PACKAGE OF PRACTICES FOR RABI CROPS OF ASSAM

2023

Published jointly by

Assam Agricultural University, Jorhat
&Department of Agriculture, Govt. of Assam

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Atul Bora
Minister
Agriculture, Horticulture, Animal Husbandry & Veterinary, Border Protection & Development. Implementation of Assam Accord.

सत्यमेव जयते

GOVERNMENT OF ASSAM

MESSAGE

I am very happy to know that the Assam Agricultural University, Jorhat jointly in association with Department of Agriculture, Government of Assam is going to publish the recent version of the "Package of Practices for Kharif/Rabi/Horticultural Crops of Assam, 2023" along with the "Organic PoP for selected Crops of Assam, 2023" with the inclusion of 59 number of recently developed technologies pertaining to crop improvement, management and protection. I am also happy to know that Assam Agricultural University, Jorhat has developed the "Package of Practices for Climate Resilient Technologies of Assam, 2023" for the first time to combat the adverse effects of climate change on agriculture in the recent times, which will provide impetus to the agricultural growth and development in the state.

Agriculture is the mainstay of the Assam's economy as the majority of the people depend on agriculture and allied activities for their livelihood directly or indirectly. Adoption of sustainable, cost effective and advanced agricultural technologies could help in achieving rapid agricultural growth through optimum utilization of available resources of the state.

I sincerely believe that this Package of Practices, 2023 will be a great help for our extension machineries and farming community to boost up production and productivity of major crops in the state.

I convey my best wishes on this auspicious occasion.

Date : 30th August, 2024

(ATUL BORA)

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Aruna Rajoria, IAS
Commissioner & Secretary to the Govt. of Assam,
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Agriculture Production Commissioner

सत्यमेव जयते

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MESSAGE

Agriculture plays a vital role in the economy of the state, contributing to about 45% of the State's Gross Domestic Product (SGDP) with an annual growth rate of 8.15% (2021-22). Owing to the availability of fertile soil and abundance of rain, the state provides a favourable environment to produce both food and cash crops. Over 70 percent of the state's population relies on agriculture as farmers, agricultural laborers, or both for their livelihood, which emphasizes the importance of agriculture in the state. Hence, a rapid growth of agriculture could help not only in achieving self-reliance on food grain production but also in attaining food security and to reduce poverty in the state.

I am glad to know that the Assam Agricultural University, Jorhat jointly with the Department of Agriculture, Govt. of Assam is going to publish the Package of Practices for Crops of Assam, 2023 with inclusion of recently developed technologies pertaining to crop improvement, management and protection. I am confident that this will serve as a handbook to empower our extension machineries and farming community towards production and productivity enhancement of the state. I am sure that the package of practices included will be adopted by the farming community of state boosting the agricultural production systems.

With best wishes,

27/8/24.

Date: 27-08-2024

(Smt. Aruna Rajoria, IAS)

Dr. Bidyut C. Deka
Vice Chancellor

ASSAM AGRICULTURAL UNIVERSITY
JORHAT-785013, ASSAM (INDIA)

(Recipient of Sardar Patel Outstanding Institution Award)

Message

I am happy to learn that the Director of Research (Agriculture) of Assam Agricultural University in collaboration with the Department of Agriculture, GoA is bringing out the publication on *'Package of Practices for Kharif, Rabi and Horticultural Crops, 2023 as well as Organic Package of Practices,2023"* wherein a total of 59 new technologies pertaining to crop improvement, management, and protection have been incorporated as per the recommendations of a workshop jointly organized by AAU and Govt. of Assam.

I sincerely believe that the technologies so generated and included in the publication through the dedicated service of the scientists shall be great help to the farmers, scientists and extension functionaries of the state increasing agricultural growth, productivity and farm income.

I place on record my sincere gratitude to the team of scientists associated with the preparation of the manuscript.

(Bidyut C. Deka)

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APPENDICES

IMPORTANT ABBREVIATIONS USED IN THIS HANDBOOK

Agroclimatic Zones

N = North Bank Plains Zone
U = Upper Brahmaputra Valley Zone
L = Lower Brahmaputra Valley Zone
C = Central Brahmaputra Valley Zone
H = Hill Zone
B = Barak Valley Zone

Reaction to pests & diseases

R = Resistant
MR = Moderately Resistant
S = Susceptible
MS = Moderately Susceptible
T = Tolerant

Others

FYM = Farm Yard Manure
HYV = High Yielding Variety
a.i. =Active ingredient
RHSDRB = Rice Husk Saw Dust Rice Bran

CEREALS

Rice (*Oryza sativa)*

Boro Rice

Varieties:

Variety	Year of notification	Sowing time	Planting time	Harvesting time	*Duration (Days)	#Agro–climatic Zone	Average yield (t/ha)
Boro 1	-	Nov.	Dec./Jan.	Apr./May	150	N,U,C,L,B	3.0
Boro 2	-	Nov.	Dec./Jan.	May	165	N,U,C,L,B	3.0
**IR-50	-	Nov./Dec.	Dec./Jan.	Apr./May	155-160	C,B	3.0
Cauvery	-	Nov./Dec.	Dec./Jan.	Apr./May	150-155	B	3.0
Banglami	-	Nov./Dec.	Dec./Jan.	Apr./May	155-160	B	3.5
Joymati	-	Nov./Dec.	Dec./Jan.	May/Jun.	175	C,L	5.1
Dinanath	-	Nov	Dec./Jan.	Apr./May	160-165	N,U,C,L,B	6.28
Swarnabh	-	Nov	Dec./Jan.	Apr./May	160-165	N,U,C,L,B	6.16
Kanaklata	2017	Dec	Jan-Feb	May/June	165-175	U,C,L, B	5.0-5.5
Bina Dhan 11	2023	Jan	February	May-June	125-130	N,U,C,L,B	5-6

* Durations of the varieties are based on experiments at RARS, Titabar. In areas with slightly higher winter temperature the duration will be shortened.

** Not recommended for blast endemic areas

Refer to page iii for full forms of the abbreviations

Land selection:

Low-lying typical boro areas or irrigation command areas are to be selected.

Seed selection:

Seeds are to be put in plain water and the healthy seeds to be selected.

Seed treatment with chemicals:

(a) Wet method: After selection, the seeds are to be soaked directly in any one of the following fungicidal suspensions for 24 hrs.

Fungicide	Concentration (g/liter of water)
Carboxin	2.0

One liter of fungicidal solution is required to treat one kg of seed. Time required for

seed treatment with fungicidal solution is for >24 hrs and incubation for > 48 hrs.

(b) Dry method: Seeds are to be put in a closed container and then shake for five minutes for thorough mixing with the following fungicide

Fungicide	**Concentration (g/kg of seed)**
Carboxin	2.0

Raising of Seedlings:

(a) Seed-bed Preparation: Flat seedbed is recommended. Beds should be 125 cm wide and 10 m long with 30 cm gap in between two beds. Six to eight such beds are required for transplanting 1 bigha. Low poly-tunnel (height: 75cm, width: 125cm, length: as per convenience) should be used for raising seedlings during the cold period (end of December to mid-January). Polytunnel is a portable structure constructed with a polythene sheet fixed onto a frame made of bamboo sticks. The structure is placed over the seedlings on the seedbed to ensure favourable temperature for the growing seedlings. Any gap between the polytunnel and the soil should be sealed with mud to maintain warmth inside the tunnel during night. The structure should be removed for 1-2 hrs daily, starting from the 7th day before uprooting in order to allow the seedlings to acclimatize. The duration of removal should be increased gradually and the seedlings should finally be kept completely exposed for about 2 days.

(b) Seed rate: Pre-germinated seeds are to be sown @ 0.65-1.0 kg per bed. Seed requirement for transplanting one hectare of main field is 40-45 kg.

(c) Plant protection in seedbed:

a) Spraying with ediphenphos @ 1 ml/liter of water is to be done as soon as one-two blast spots are seen.

b) For the control of insect pest any one of the following chemical could be sprayed

Insecticide	**Dosage**
Chlorantraniliprole 20 SC	30g *a.i* /ha or 0.3 ml/*l*
Fipronil 5 SC	50g *a.i.*/ha or 1.5-2ml/*l*
Imidachloprid 70 WG	24.5g *a.i.*/ha or 0.3g/*l*
Thiamethoxam 25 WG	25g *a.i.*/ha or 100g/ha

- High volume spray: 400 ml of water/10 sq.m
- Low volume spray: 100 ml of water/10 sq.m

(d) Age of seedlings: 5-6 leaf stage is suitable for planting.

Field preparation:

The field should be ploughed 3-4 times followed by laddering. Leveling should be done properly to retain water uniformly in the field.

Fertility Management:

Land situation	Nutrient requirement (kg/ha)			Fertilizer requirement (kg/bigha)		
	N	P_2O_5	K_2O	Urea	SSP	MOP
Low lying area	0	0	0	0	0	0
Periphery of low-lying area	40	20	20	12	18	4
Irrigated area	60	30	30	18	27	6

N.B. For Barak Valley Zone and Central Brahmaputra Valley Zone, in the periphery of low lying area, N-P_2O_5-K_2O dose of 20-10-10 kg/ha (5 kg urea, 9 kg SSP and 2 kg MOP/bigha is recommended).

