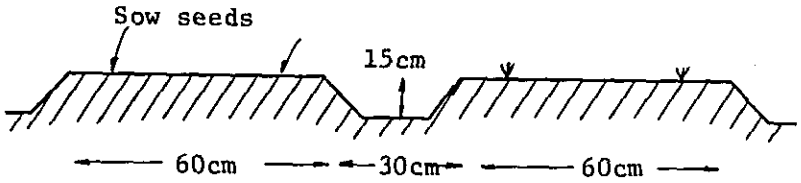
An example of expenditure and Income per 10 a.

Labor charge	25 days x 2 men x Rs. 5.0 =	Rs. 250
Seed		Rs. 20.0
Fertilizer		Rs. 86.0
Spraying		Rs. 20.0
	Total	Rs. 376

Exp. yield : Dry S. 2,500 kg
Rainy S. 1,000 kg
(including good leaves)

Income Dry S. Rs. 0.5/kg x 2,500 kg = Rs. 1,250
1,250 - 376 = Rs. 874
Rainy S. Rs. 1.0/kg x 1.000 kg = Rs. 1.000
1.000 - 376 = Rs. 624

Ⓑ Cultivation outline



(1) Field preparation :

Broadcase fertilizer after plowing, and make the bed above.

(2) Seed sowing

Sow seeds 5 - 6 seeds a hill and cover them with soil. Put rice straw or husk for the protection of seeds against run-off by heavy rain.

(3) Thinning

Make thinning at the time of 2-3 true leaves, remain 3 plants. Make thinning again at the time of 5-6 leaves and make one.

(4) Top dressing

When plants is 8-10 leaves give top dressing and cultivation.

(5) Harvest

50 - 60 days after sowing.

Typical Minowase

IV-15 Turnip Variety Shogoin

Ⓐ Cultivation standard

Sowing time : The middle of Sep. ∿ middle of Oct.
(The beginning of Ashvina ∿ beginning of Kartika)

Harvest : The middle of Oct. ∿ middle of Dec.
(The beginning of Kartika ∿ end of Margashirsha)

Spacing : 70 cm bed, 3 line and 30 cm path line sowing

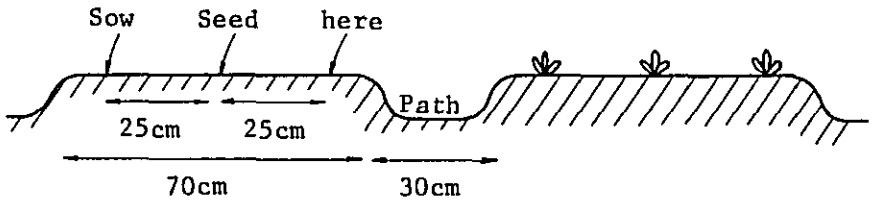
Rate of seed : 1 kg/10a.

Fertilizer application Same as radish (IV-14)

* An example of expenditure and income per 10 a.

Labor charge	20 days x 2 men x Rs. 5.0 =	Rs. 200
Seed		Rs. 15.0
Fertilizer		Rs. 86
Spraying		Rs. 20.0
	Total	Rs. 321
Exp. yield	2.000 kg	
	Rs. 0.5/kg x 2.000 kg =	Rs. 1.000
Income	Rs. 1.000 - Rs. 321 =	Rs. 679