Time of application:

In marshy areas, whole of super phosphate and muriate of potash is to be applied and entire quantity of urea is to be top dressed after 21-25 days of transplanting. For irrigated area, 1/3rd urea as basal, 1/3rd at the time of tillering and the remaining part at panicle initiation stage are to be applied. Super phosphate can also be incorporated into the soil at active tillering stage 25-35 days after transplanting along with second dose of N.

Transplanting:

Variety	No. of seedling per hill for marshy area	Depth of planting (cm)	Spacing row× plant (cm)
Mahsuri Boro 1 Boro 2	2	5	25×20
Kalinga 2	2	5	20×20

Gap filling:

The dead hills are to be replaced within 7-10 days of transplanting.

Water management:

Irrigation water is to be applied to maintain 5.0±2 cm of standing water in the field after 2-3 days of transplanting up to 7-10 days before harvest. But under constrained availability of water, 7 cm irrigation water may be applied one day after disappearance of ponded water.

Interculture:

Two weedings are to be given preferably at 20 and 40 days after transplanting. Weeder can also be used after top dressing to incorporate the nitrogenous fertilizer with the soil. Pre-emergence application of pretilachlor @ 0.75kg a.i./ha followed by rotary paddy weeder at 40 days after transplanting.

Plant protection:

A). Insect Pests: Plant protection measures to be adopted against insect pests at their Economic Threshold Levels (ETLs) are given in Table 1.

To control rice pests, erect 50 Nos. of 'T'-perches per ha 2 ft (60 cm) above crop canopy as roosting site for insectivorous birds, which are to be removed before flowering in order to prevent activity of granivorous birds

B). Diseases:

i). Blast: As soon as one or two spots on leaf are seen, the following spraying schedule is to be followed immediately.

Fungicide	**Concentration**
Ediphenphos	0.1% (1 ml/*l*)
Copper oxychloride	0.4% (4g/*l*)

- Volume of spray solution required is 525-750 liter /ha.
- Spraying is to be repeated at 10-15 days intervals till the disease gets controlled.

ii). Sheath blight:

For control of this disease, hexaconazole (2 ml/*l*) with 525-750 liters of spray solution/ha is to be sprayed. Two sprays are required, the first at the appearance of the disease and another at 10 days after the first spraying.

Spray 2 rounds of tebuconazole 25.9 EC @ 1.5 ml/*l* at 15 days interval starting just after appearance of the disease to reduce Sheath Rot and Stem Rot incidence of rice.

Rice *(Oryza sativa)*

Hybrid *Boro* rice

Varieties:

Variety	Year of notification	Duration (days)	Yield (t/ha)	Agroclimatic Zone	Pest and disease reaction
Pro Agro 6444 (Arize 6444)	2015	170-175	7.5	All the zones	-
KRH 2	-	175-180	6.0	All the zones	-
PAC 837	2009	120-125	6-7	UBVZ, LBVZ, HZ & CBVZ	Resistance to Blast; MR to RTV & BS; tolerant to GLH
Arize 6129	2017	115-120	6-7	UBVZ, LBVZ, HZ & CBVZ	MR to BS, BLB & Sheath Blight; tolerant to blast & SB

Land selection:

Area with assured irrigation facilities are to be selected.

Seed treatment:

a) **Wet method:** Seeds are to be soaked directly in the following fungicidal suspensions for 24 hours.

Fungicide	Concentration (g/liter of water)
Carboxin	2.0

b) **Dry method:** Seeds and the following fungicide are to be put in a closed container and for five minutes for thorough mixing.

Fungicide	Concentration (g/kg of seed)
Carboxin	2.0

Raising of seedlings:

a) **Seedbed preparation:** Flat seedbed with 1.25 m width, 10.0 m length and 30 cm gap between two beds is to be prepared. Land is to be thoroughly puddled.

b) **Seed rate:** Pre-germinated seeds are to be sown @ 250-300 g/bed. Seed requirement for transplanting one hectare of main field is 7.5kg.

c) **Manures and fertilizers:** 20-30 kg FYM or compost, 80 g urea, 80 g SSP and 40 g MOP are to be applied in each bed.

d) **Sowing time:** 15-30th November

e) **Water management:** Standing water in the furrows between beds is to be kept to maintain saturated condition in the seedbeds. Irrigation up to submergence of beds before uprooting of seedlings facilitates the process.

f) **Plant protection:** Same as *boro* rice.

g) **Age of seedling:** 45 days old seedling (5-6 leaf stage).

Main field preparation:

1. The field should be ploughed properly and leveled to retain water uniformly in the field.
2. First irrigation for soaking the land is to be applied before preparatory tillage. Second irrigation is to be applied at 10-12 days prior to transplanting followed by ploughing, laddering and puddling accompanied by repairing and mud plastering of bunds. Thereafter, irrigation is to be applied for land submergence.
3. The final puddling is to be done just before transplanting. One irrigation is to be applied before final puddling.

Fertility management:

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
N	100	Urea	217	29
P_2O_5	60	SSP	375	50
K_2O	60	MOP	100	13

Time of application of fertilizer:

One fourth of total urea, full doses of SSP and MOP at the time of final puddling are to be applied as basal dressing. The 2nd, 3rd and 4th doses of urea are to be applied as top dressing and incorporated with soil at maximum tillering, panicle initiation and booting stages, respectively.

FERTILIZER RECOMMENDATION AS PER FERTILIZER PRESCRIPTION EQUATIONS (FPE)

Fertilizer prescription equations can be used to find out the amount of NPK fertilizers to obtain a certain yield target of the crop based on soil test values for NPK. The yield target must not cross the potential yield of the crop. For hybrid rice, calculate fertilizer requirement using Fertilizer Prescription Equation or consult the ready reckoner at Annexure XVII (A)-(D).

Fertilizer Prescription Equations (Only chemical fertilizer)

FN= 4.08 * T – 0.75 * STVN

FP= 1.39 * T – 2.57 * STVP

FP= 4.17 * T – 1.15 * STVK

Fertilizer Prescription Equations (Chemical fertilizer + FYM)

FN= 4.08 * T – 0.75 * STVN - 0.59 * M

FP= 1.39 * T – 2.57 * STVP - 0.37 * M

FP= 4.17 * T – 1.15 * STVK - 0.58 * M

Where FN FP & FK- Fertilizer N, P, and K; T- Targeted yield, STV- Soil test values, M- FYM

Spacing: 20 cm × 15cm (33 hills/sq. m)

No. seedlings per hill: 1 (one)

Depth of planting: 5 cm

Gap filling:

The dead hills are to be transplanted within 7-10 days of transplanting.

Water management:

Irrigation water is to be applied at a depth of 5cm 3 days after disappearance of ponded water from the date of transplanting.

Intercultural operation:

Two weedings are to be given at 3-4 weeks and 6-7 weeks after transplanting. Paddy weeder can be used after top dressing to incorporate the nitrogenous fertilizer with soil.

Plant protection:

Plant protection measures against insect pests and diseases are same as for *boro* rice.

Rice (*Oryza sativa*)

Early *Ahu* (Direct Seeded)

Varieties:

Varieties	Year of notification	# Agroclimatic zone	Duration (days)	# Reaction to blast
A. Semi Dwarf				
IR50*	-	U,C	110-120	S
Rasi	-	N,U,L	125-130	T
IR36	1982	-	120-130	-
Luit	1997	N,U,C,L	95-100	T
Kapilee	-	N,U,C,L	95-100	T
B. Tall				
Banglami	-	N,L	115-120	S
Rangadoria	-	N,U	115-120	S
Dubaichenga	-	N,U	115-120	S
Dagaranga	-	N	85-95	S
Ihajit	-	C	-	-
Fapori ahu	-	C	-	-
Koijapori	-	L	95-105	S
Hasakumra	-	L	80-85	-
Guni	-	L	80-85	S
Koimurali	-	B	95-100	-
Nilajee	-	U,L	-	S
Harin Kajali	-	L	115-120	-
Dishang	1998	N,U,C,L,B	90-95	-

* Not recommended for blast endemic areas

Refer to page iii for full forms of the abbreviations

Newly recommended variety:

Variety	Year of notification	Plant height (cm)	Duration (days)	Sowing time	Transplanting time	Age of seedlings (days)	Yield (q/ha)	*Agroclimatic Zone	Disease reaction
Kanaklata	2017	125	130-135	February	March	25-30	40-45	U,C, L,B	MS to blast & sheath rot, and T to BLB & sheath blight

Land selection*:*

Low lying areas having sufficient soil moisture even during January and February should be selected. The land should be prepared by ploughing 3 to 4 times followed by laddering. Proper leveling has to be done so as to retain water uniformly in the field.

Fertility management:

Compost or FYM @ 10 t/ha (15 q/bigha) is to be applied during initial ploughing.

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
A. Dwarf variety				
N	40	Urea	88	12
P_2O_5	20	SSP	125	18
K_2O	20	MOP	33	4
B. Tall variety				
N	20	Urea	44	4
P_2O_5	10	SSP	62	9
K_2O	10	MOP	16	2

***N.B.*:** For problem areas like flood affected areas of Majuli, where farmers have to take some risk in growing early *ahu* crop before flood, need-based fertilizer is to be recommended.