Ⓑ Cultivation outline

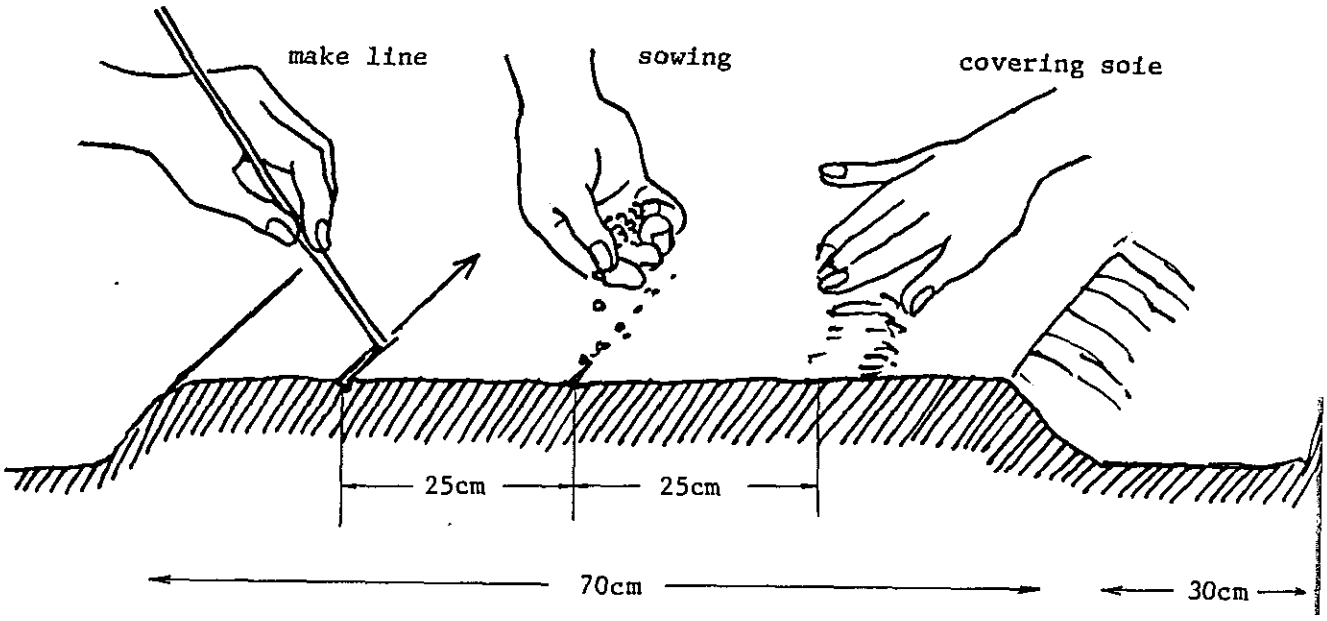


① Field preparation

Broadcase fertilizer after plowing and make the bed like above.

Application of compost in previous cropping seems to be better for turnip cultivation.
Fertilizers can be saved.

② Sowing



Sow evenly and don't sow many seeds at a place.
Cover seeds with fine soil and press them with hand.
Put straw mulching and water it.

③ Thinning

First thinning is done at 2-3 true leaves stage for 1-2 cm apart and the second thinning at 15-20 cm leaf height stage setting the spacing at some 15 cm apart in the rows. The second thinned plants can be utilized for a leaf vegetable, give top dressing.

④ Top dressing and cultivation

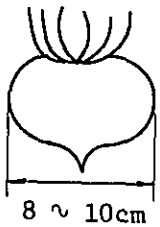
At 8 - 10 leaves stage and cultivate the row.

⑤ Harvest

Harvest big plant like thinning after one month of sowing. Them harvest from time to time.

The peak of harvesting is 50 ∿ 60 days after sowing.

Weight of a plant with leaves 400 ∿ 500 g



IV-16 Asparagus bean Variety Kuro 3 shaku

Ⓐ Cultivation standard

Sowing time : The beginning of May ∿ middle of Aug.
(The middle of Vaishakha ∿ end of sharvana)

Harvest : The middle of Jul. ∿ middle of Nov.
(The beginning of Shrvana ∿ beginning of Margashirsha)

Spacing : 80 cm x 45 cm

Plants per 10 a. : 2,770 plants

Rate of seed : 1.5 kg (2.1ℓ) 3 seeds a hill

Fertilizer application

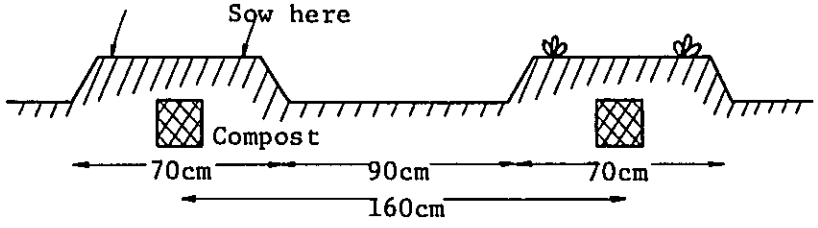
Compost	1.000 Kg
Ash	20 Kg

No use of chemical fertilizers

* An example of expenditure and income per 10 a.

Labour charge	20 days x 2 men x Rs.5.0 =	Rs. 200
Seed		Rs. 15.0
Spraying		Rs. 20.0
Supporting Materials (bamboo, string)		Rs. 300
	Total	Rs. 535.0
Exp. yield	700 kg	
Income	Rs. 1.50/kg x 700 kg = Rs. 1050	
	Rs. 1.050 - Rs. 535 = Rs. 515	

Ⓑ Cultivation outline



① Field preparation

Broadcast ash after plowing and make the ditch every 160 cm apart and put compost in the ditch.

Make the bed like above figure 70 cm bed, 90 cm patch.

Make higher bed in rainy season.

② Seed sowing

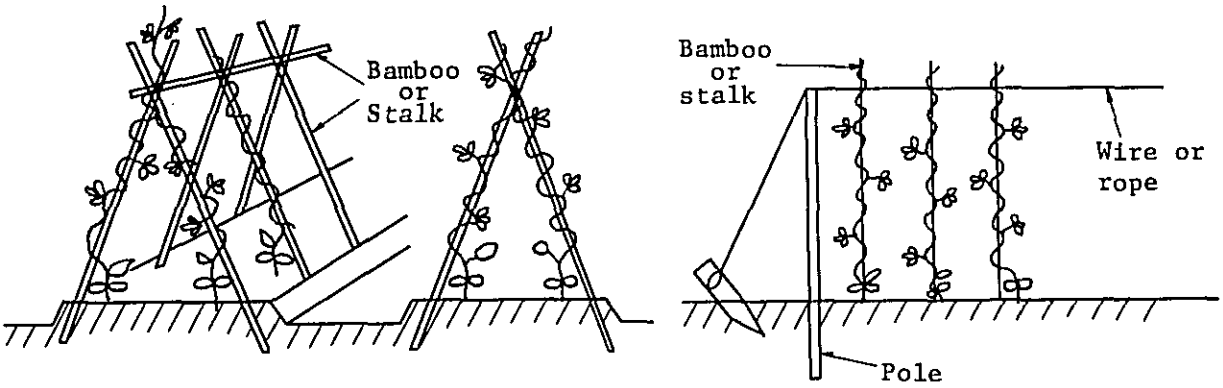
Sow 3 seeds per hill, every 45 cm at the shoulder of the bed.

③ Thinning

Make thinning to make only one crop at the time of 5 ∿ 6 leaves.

④ Supporting

This is quite necessary especially in raing season



⑤ Harvest

At the time of seeds in the pod are start to develop.

Don't harvest late, may be, unmarketable.

Length : 20 ∿ 25 cm

Young pod of asp. bean.

IV-17 Garden pea Variety Alaska (Tall type)
Dwarf grey sugar (Dwarf type)

Ⓐ Cultivation standard (Tall type)

Sowing time : The end of Oct. (The Beginning of Kartika)

Harvest : The end of Jan. ∿ beginning of Mar. (The middle of Magha ∿ middle of Phalguna)

Spacing : 80 cm x 20 cm

Plants per 10 a. : 6,250 plants

Rate of seed : 3.9 kg (5.4ℓ) 3 seeds a hill.

Fertilizer application :

Compost	1.000 kg
Ash	20 kg

* An example of expenditure and income per 10 a.

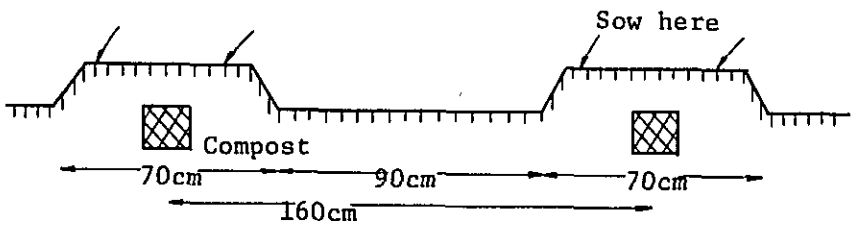
Labor charge	30 days x 2 men x Rs. 5.0 =	Rs. 300
Seed		Rs. 20
Spraying		Rs. 20
Materials (bamboo)		Rs. 300
	Total	Rs. 640

Exp. yield 1.000 kg

Rs.1.50/kg x 1.000 kg = Rs. 1.500

Income Rs.1.500-Rs.640 = Rs.860

Ⓑ Outline of cultivation (Tall type)



① Field preparation

The same as asparagus bean make lower bed in dry season.