In absence of SSP, Diammonium Phosphate (DAP) can be applied in proportion to the quantities of N and P_2O_5 as suggested above.

1. Full dose of phosphatic fertilizer is to be applied at the time of final ploughing. Half

of the nitrogenous and potassic fertilizers have to be applied during 15-25 da

***N.B.*:** For problem areas like flood affected areas of Majuli, where farmers have to take some risk in growing early *ahu* crop before flood, need-based fertilizer is to be recommended.

In absence of SSP, Diammonium Phosphate (DAP) can be applied in proportion to the quantities of N and P_2O_5 as suggested above.

2. Full dose of phosphatic fertilizer is to be applied at the time of final ploughing.
3. Half of the nitrogenous and potassic fertilizers have to be applied during 15-25 days after germination or after first weeding.
4. The second top dressing with the remaining quantities of nitrogenous and potassic fertilizers should be done during 45-50 days after germination or after the second weeding, but not later than panicle initiation stage.

Sowing time:

The optimum time of sowing is in the middle of February. For Barak Valley Zone, the broadcast sowing should be done in March.

Seed selection: Same as in *boro* rice.

Seed treatment with chemicals:

A. **Wet method**: Same as in *boro* rice
B. **Dry method**: Same as in *boro* rice

Seed rate and sowing:

Sowing is done in lines with an inter-row spacing of 20 cm. Seeds are to be sown @ 75 kg/ha (10 kg/bigha)

Broadcasting:

For broadcast crops, seed rate of 85-105 kg/ha is to be used.

Interculture:

1. Weeding is preferably done with wheel hoe, dry land weeder or *bindha* followed by laddering after 3 to 4 weeks from sowing. The second weeding should be done with wheel hoe or dry land weeder at 2-3 weeks after the first weeding. If wheel hoe or dry land weeder is not available, manual weeding should be given. Weeding should precede fertilizer application.
2. Pre-emergence herbicide pretilachlor @ 0.75 kg a.i./ha after 2-3 days of sowing or post-emergence herbicide bispyribac sodium @ 25.0 g a.i./ha at 2 to 3 leaf stage of dicot weeds and sedges or 25-30 days after emergence of rice should be applied.

Plant Protection

A). Insect pests: Plant protection measures should be adopted against insect pests at their

economic threshold levels as given in Table 1. Wherever threshold level is not mentioned, control measures are to be taken with the appearance of the pest. To control rice pests, erect 50 'T'-perches per ha 2 ft (60 cm) above crop canopy as roosting site for insectivorous birds, which are to be removed before flowering in order to prevent activity of granivorous birds.

B). Root-knot nematode: Apply, *Pseudomonus flourescens* @ 20g/ sq. m at the time of sowing. Apply *Bacillus subtilis* ($1x10^8$ cfu/g) @ 10 kg/ha before sowing to control rice root knot nematode (*Meloidogyne graminicola*). The bioagent should be enriched in well decomposed FYM (10 kg in 200 kg FYM) before application

C). Diseases

i). **Blast**: As in case of *boro* rice. Sheath blight: As in case of *boro* rice

War management: As in case of *boro* rice

Rice *(Oryza sativa)*
Transplanted Early *Ahu*

Varieties:

Varieties	Year of rel	#Agroclimatic zone	Duration** (days)	Grain character	Reaction to blast
A. Semi dwarf					
Rasi	-	N,U,C,L,H	130-135	Medium slender	T
IR-50*	-	N,U,C,B	115-125	Long slender	S
Govind	-	N,U,B	115-125	Long slender	T
IR-36	1982	C,L,B	125-135	Long slender	T
Jaya	1969	N,U,C,B,H	140-145	Long bold	-
IR-8	-	U,C,B,H	140-145	Long bold	-
Luit	1997	U,C,L,B	100-105	Long slender	T
Kapilee	-	U,C,L,B	100-105	Long slender	T
AAU Diphu Dhan 4 (Haccha)	2022	H	100	Slender	T

Refer to page iii for full forms of the abbreviations
* Not recommended for blast endemic areas
** Durations of semi dwarf modern varieties are based on experiments conducted at Titabar. Durations of traditional varieties are collected from Field trials of stations of respective zones.

Land selection:

Areas with assumed irrigation facilities should be selected. Heavy to medium textured soils are preferred.

Seed selection:

Seeds are to be put in plain water, stirred well and floated ones are to be rejected.

Sowing in nursery bed:

Seeds should be sown in nursery bed during mid-February.

Seed treatment with chemicals:

A. **Wet method:** Same as in *boro* rice.

B. **Dry method:** Same as in *boro* rice

Raising of seedlings:

a) **Preparation of seedbed**: Land is to be thoroughly puddle and seedbeds of 10 m length and 1.25 m breadth are prepared with 30 cm gap in between beds.

b) **Manures and fertilizers**: In each seedbed, 20-30 kg cowdung or compost, 80 g urea, 80 g SSP and 40 g MOP are to be applied.

c) **Seed rate**: Well germinated seeds are to be sown @ 650 to 1000 g per bed. Seed requirement for transplanting one hectare of main field is 40-45 kg.

d) **Plant protection in seedbed**:

1) As soon as one or two blast spots are seen. ediphenphos @ 1 ml/liter of water is to be sprayed.

2) In case nematode is not a problem, any one of following insecticides is to be sprayed against nursery insect pests as and when necessary. Generally, an insecticidal spray 5 to 7 days after sowing is effective against most pests.

Insecticide	**Dose**
Chlorantraniliprole 20 SC	30g *a.i* /ha or 0.3 ml/*l*
Fipronil 5 SC	50g *a.i.*/ha or 1.5-2 ml/*l*
Imidachloprid 70 WG	24.5g *a.i.*/ha or 0.3 g/*l*
Thiamethoxam 25 WG	25g *a.i.*/ha or 100 g/ha

- High volume sprayer: 400 ml of water/10 sq. m
- Low volume sprayer: 100 ml of water/10 sq. m.

e) **Irrigation:** Standing water in the furrows between the beds is to be kept to maintain saturated condition in the seedbeds. An irrigation upto submergence of beds before uprooting of seedlings facilitates the process.

Field preparation:

1. First ploughing is to be given at 21-24 days prior to transplanting. Irrigation for soaking the land is to be applied before preparatory tillage.
2. Second irrigation is to be applied at 10-12 days prior to transplanting followed by ploughing, laddering and puddling accompanied by repairing and mud plastering of

bunds. Thereafter irrigation is to be applied once again for land submergence.

3. The final puddling is done just before transplanting. Irrigation is applied before final puddling (depth of each irrigation 5±2 cm). Excess water, if any, should be drained out from the field.

Fertility management:

Well rotten FYM or compost has to be applied @ 10 t/ha in addition to the fertilizers at rates given below in areas with moderate fertility level.

Nutrient	**Requirement (kg/ha)**	**Form**	**Fertilizer requirement**	
			kg/ha	**kg/bigha**
A. Semi dwarf varieties				
N	40	Urea	88	12
P_2O_5	20	SSP	125	18
K_2O	20	MOP	33	4
B. Tall varieties				
N	20	Urea	44	6
P_2O_5	10	SSP	62	9
K_2O	10	MOP	16	2

In absence of SSP, Diammonium phosphate (DAP) can be applied in proportion to the quantities of N and P_2O_5 as suggested above.

Above rate of fertilizer will be valid for most of the rice growing areas of Assam. In case of poor soil, fertilizer rates may be increased to the extent of 60:30:30 kg/ha of N, P_2O_5 and K_2O, respectively. Amrit or granular mixed fertilizers could be used with proper adjustment.

Time of application of fertilizers:

Only one third of the total urea, full doses of super phosphate and potash at the time of final puddling are to be applied. The 2nd one third and 3rd one third doses of urea are to be applied at tillering and panicle initiation stages respectively. Top dressing of urea should be preceded by weeding. Super phosphate can also be incorporated into the soil at the active tillering stage (25-35 days after transplanting) along with 2nd dose of nitrogenous fertilizer.

Use of *Azolla* to supplement nitrogenous fertilizer:

Nitrogenous fertilizers can be supplemented by using *azolla*. About 500 kg fresh *azolla*/ha is to be inoculated in the field ponded with 5-10 cm depth of water for about 2-3 weeks prior to final puddling. At the time of inoculation 8-10 kg P_2O_5/ha in the form of SSP is to be applied in the field, and the corresponding quantities of phosphatic fertilizer is to be reduced at the time of transplanting.

Fresh *azolla* @ 500 kg/ha also can be applied in the standing water in transplanted crop after establishment of seedlings. There is no need for application of additional phosphatic fertilizer in the field at the time of inoculation with fresh *azolla* after transplanting when recommended doses of phosphatic fertilizer is applied at the time of transplanting. Thereafter, *azolla* will multiply itself to cover the field. Care should be taken to keep 5-10 cm depth of water for rapid multiplication. Normally, sufficient quantities of biomass will be produced in two weeks and then it should be incorporated into the soil. It is preferable to drain out water before incorporation taking precaution so that azolla is not drained out with water.

Natural depressions and ponds or tanks may be used for *azolla* multiplication outside the main field and can be incorporated at the time of land preparation @ 6 t/ha of fresh *azolla.* Nitrogen dose can even be reduced upto 50% when *azolla* is applied /incorporated in the field.

Nutrient management in rice using Leaf Colour Chart (LCC):

Apply urea as top dressing only when LCC reading is less than 4. If LCC is more than 4 then avoid top dressing to save urea and labour cost. Check LCC from 14 days after transplanting upto flowering at weekly interval.

Time of transplanting:

Transplanting is done by the end of March.

Transplanting:

Transplanting has to be done by putting 2-3 seedlings/hill at a depth of 4- 5 cm. The spacing is 20×15 cm for semi-dwarf and 20×20 cm for tall traditional varieties. A wooden line marker of required spacing may be used for this purpose.

Gap filling:

Replanting of dead hills has to be done within 7-10 days of transplanting.

Water management:

`Apply irrigation at 15 cm depletion of water from soil surface measured in field installed perforated open plastic pipe (15 cm diameter and 30 cm length).

Description of the technology

A practical way to measure irrigation water precisely is by using a 'field water tube' ('Pani Pipe') to monitor the water depth on the field. After irrigation, the water depth will gradually

decrease. When the water level has dropped to about 15 cm below the surface of the soil, irrigation should be applied to re-flood the field to a depth of about 5 cm over surface.

When the field is flooded, check that the water level inside the tube is the same as outside the tube. If it is not the same after a few hours, the holes are probably blocked with compacted soil and the tube needs to be carefully re-installed. The tube should be placed in a readily accessible part of the field close to a bund, so it is easy to monitor the ponded water depth. The location should be representative of the average water depth in the field (i.e. it should not be in a high spot or a low spot).

The field water tube can be made of 30 cm long plastic pipe or bamboo and should have a diameter of 10−15 cm so that the water table is easily visible, and it is easy to remove soil inside. Perforate the tube with many holes on all sides, so that water can flow readily in and out of the tube. Hammer the tube into the soil so that 15 cm protrudes above the soil surface. Take care not to penetrate through the bottom of the plow pan. Remove the soil from inside the tube so that the bottom of the tube is visible.

Interculture:

Two weedings at 20 and 40 days after transplanting are suggested. Alternatively, weeder can be used at the time of top-dressing nitrogenous fertilizer. For chemical control of weeds post-emergence herbicide bispyribac sodium @ 25.0 g a.i./ha should be applied at 2-3 leaf stage of dicot weeds and sedges.

Plant protection:

A. Insect pests: Plant protection measures are to be adopted against insect pests at their Economic Threshold Levels (ETLs) as given in Table 1.

To control rice pests, erect 50 'T'-perches per ha 2 ft (60 cm) above crop canopy as roosting site for insectivorous birds, which are to be removed before flowering in order to prevent activity of granivorous birds

B. Diseases:

(i) Blast : Hexaconazole 5EC @ 2 g/*l* is to be sprayed at tillering stage followed by two sprayings of ediphenphos @ 1 ml/*l* at panicle initiation and when the tip of the panicle just comes out.

(ii) Sheath blight: Two sprayings of hexaconazole @ 2 ml/*l* of water are to be given, the first at appearance of symptoms and the other 10 days after the first spraying.

(iii) **Sheath Rot and Stem Rot:** Spray 2 rounds of tebuconazole 25.9EC @ 1.5 ml/*l* at 15 days interval starting just after appearance of the disease

Table 1. Damage identification, Economic Threshold Levels (ETLs) and chemical control of different insect pests of rice

Crop stage and damage identification	Key pest	ETL	Insecticide (Technical Name)	Conc. (%)	Dose
A. Nursery					
Curling of leaves, leaf blade rolls, yellowish to reddish discolouration	Thrips	Moderate to severe	Imidachloprid 70WG Thiamethoxam 25WG		24.5g *a.i.*/ha 25g *a.i.* /ha
Yellowing and withering of plants	Leaf and plant hoppers	Moderate to severe	Imidachloprid 70WG Thiamethoxam 25 WG		24.5g *a.i.*/ha 25g *a.i* /ha
Presence of dead heart	Stem borer	Moderate to severe	Chlorantraniliprole 20SC Fipronil 5SC		30g *a.i.* /ha 50g *a.i.* /ha
B. Main field (After transplantation)					
Upon unfolding, the edge of the central leaf shows discoloured (yellowish to whitish) patches	Whorl maggot	More than 20% damaged hills upto 30 days after transplanting	Fipronil 5SC		50g *a.i.*/ha
Leaf tissues scrapped in white parallel lines	Hispa	1 adult or 1 damaged leaf/hill	Lambda-cyhalothrin 5 EC Emamectin benzoate 1.9EC	0.035	12.5g *a.i.*/ha 8.08 g a.i./ha
Presence of dead heart	Stem borer	1 egg mass/sq.m or 5% dead hearts	Chlorantraniliprole 18.5 SC Fipronil 5 SC		30g a.i. /ha or @ 150 ml in 500 liter per ha 50g a.i. /ha
Yellowing and withering of plants	Leaf and plant hoppers	10 insects/ hill or 2 insects/ hill in tungro endemic areas	Imidachloprid 70WG Thiamethoxam 25WG		24.5g a.i./ha 25g a.i. /ha
Presence of silver shoots (galls)	Gall midge	1 silver shoot/ sq.m in endemic areas or 5%	Fipronil 5SC Lambda-cyhalothrin EC		50g a.i. /ha 12.5ga.i./ha

		silver shoots in non endemic areas			
C. Active tillering stage					
Presence of tubular case by cutting the tips of the leaves, leaf tissues scrapped in white patches	Case worm	1-2 cases/hill	Chlorantraniliprole 18.5 SC Cartap hydrochloride 50 SC		30g a.i. /ha or @ 150 ml in 500 liter for 1 ha 2 ml/*l*
Leaves are folded along margins by webbing them together	Leaf folder	More than 1 damaged leaf per hill	Chlorantraniliprole 18.5 SC Fipronil 5SC Cartap hydrochloride 50 SC		30g a.i. /ha @ 150 ml in 500 liter for 1 ha 50g a.i. /ha 2 ml/*l*
Presence of silver shoots (galls)	Gall midge	1 silver shoot/sq.m. in endemic areas or 5% silver short in non-endemic areas	Fipronil 5SC Lambda-cyhalothrin 5EC		50g a.i /ha 12.5g a.i./ha
Leaf tissues scrapped in white parallel lines	Hispa	1 adult or 1-2 damaged leaves per hill	Lambda-cyhalothrin 5EC Emamectin benzoate 1.9 EC		12.5g a.i./ha 8.08 g a.i./ha
Presence of dead heart	Stem borer	More than 5% dead heart	Chlorantraniliprole 18.5SC Fipronil 5 SC Cartap hydrochloride 50 SC		30g a.i. /ha 50g a.i. /ha 2 ml/*l*
D. Boot leaf to heading stage					
Presence of partially or completely chaffy grains in the panicle	Rice bug	1-2 bugs/ sq.m	NSKE 1500 ppm	0.5%	3-5 ml/*l*
Presence of white earhead	Stem borer	1 moth/ sq.m.	Chlorantraniliprole 18.5 SC Fipronil 5SC Cartap hydrochloride 50 SC		30g a.i. /ha 50g a.i./ha 2 ml/*l*

Wheat

(*Triticum aestivum*)

Varieties:

Varieties	Year of notification	Duration (days)		Yield (q/ha)		Remarks
		Rainfed	Irrigated	Rainfed	Irrigated	
Sonalika	1967	102-107	115-120	18-20	30-35	-
UP 262	1977	106-111	120-125	19-25	30-35	-
HDR-77	1999	110-115	-	20-22	-	-
DBW-14	2003	-	100-105	-	30-35	Recommended for all zones except B & H, sowing time Nov 5 – Dec 15,tolerant to Leaf blight, Insect attack negligible
HUW-468	1997	-	105-110	-	25-30	Recommended for all zones except B & H, sowing time Nov 5 – Dec 15, tolerant to Leaf blight, Insect attack negligible
HD 2967	2014	-	120-125	-	30-35	Adaptation: CBVZ, LBVZ, NBPZ
DBW 39	2010	-	110-115	-	30-35	Adaptation: CBVZ, LBVZ, NBPZ

Refer to page iii for full forms of the abbreviations

Soil:

Sandy loam to silty loam soils, rich in organic matter are suitable. Clayey soil is not suitable for wheat.

Field preparation:

The land is to be ploughed thoroughly and leveled properly. The first ploughing is done preferably about one month ahead of sowing. Four to five ploughings followed by laddering

are required to obtain a good tilth.

Rotary Tillage with Rotavator and Reduced tillage (2-3 ploughings followed by laddering) can be used profitably for wheat cultivation in rice-wheat system.

In rice-wheat cropping system, zero tillage with the use of Zero-till-cum-seed- cum-fertilizer drill for sowing of wheat is recommended in light textured soil of Central Brahmaputra Valley Zone and Upper Brahmaputra Valley Zone.