② Seed sowing

Sow 3 seeds per hill, at 20 cm apart at the shoulder of bed.

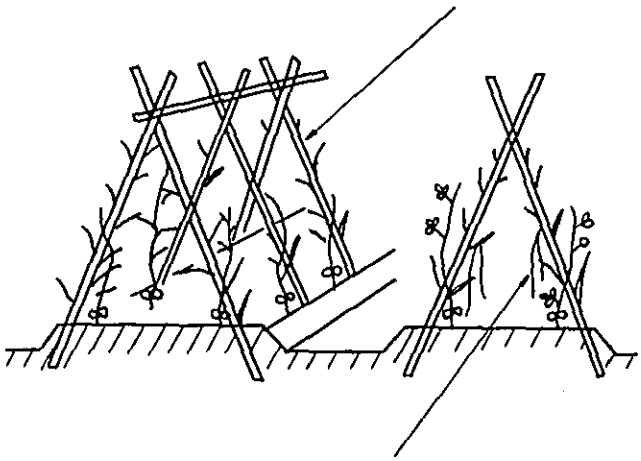
③ Thinning

Make thinning at 5 ∿ 6 leaves stage.

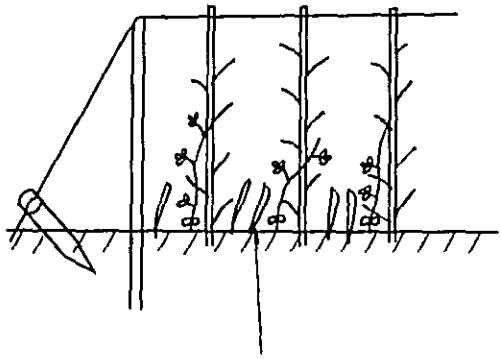
④ Supporting :

This is the most important work. Use bamboo or stalk like Arhar and Daincha.

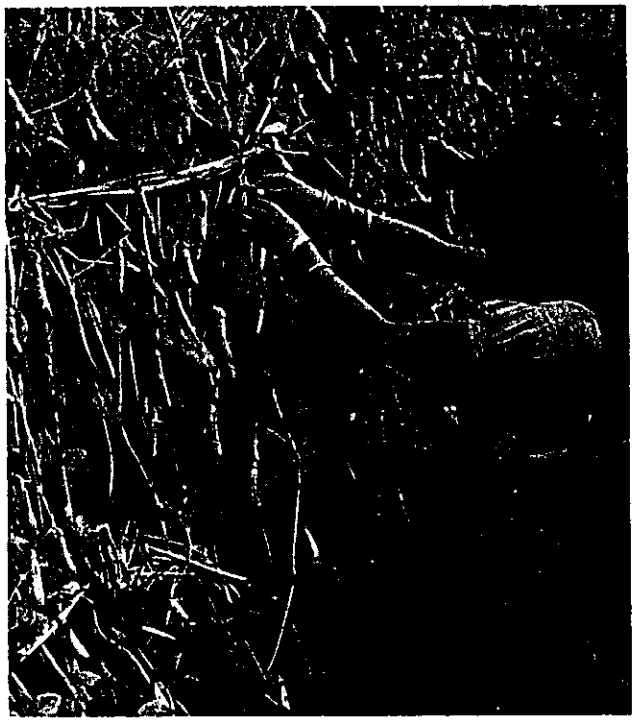
Bamboo or stalks with many lateral branches.



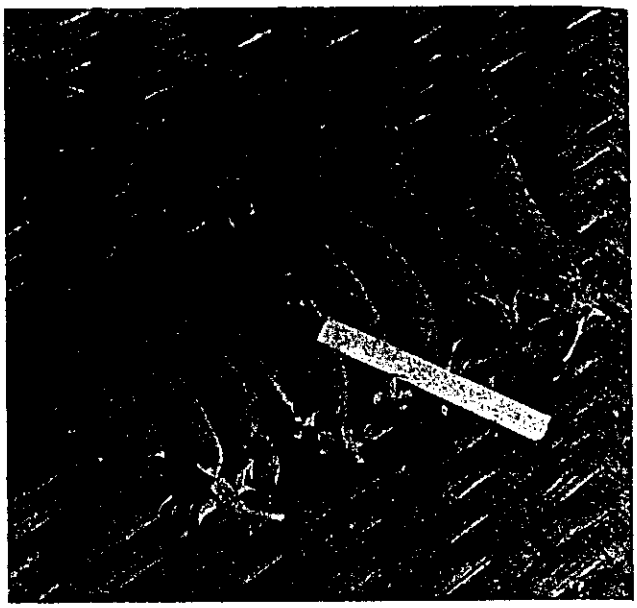
If garden pea don't climb well, put rice straw down for supporting.