Time of sowing:

Zone (Districts)	**Period**
Central Brahmaputra Valley Zone (Nagaon & Morigaon) and Lower Brahmaputra Valley Zone (Kamrup, Borpeta, Bongaigaon, Nalbari, Goalpara, Dhubri & Kokrajhar)	November 5 to December 15
Upper Brahmaputra Valley Zone (Sibsagar, Jorhat, Golaghat, Dibrugarh & Tinsukia) and Hills Zone (Karbi Anglong & N. C. Hills)	November 5 to 30
North Bank Plain Zone (Lakhimpur, Dhemaji, Sonitpur & Darrang)	November 5 to 20

N.B.

i) In Sadia sub-division, middle of October is favourable time for sowing of wheat variety "Sonalika".

ii). The optimum time of sowing of wheat is when the mean temperature of 25°C prevails in the areas.

iii). Growing of wheat after short duration rice is feasible in medium lowland situations. Transplanting rice in mid-July and sowing wheat in late November with full recommended dose of fertilizers for both the crops is necessary.

iv). Early sowing helps in utilizing residual soil moisture and escaping pre-monsoon rains.

Seed treatment:

Seed priming should be done by soaking the seeds overnight before sowing, for faster emergence and uniform crop establishment. Seed treatment should be done with the following fungicides.

Fungicide	**Dose/kg of seed**	**Diseases**
Carboxin	3 g	Loose smut

Seed rate, spacing and method of sowing:

A seed rate of 100-120 kg/ha (13.34-16.0 kg/bigha) is adequate. Row to row distance of 20 cm is to be maintained for optimum plant population. Depth of sowing should be 3-5 cm but not deeper than 5 cm. After sowing the seeds in furrows, laddering should be done along the furrows followed by another laddering across the furrows. This ensures compaction resulting in uniform and quick germination. Seeds can be sown in line by 'Pora' 'Kera' or 'Sirolua' methods.

Surface seeding of wheat is recommended for low land rice-wheat cropping system where excessive soil wetness is the main constraint for taking another crop after harvest of rice in the Central Brahmaputra Valley Zone.

Fertility Management:

Fertilizer is to be applied in furrows at 10 cm deep, mixed and covered by 5 cm of soil. The fertilizer can also be applied by broadcasting before last ploughing and mixed thoroughly with the soil.

Under noted dosages of fertilizers are recommended sub-division wise for irrigated conditions.

District	**Agril. Sub-division**	**Dosages (kg/ha)**		
		N	**P_2O_5**	**K_2O**
Kokrajhar	Kokrajhar	80	46	42
	Sidli	80	46	42
Dhubri	Dhubri	80	46	42
Goalpara	Goalpara	60	34	42
	Mancachar	60	34	42
Kamrup	Guwahati	45	34	42
	Rangia	80	46	42
Nalbari	Nalbari	80	46	42
Barpeta	Barpeta	80	46	42
Sonitpur	Tezpur	80	34	42
Biswanath	Biswanath	80	34	42

Darrang	Mongoldoi	60	34	46
Nagaon	Nagaon	60	45	42
Morigaon	Morigaon	60	35	42
Hojai	Hojai	60	45	42
Sivasagar	Sivasagar	60	45	42
Charaideo	Charaideo	-	-	-
Jorhat	Jorhat	80	46	42
Majuli	Majuli	60	30	20
Golaghat	Golaghat	80	46	42
	Sarupathar	80	46	42
Dibrugarh	Dibrugarh	80	46	30
Tinsukia	Tinsukia	80	34	24
Lakhimpur	Lakhimpur	80	34	12
Karbi Anglong	Karbi Anglong	80	23	36

Under irrigated condition, half of N and the whole quantity of P_2O_5 and K_2O is to be applied as basal and the remaining half of N at CRI stage just before first irrigation.

Under rainfed condition, N-P_2O_5-K_2O @ 40-20-20 is recommended for all the zones.

In absence of SSP, DAP can be applied in proportion to the quantities of N and P_2O_5 suggested above. Granulated mixed fertilizers can be used for basal application only.

On the basis of availability, sufficient quantities of FYM should be incorporated in the soil at the time of field preparation.

In addition to recommended dose of fertilizers, Zinc Sulphate @ 15 kg/ha (2 kg/ bigha) should be applied as basal.

Borax as basal should be applied @ 7.5 kg/ha for Lower Brahmaputra Valley Zone, 10 kg/ha for North Bank Plains Zone and Central Brahmaputra Valley Zone in addition to recommended dose of N-P_2O_5-K_2O fertilizers.

For higher yield of wheat, seed should be treated with *Azotobacter* and PSB (20g each/kg seed), in addition to recommended dose of inorganic fertilizer

Water Management

Irrigation schedule:

In case of dry topsoil, pre-sowing irrigation is to be applied 3-4 days before sowing for quick and uniform germination of seeds.

Two irrigations of 6 cm depth have been recommended for all the agroclimatic zones. The first irrigation has to be applied at the CRI stage (20-25 days after sowing) of the crop and the second one at the heading stage (70-75 days after sowing). Irrigation should be avoided when the ground water table remains within 50 cm of the root zone.

Mulching:

Rice straw mulching with 3 irrigations of 6 cm depth each at CRI stage (20-25 DAS), Booting stage (60-65 DAS) and milk stage (90-95 DAS) increases the grain yield of wheat with higher monetary return in rice wheat system

Weed management:

Weeding is to be done when plants attain 4-5 leaf stage. Post emergence application (30-35 days after sowing) of isoproturon @ 1.00 kg a.i./ha + metsulfuron methy @ l4.00g/ha in 700 liters of water controls weeds effectively. Running twin wheel hoes in between rows once at 20 days after seeding controls weed effectively.

Pre-harvest sprouting management

To prevent pre-harvest sprouting in wheat, spray 7.5% NaCl (Common salt) or 0.015% (150 ppm) sodium molybdate at milk and maturity stage.

Plant protection:

Pesticides/Operation/ Disease	**Dose/ha**	**Conc.(%)**	**Time of application**	**Insect/pests**
Rouguing of affected plants	-	-	As soon as noticed	Loose smut
Thiamethoxam 25 WG	12.5 g a.i./ha or 100g/ha or 0.3g/*l*	-	As soon as noticed	Aphid Cricket, mole cricket, red ant, white ant
Zinc phosphide poison bait	-	Apply in bait stations	Rat	
Bait composition:				
Atta/crushed maize	: 80 g			
Gur	: 10 g			

Dry fish or fried fish	: 5 g			
Zinc phosphide	: 5 g			

N.B.: Micronutrient preparations should be applied as foliar spray when micronutrient deficiency is suspected.

Harvesting:

Wheat is to be harvested during sunny days as soon as it matures. The mature grain produces a cracking sound when passed between teeth.

Storage:

Steps for storage of wheat for seed purpose are as follows:

1. Seeds should be collected from disease free fields.
2. Wet seeds should not be kept for seed purpose.
3. Seeds must be dried for 4 to 6 days or more to bring the moisture content below 12 per cent.
4. Seeds can be preserved in sealed thick polythene bags or in tightly closed metallic containers or '*Juria duli'*. When stored in '*Juria duli'* or metallic bin.
5. Seeds should be examined periodically and if necessary, it should be dried and repacked.

Protection of wheat seeds from insect pests during storage with the following practices:

- Dry the wheat seeds to reduce moisture content up to 11-12%
- Mix black peeper seed powder @ 6 g / kg seed thoroughly
- Store in gunny bags impregnated with polyethene in dry places

Rabi Maize

(*Zea mays*)

Varieties:

Varieties	Duration (days)	Yield (q/ha) under assured irrigation
Hybrids :		
Ganga 101	145-150	50-55
Ganga 5	150-155	55-60
Composites :		
Kishan	150-155	50-55
Vijay	155-160	55-60
Pratap	155-160	40-45

* Specially recommended for flood affected areas in agroclimatic zones U, L, N and B for sowing in the middle of November

In case hybrids are grown, it is advised not to keep seeds from previous year's harvest for sowing in the following years. However, seeds from composite varieties can be kept for sowing in the following year, without appreciable decrease in yield.

Land selection:

Well drained sandy loam soil is to be selected. Field should never be water-logged.

Field preparation:

Field should be ploughed thoroughly to obtain a deep, fine and firm tilth. Laddering should be done properly for leveling as well as to conserve moisture in the soil.

Time of sowing:

The optimum time of sowing of *rabi* maize is middle of September to middle of October. Sowing may be delayed up to middle of November, under exceptional circumstances, but these results in delayed maturity. No sowing should be done after November 15.

Seed treatment:

Seeds are to be treated with carboxin @ 2 g/kg seeds. Seeds procured from NSC are usually pretreated.

Seed rate, spacing and method of sowing:

A seed rate of 22.5 kg/ha (3 kg/bigha) is required for line sowing. Seeds are to be dibbled in lines at a spacing of 60 cm × 25 cm to maintain a plant population of around 60,000 to 65,000/ha. A seeding depth of 3 cm is optimum for quicker germination.

Fertility management:

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
N	60*- 80**	Urea	130-175	18-24
P_2O_5	40	SSP	250	33
K_2O	40	MOP	65	8

* For short duration varieties, ** For long duration varieties

FYM @ 4.5 t/ha (6 q/bigha) should be applied at the time of field preparation. Whole of P_2O_5 and K_2O and half of N are to be applied in the furrows before sowing. The remaining quantity of N is to be top dressed at 30 days after emergence of seedlings. Where irrigation facilities are available, N should be applied in 3 split doses, one fourth, half and one fourth at sowing, 30 days after seedling emergence (knee-high stage) and at the time of silking respectively. Placement of fertilizer is more effective than broadcasting.

Interculture:

Light hoeing is to be given as and when necessary for better control of weeds. Metribuzin 500 should be applied @ 0.5-1.0 kg a.i./ha in 1000 liters of water as pre-emergence spray.

Plant protection:

A). Insect pests:

i). **Stem borer**: The dead hearts should be pulled out and destroyed to kill the lingering stage of the pest in the stubbles.

ii). **Aphids, cob borers, jassids and mites**: Thiamethoxam 70 WS @ 1.75 g/kg of seed can be used as seed dresser at the time of sowing against shoot fly and aphids.

B). Diseases:

i. **Maydis leaf blight**: Use of protective fungicides of hexaconazole @ 2ml/*l* at the time of appearance of the disease symptoms or at knee-high stages.

ii. ***Turcicum* leaf blight (also known as southern corn blight)**: The disease can be controlled by 2-3 foliar sprays with hexaconazole @ 2 ml/*l* at 10-15 days interval.

Application of urea followed by a light irrigation also helps to minimize the disease as it sometimes becomes serious due to poor management.

iii. **Seed rot and seedling blight**: The best recourse to these problems is to sow certified seeds from a reliable source, which is pretreated with desired fungicides. If one wants to use his own seed, seed treatment is a must.

iv. **Pythium stalk rot:** Apply carboxin 2.5 kg/100 liters of water/ha at the lower internodes of plants 30-35 days after planting. Drain out excess rainwater from the field.

v. **Charcoal rot**: Sow resistant cultivars e.g. Diara, Hinius, etc.

vi. **Banded sclerotial disease**: In areas where this disease is noticed the plant should be sprayed with hexaconazole @ 2ml/*l* at an interval of 12-15 days.

C). Bird damage:

Maize cobs can be protected from granivorous birds by wrapping the cobs with adjacent leaves of the same plant at vulnerable grain maturity stage in outer 3 border rows. Also, erect Shining Reflective Ribbon Stripes 1 feet above the crop canopy in North-South direction with twisting to reflect the sunlight for better protection.

Irrigation:

Irrigation is needed at grand growth period, and tasseling and grain setting stages of the crop, which will vary according to duration of varieties as mentioned below:

Irrigation No.	Stage of crop	Short duration variety	Medium duration variety	Long duration variety
1st	Grand growth period	35-40 DAS	-	45-50 DAS
2nd	Tasseling	55-60 DAS	-	70-75 DAS
3rd	Grain setting stage	85-95 DAS	100-115 DAS	110-115 DAS

Excess irrigation should be avoided as maize cannot withstand waterlogging.

Intercropping:

Maize should be sown in paired rows of 50 cm between pair and 70 cm gap is to be given between two pairs. Two rows of black gram should be sown in-between two pairs of maize along with residue retention as mulch.

Harvesting:

Cobs are harvested when the husk cover turns pale yellow. This does not necessarily coincide with complete drying of the plant, and therefore, one should not wait till the plant becomes bone dry. It should not be harvested immediately after a shower. The harvested ears

should be sun-dried before shelling. Grains should again be dried after shelling and stored in gunny bags.

Use of Maize:

Maize or corn flour is used as *atta* by mixing with wheat flour. Mixed with soybean flour, it makes good *atta* for making *chapatti*. Corn flakes are delicious diet for men of all ages. Corn flour can also be made into a good *halwa*. Crushed grains are nutritious feed for cattle, poultry and fish. Stovers are also used as cattle-feed by making pieces with a chaffcutter. Maize starch is used by modern industries for manufacture of various fabrics. Corn (maize) oil is an important cooking medium.

Baby corn

(*Zea mays* L)

***Zones**:* All Zones

Variety: G-5414, G-5411, HM-4 and Golden Baby

Land Preparation: Field should be ploughed thoroughly to obtain a deep, fine and firm tilth.

Seed Rate: 20 - 25 kg /ha (2.66 - 3.33 kg/bigha) Seed

Seed Treatment: Carboxin @ 2g/kg of seed

Sowing Time: Middle of October to middle of November (as *Rabi*)

Spacing: 45 cm x 20 cm

Fertilizer and Manure: FYM @ 5t/ha

Nutrients	**Requirement (kg/ha)**	**Source**	**Fertilizer requirement**	
			kg/ha	**kg/bigha**
N	120	Urea	260	35
P_2O_5	60	SSP	375	50
K_2O	60	MOP	100	13.3
$ZnSO_4$ Heptahydrate			22.5	3

Weeding and Interculture:

Light hoeing and earthing up should be done as and when necessary

Detasseling:

It is essential operations; it is done by removing the tassel of the plant as soon as it emerges from the flag leaf and before it starts shedding pollen grains.

Harvesting:

Harvesting of baby corn will be ready when corn silk comes out 2-4 cm from the top of ears, usually in 3-5 days after their emergence. Maximum 4-5 times harvesting of cob is possible from a single plant depending upon plant health.

Storing:

To be stored at 0-5°C to maintain the high quality of the product. It is better to transport with frozen containers when exported.

Cob Yield: 7-9 t/ha (with husk); 2-3 t/ha (without husk)

Green fodder yield: 30 -33 t/ha

Sweet Corn

(*Zea mays* L. *Saccharata*)

***Zones**:* All Zones

Varieties:

Varieties	Year of notification	Duration (Days)	Green cob yield (t/ha) (Dehusked)	Special Characters
Sugar-75		78-85	16-20	Vigorous plant growth with 5-6 feet height, Kernel colour: Golden yellow, Sugar: 15-16 Brix
Hy-brix 53 (ADVSW-2)	2017		13.7	-
CANDY (KSCH-333)	2015		11.9	-
NSCH-12 (mISTHI)	2013	75-85	14.94	-
VL Sweet Corn-1 (FSCH18)	2016	75-85	13.7	Sturdy plant with medium height; yellow dent flat
VL Sweet Corn-1	2019	72-75	9.5-10.3	Sturdy plant with medium height; yellow grains; TSS: 14.5-15.3%

Soil Type : Sandy loam soils are preferable

Land Preparation : Field should be ploughed thoroughly to obtain a deep, fine and firm tilth

Time of sowing : The optimum time of sowing of Sweet corn is middle of October to middle of November

Field Preparation : The land should be ploughed 4-6 times followed by laddering to obtain a deep, fine and firm tilth

Seed rate : 6 - 8 kg/ha (800 – 1067 g/bigha)

Seed Treatment : Treat the seeds with Carboxin @ 2 gm/kg of seed before sowing

Spacing : For line sowing Seeds are to be dibbed in line at a spacing of 50 cm x 20 cm to maintain a plant population of around 1,00,000/ha

Weeding and Interculture: Light hoeing and earthing up should be done within 25-30 DAS

Irrigation : Irrigation should be applied at knee high stage and flowering / tasseling stage

Fertilizer and Manure:

Nutrients	**Requirement (kg/ha)**	**Source**	**Fertilizer requirement**	
			kg/ha	**kg/bigha**
N	123	Urea	260	35
P_2O_5	60	SSP	375	50
K_2O	50	MOP	84	11
$ZnSO_4$ Monohydrate		Fertilizer Grade	22.5	3

FYM @ 5 t/ha (667 kg/bigha) should be applied at the time of field preparation. Whole P_2O_5, K_2O, $ZnSO_4$ and half of N are to be applied in the furrow before sowing. The remaining quantity of N should be top dressed in 2 split doses, one half during earthing up (25-30 DAS) and second half during silking stage. Furrow application of fertilizer is more effective than broadcasting.

Harvesting : Harvest when corn attain in milk stage just after 25-30 days after cob filling

Green Cob Yield: 25-30 t/ha

Green fodder: 30 -35 t green fodders can be harvested form one hectare of land

B:C Ratio : 4.44-5.65

Buckwheat (*Dhemchi*)

(*Fagopyrum esculentum* L.
syn. *Polygontum fagopyrum*)

Variety: Local

Duration: 90-110 days

Soil type: Sandy loam

Land preparation:

The land should be ploughed thoroughly and leveled properly. Four to five ploughings followed by laddering are sufficient to obtain a good tilth. The first ploughing should be done preferably about one month ahead of sowing.

Time of sowing:

Sept-Oct for Upper Brahmaputra Valley Zone and Oct-Mid Nov. for Lower Brahmaputra Valley Zone

Seed rate: 20 kg/ha (2.7 kg/bigha)

Spacing: 30 cm between rows

Method of sowing:

Furrows of about 5 cm depth are to be prepared at a distance of 30 cm. Seeds are to be sown in the furrows preferably at 3-5 cm depth but not deeper than 5 cm. Then laddering is to be done along the furrows which will cover the seeds with soil and ensure soil compaction resulting in uniform and quick germination.

Fertilizer management:

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
N	20	Urea	44	6
P_2O_5	10	SSP	63	9
K_2O	10	MOP	15	2

All the fertilizers are to be applied by thoroughly mixed with soil, preferably one day before sowing.

Weed control:

Weeding should be done before the weed plants attain 4-5 leaf stage. Dryland weeder may effectively be used.

Plant protraction:

A). Insect pests:

i). Aphid: When the aphid attack is heavy, imidacloprid 17.8SL @ 20.0 g a.i./ha or 0.3 ml / *l* may be applied.