Put supplemental sticks to help climbing of pea.



Harvesting of garden pea



Matured garden pea

⑤ Harvest

When seeds in the pod are enlarged.

⑥ If garden pea grow very tall (2m), cut the top so that it is safe from wind damage.

⑦ Disease and Insect

Powdery mildew is the most dangerous.

V-1 Periodical Checking and Servicing for Maintenance of Machines

(1) Daily

1. Checking on water and oil leakages
2. Checking on water level and replenishing, if necessary.
3. Draining of cooling water.
4. Checking on fuel oil level and replenishing, if necessary.
5. Feeding of lubricating oil to valve lever cover.
6. Checking on lubricating oil volume and replenishing.
7. Checking on movement of oil light rotor.
8. Checking on oil volume of air cleaner and replenishing, if necessary

(2) Every 50 hours

1. Retightening of cylinder head nuts.
2. Retightening of pulley fitting bolts.
3. Retightening of all engine fitting bolts and nuts.

(3) Every 100 hours

1. Discharge of drain from fuel tank.
2. Cleaning of oil light.
3. Exchange of lubricating oil.
4. Cleaning of crankcase and inlet strainer of lubricating oil pump.
5. Cleaning of air cleaner interior and exchange of oil.
6. Disassembling and cleaning of air breather.

(4) Every 300 hours

1. Cleaning of fuel tank (inlet and outlet) strainers.
2. Adjusting of valve clearance.
3. Adjusting of governor link.
4. Adjusting of fuel injection pressure.
5. Adjusting of fuel injection timing.

V-2 A Standard Table of Fertilizer Composition.

Fertilizer	Nitrogen	Phosphate	Potassium	Calcium
	%	%	%	%
Ammonium sulphate	21.0			
Urea	45.0			
S. phosphate		18.0		
Potassium chloride			60.0	
Slaked lime				65-75
Cattle dung (fresh)	0.59	0.28	0.14	
Cattle urine "	1.50	0.15	1.55	
Goat dung "	0.62	0.30	0.17	
Horse dung "	0.56	0.30	0.33	
Chicken drop "	1.63	1.54	0.85	
- do - (dried)	2.00	2.00	1.00	
Compost	0.50	0.25	0.50	
Matured compost	0.58	0.30	0.63	
Wooden ash		1.0	4.8	19.7
Grass ash		1.2	5.5	19.0
Rice straw ash		1.0	4.5	3.2
Rice straw (dried)	0.63	0.11	0.85	
Wheat straw "	0.48	0.22	0.60	
Soyabean forage	1.31	0.31	0.50	
Garden pea " "	1.04	0.35	0.90	
Sweet potato - do -	0.27	0.05	0.35	
Maize stalk (dried)	0.48	0.38	1.64	
Peanut "	0.59	0.08	0.33	
Rape seed cake "	5.1	2.2	1.5	

V-3 Nepalese Calendar

Nepalese calender	Solar calender
Vaishakha	April 14 - May 13
Jaishtha (Jyestha)	May 14 - Jun. 14
Ashadha	Jun. 15 - July 15
Shravana	Jul. 16 - Aug. 16
Bhadra	Aug. 17 - Sept. 16
Kartika	Oct. 17 - Nov. 15
Margashirsha (Mangsis)	Nov. 16 - Dec. 15
Pausha	Dec. 16 - Jan. 13
Magha	Jan. 14 - Feb. 12
Phalguna	Feb. 13 - Mar. 13
Chaitra	Mar. 14 - Apr. 13

Unit Conversion

1. Bigha = 13.3 Rapani = 67.7 a
   = 20 Katha

1 Ropani = 5.1 a

1 Katha = 3.4 a

1 Dharni = 2.27 kg

1 Pathi = 8 mana = 4.36
   1 mana = 545 cc

1 Ha. = 100 a = 2.47 acre

1 Acre = 40.5

1 Pound = 16 oz. = 453.6 g.