Spray solution requirement for hand sprayer and power sprayer are 500-700 liter/ ha (65-90 liter/bigha) and 200-250 liter/ha (25-30 liter/bigha) respectively.

Bee pollination:

For enhancing yield through increased pollination, 5-6 numbers of honeybee colonies/ ha should be installed.

Harvesting:

Harvesting should be done when the grains turn blackish and ears are dry. After harvesting, the plants are to be kept in the field for 2-3 days for sun drying. Threshing is done by treading with bullocks or beating the plants with sticks.

Average yield: 12-15 q/ha

Uses:

After threshing, the grains are to be dehusked in *dhenki*, a locally used dehusking device. The dehusked grains are pure white and flour is made out of the grains. The flour is used to make *chapattis*. Sometimes it is mixed with wheat and barley flour. The tender green plants are used as green vegetables and the straw of plants are used for cattle feed. The dried plants can be used as firewood.

Foxtail Millet (*Cawn*)

(*Setaria italica*)

Variety: Local (yellow grain type)

Duration: 100-120 days

Soil type: Silt loam to Sandy loam

Field preparation:

The field should be prepared thoroughly by giving 4-6 ploughings followed by one laddering to obtain a fine tilth.

Time of sowing:

Middle of January to middle of February (the best time is last week of January).

Seed rate:

Seed rate is 8-10 kg/ha, which may be increased to 15 kg/ha under broadcast sowing.

Spacing: 25 cm between rows.

Method of sowing:

Furrows of 5 cm depth are to be prepared at 25 cm apart. Seeds are to be placed in the furrow preferably at 3-5 cm depth but not below 5 cm depth. Laddering should be done along the furrows to cover the seeds with a soil layer of about 3-5 cm. Laddering also ensures compaction of soil which results in uniform and quick germination.

Fertilizer:

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
N	20	Urea	44	6
P_2O_5	10	SSP	63	9
K_2O	10	MOP	17	2

Full doses of inorganic fertilizer are to be applied in soil preferably one day before sowing. The fertilizer should be thoroughly mixed with soil.

Weed control:

Weeding should be done manually before the weed plants attain 4-5 leaf stage. Dry land weeder may effectively be used in case of line sowing.

Plant protection:

A). Insect pests:

i). Gundhi bug: When the attack of gundhi bug is observed in the field, neem seed kernel extract (NSKE) 1500 ppm @ 3-5 ml/*l* may be applied for its effective control.

Harvesting:

Harvesting should be done when the millet panicles turn yellowish.

Threshing:

Immediately after harvest, threshing is to be done by treading with bullocks or by foot.

Uses:

The grains are to be dehusked with *'dhenki'*, a locally used dehusking device. The dehusked grains can be cooked like rice. It makes good porridge. It is also used in making flour and '*laddus*'. The straw can be used as cattle feed.

Average yield: 12 q/ha.

FORAGE CROPS

Oats

(*Avena sativa*)

Varieties:

Varieties	GFY	DMY	Adaptation	Disease & pest reaction	Crude protein	Crude fibre	Ash
Kent	483	96.6	*Rabi* season	Resistant to rust & blight disease, Lodging resistant	9.98-12.44 %	31-34%	1.78-1.94 %
Phule Hariata (RO-19)	320-340 q/ha	50-60 q/ha	*Rabi* season	Resistant to Anthracnose, Crown rust, Loose smut, Powdery mildew, Barley yellow dwarf virus, Army Worms, Stinkbugs, Wireworms, Aphids	12.5-14.5%	30-35%	-
JHO-99-2 (Multi cut purpose)	320-340 q/ha	50 - 60 q/ha	*Rabi* season	Resistant to diseases - PM, anthracnose, CR, LS & bean yellow dwarf virus; resistance to insect pests armyworm, sting bug, wireworm & aphids.	12.5-14.5%	32-35%	1.9-2.1%

Soil: Well drained silty loam, sandy loam soils are suitable. In such soils it can be grown after *sali* paddy.

Field Preparation : Oats need fine compact seedbed.

Time of Sowing : Mid-October to December

Seed Rate : 100 kg/ha. (13-14 kg/bigha)

Spacing: Seeds are to be sown in rows 25-30 cm apart in furrows at a depth of 4-5 cm

Fertility Management:

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
N	40	Urea	88	12
P_2O_5	20	SSP	125	17
K_2O	20	MOP	33	4

Application of 54 kg urea, 125 kg SSP and 33 kg MOP per hectare as basal dose and 34 kg urea after first cutting (60-70 days after sowing) as top dressing is essential. 50% recommended dose of fertilizer + vermicompost @ 2.5 t/ha + FYM @ 2.5t/ha should be applied if oat is grown in fodder-based cropping sequence.

Irrigation:

Oats can be grown successfully as rainfed crops. If the soil is dry, first irrigation is to be applied immediately after sowing, second at maximum tillering (45 days after sowing) and third immediately after the first cutting.

Interculture: One weeding is necessary 3 to 4 weeks after sowing.

Cutting:

First cutting is to be done at 60-70 days after sowing, and second cutting at 50% flowering. The crop should be cut at a height of 8 to 10 cm from the ground level.

Seed Production:

Oats seeds can be obtained by allowing the crop for seed setting after the first cutting. One fifth of a hectare produces seeds sufficient for sowing one hectare.

Special practices for cultivating of oats after *sali* rice:

- Cutting of rice stubbles at ground level.
- Application of minimum tillage with one cross ploughing.
- Application of recommended dose of fertilizer @ 20-20-20 :: N-P_2O_5-K_2O kg/ha
- Seed inoculation with *Azospirillum* @ 40 g/kg seed and PSB @ 40 g/kg seed.
- Sowing of seeds behind the plough with row spacing 25 cm
- Top dressing N @ 20 kg/ha after the first cut at 50 DAS.

Lucerne

(*Medicago sativa*)

Varieties:

Varieties	Duration (days)	Green forage (q/ha)	Dry forage (q/ha)	No. of cuttings
LL-Comp 5	75	298	49.66	1
T 9	75	280	42.42	1

Spacing: Rows 25 cm apart

Seed Rate: 20 kg/ha

Time of Sowing: October to November

Fertilizer management:

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
N	25	Urea	56	7.5
P_2O_5	87	SSP	539	17
K_2O	40	MOP	66	4

Irrigation:

Two to three irrigations are necessary at weekly intervals for establishment of the crops and subsequent irrigations depend upon soil moisture status.

Cutting Details:

a) **Numbers of cutting**: As many cutting as possible

b) **Time of cutting**: First cutting is to be done at 55 to 60 days after sowing and subsequent cuttings at an interval of 30 to 35 days.

Subabul

(*Leucaena leucocephala*)

Varieties:

Varieties	Spacing	Green forage stem & leaves (q/ha)	Green leaves (q/ha)	Dry leaves (q/ha)
Hawain	1 m x 20 cm	850.00	83.33	51.41
Common	1 m x 30 cm	1128.83	162.50	87.07

Seed Rate: 3 to 4 kg/ha

Seed Treatment: Dipping seeds in boiling water at 80°C for proper germination is necessary.

Fertilizer and manure: FYM @ 3 t/ha or 4 q/bigha

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
N	20	Urea	45	6
P_2O_5	50	SSP	310	42
K_2O	0	MOP	0	0

Time of Sowing: March to September

Cutting Management:

First cutting should be taken at 50 days after sowing, leaving 60 cm stubble height; and 2nd and 3rd cuttings at 40 days interval with stubble heights of 75 cm and 90 cm respectively. Rest of the cuttings will also be taken at 40 days interval with 90 cm stubble height

Rye grass

(*Lolium* sp.)

Adaptation: All agroclimatic Zones

Variety: PRG-1, Makhan grass

Land preparation:

One primary tillage followed by 2-3 harrowing. Land should be leveled properly and free from stubbles.

Sowing Time: November to Mid-December

Seed Rate: 15 - 20 kg/ha

Method of Sowing: Line sowing/ broadcasting. If sown in line sow at 30 cm spacing.

Fertilizer management: Apply FYM @ 5 t/ha in addition to the following fertilizer dose

Nutrients	**Requirement (kg/ha)**	**Source**	**Fertilizer requirement**	
			kg/ha	**kg/bigha**
N	60	Urea	130	17
P_2O_5	30	SSP	188	25
K_2O	30	MOP	50	7

1/3rd N and full dose of P and K should be applied as basal. Top dressing N @ 20kg /ha after each cut

Irrigation:

Three most important stages of irrigation are:

1. At sowing time
2. 35 days after sowing or at maximum tillering period
3. Immediately after the first cut and subsequent cut

Number of Cuttings:

1st cut at 50-60 days after sowing (DAS)

2nd cut at 80-90 DAS and third cut at 30-35 days after second cut

The crop should be cut at a height of 5-6 cm. above the ground at first cut and second cut.

Green Fodder Yield: 350-400 q/ha (Total of 3 cuts).

PULSES

Summer black gram

(*Vigna mungo* L.)

Varieties:

Varieties	Year of notification	Duration (days)	Days to first picking	Grain yield (q/ha)	Reaction to diseases
Pant U 19	1996	75-85	65-70	10-12	Tolerant to YMV and *Cercospora* leaf spot
SBC 40	-	75-85	65-70	10-12	Resistant to YMV and *Cercospora* leaf spot

Time of Sowing:

The optimum time for sowing summer black gram is from mid-February to March

Soil Type:

Black gram can be grown on a wide range of soils, but sandy loam soil is preferable.

Field Preparation:

The land is to be ploughed 2-3 times followed by leveling.

Fertility Management:

Application of FYM or compost @ 4-5 t/ha or 6 q/bigha not only adds fertility but also improves soil structure.

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
A. Without Rhizobium culture				
N	15	Urea	32	4.5
P_2O_5	35	SSP	220	30
K_2O	15	MOP	25	3.5
B. With Rhizobium Culture :				
N	10	Urea	22	3
P_2O_5	35	SSP	220	30
K_2O	15	MOP	25	3.5

Diammonium phosphate (DAP) @ 75 kg/ha or 10 kg/bigha can be applied in lieu of urea and SSP in non-inoculated crop. N-P_2O_5-K_2O may also be supplied in the form of mixed fertilizers.

Application of Lime:

$CaCO_3$ in the form of dolomitic lime @ 65.5 kg/bigha should be applied 15 days before seeding and incorporate in the soil in area where multiple cropping is practiced.

Seeds are to be moistened carefully with clean water so as to avoid excessive wetting. Rhizobium culture is to be mixed with seeds @ 50 g/kg so that a thin layer of inoculum is deposited on the seed coat. Treated seeds are to be dried under shade. Inoculated seeds should not be exposed to sun.

Seed Rate:

Line sowing : 22.5 kg/ha (3.0 kg/bigha)

Spacing:

Row to row : 30 cm

Plant to plant : 10 cm

Interculture:

One weeding at 20 – 25 days after sowing is to be done.

Plant Protection

Disease/ Insect pest	**Fungicide/ Pesticide**	**Dose**	**Conc. (%)**	**Spraying interval**
A. Diseases:				
Leaf spot	Cu-oxychloride	1.8-2.0 kg in 600-700 liter of water	0.3	7-10 days
Blight	Hexaconazole	1.2-1.4 *l*/ha in 600-700 liter of water	0.2	12-15 days
Powdery mildew	Wettable sulphur	1-1.4 kg/ha in 500-700 liters of water	0.2	As soon as disease appears
B. Insect pests :				
Aphids & Jassids	Lamda-cyhalothrin 5EC	150-250 ml/ha	-	-
Pod borer	Chlorantraniliprole 18.5 SC	20 g a.i./ha	-	-

Harvesting:

Harvesting is to be started when pods mature indicating full darkish colour and brittle on slight pressure. Harvesting should be completed in 2 to 3 pickings.

Protection against storage pests:

Properly dried seeds of black gram should be mixed thoroughly with black pepper seed powder @ 3 g/kg of seed for protection against bruchid infestation during storage. Treated seeds should be kept in polybags with outer covering of gunny bags.

Summer green gram

(*Vigna radiata* L.)

Varieties:

Varieties	Year of notification	Duration (days)	Grain yield (q/ha)	Days of 1st picking	Reaction to diseases
K 851	-	70-75	10-12	60-65	Tolerant to YMV and *Cercospora* leaf spot
Pratap (SG-1)	1999	65-75	10-14	-do-	Tolerant to *Cercospora* leaf spot & susceptible to YMV

Soil:

Well drained sandy loam soil is preferable.

Field Preparation:

Field is to be ploughed 2-3 times followed by leveling. Surface drains are to be provided to facilitate quick removal of excess water from the field.

Time of Sowing:

The optimum time of sowing is from mid-February to mid-March.

Fertility Management: Same as in black gram

Soil application of 0.4 % (w/w) biochar (80 kg/bigha) produced from weed biomass or crop residue along with RDF

FERTILIZER RECOMMENDATIONS AS PER FERTILIZER PRESCRIPTION EQUATIONS (FPE)

Fertilizer prescription equations can be used to find out the amount of NPK fertilizers required to obtain a certain yield target of the crop based on soil test values for NPK. The FPEs can be used under cultivation practices where only chemical fertilizers are used and where chemical fertilizers + FYM/Vermicompost/Enriched compost etc. are applied. The FPEs are valid for different varieties of the same crop having not more than 15% variations in yield. The amount of NPK fertilizers will vary according to yield target and soil test values. Yield target must not cross the potential yield of a particular crop.

Only Chemical Fertilizers

FN =11.37 x T - 0.62 x STVN

FP =3.82 x T - 0.22 x STVP

FK =12.81 x T - 1.29 x STVK

Chemical Fertilizers + FYM

FN =11.37 x T - 0.62 x STVN - 0.13 x OM

FP =3.82 x T - 0.22 x STVP - 0.17 x OM

FK =12.81 x T - 1.29 x STVK - 0.2 x OM

where, FN, FP, FK-Fertilizer N, P_2O_5, K_2O; STVN, STVP, STVK-Soil Test Values for N, P_2O_5, K_2O, T-Targeted yield, OM- Organic component (FYM, Vermicompost, Enriched Compost etc).

*Seeds should be inoculated with 150 g of Rhizobium culture/3-4 kg of seeds.

Ready Reckoners for two yield targets for this equation are given in Appendix-IIIa & IIIb.

Application of Lime:

$CaCO_3$ in the form of dolomitic lime @ 65.5 kg/bigha should be applied 15 days before seeding and incorporate in the soil in areas where multiple cropping is practiced.

Seed inoculation:

For inoculation with Rhizobium culture, either Majuli 19 or any other suitable strains may be used. Seeds are inoculated @ 50 g/kg of seeds. Detailed instructions are available in each packet of culture (for details of procedure for seed inoculation, refer to black gram). Also inoculate seeds with PSB @ 50 g/kg seed.

Seed rate: 22.5 kg/ha or 3 kg/bigha

Spacing:

Row to row: 30 cm

Plant to plant: 10 cm

Interculture:

One weeding is to be done at 20-25 days after sowing.

Plant Protection: Same as in black gram

i) Spraying of spiromesifen 22.9 SC @ 1.25 ml/liter of water at vegetative and reproductive stages of mung bean is effective against sucking pests.

Harvesting:

Harvesting is to be done when 75% of the pods turn darkish in colour and splits on pressure. Harvesting should be completed in 2-3 pickings.

Protection against storage pests:

Properly dried seeds of green gram should be mixed thoroughly with black pepper seed powder @ 3g/kg of seed for protection against bruchid infestation during storage. Treated seeds should be kept in polybags with outer covering of gunny bags.

Lentil

(*Lens culinaris*)

Varieties:

Varieties	Year of notification	Duration (days)	Yield (q/ha)	Disease reaction	Protein content (%)	Zone for which recommended	Adaptation
Pant L 406 (Medium seeded branched semi spreading variety)	1980	120-125	10-12	-	-	All zones	Pant L 406 (Medium seeded branched semi spreading variety)
HUL 57 (Small Seeded Lentil Variety)	2005	112-115	12-14	Resistant to rust & tolerant to wilt	24.50	CBVZ, LBVZ & UBVZ	*Rabi* season
Axom Masur 1 (SL 2-24)	-	115-120	12-14	Moderately resistant to wilt	27.60	All zones except BVZ	*Rabi* season
Axom Masur 2 (SL 2-28)	-	115-120	12-14	Moderately resistant to wilt	26.90	All zones except BVZ	*Rabi* season
PL 9	2017	115-135	13-14	Resistant to *Aschophyta* blight and rust and moderately resistant to wilt	26.00	CBVZ, LBVZ, UBVZ and NBPZ	*Rabi* Season

Soil type: Loam or silty loam is preferable.

Time of Sowing: Mid-October to mid-November.

Field Preparation: The field is to be ploughed 3-4 times to obtain a good tilth.

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
A. Without Rhizobium culture				
N	15	Urea	32	4.5
P_2O_5	35	SSP	220	30
K_2O	15	MOP	25	3.3
B. With Rhizobium Culture :				
N	10	Urea	22	3
P_2O_5	35	SSP	220	30
K_2O	15	MOP	25	3.3

Fertility Management:

In both the cases vermicompost @ 1 t/ha or FYM @ 2 t/ha as basal.

Diammonium phosphate (DAP) @ 75 kg/ha or 10 kg/bigha is to be applied in lieu of urea and SSP in non-inoculated crop. N-P_2O_5-K_2O may also be supplied in the form of mixed fertilizer.

Foliar spray of 2% urea at branching (35 DAS) and pod formation (75 DAS) stages in addition to the recommended dose of P & K. In addition to fertilizer dose of 10-26-15 N-P_2O_5-K_2O kg/ha, Ammonium molybdate 0.5 kg/ha (67 g/bigha) and 20 kg $ZnSO_4$/ha (2.7 kg/bigha) should be applied to soil.

Seed should be inoculated with Rhizobium and PSB and ZSB each @ 50 g/kg of seed along with basal application of 15 kg $ZnSO_4.7H_2O$/ha (2 kg/bigha)

Application of Lime:

$CaCO_3$ in the form of dolomitic lime @ 65.5 kg/bigha should be applied 15 days before seeding and incorporate in the soil in areas where multiple cropping is practiced.

Seed priming: Soak the seeds for 6 hrs and dry under shade to bring it back to almost the original weight.

Seed Inoculation with Rhizobium Culture:

Seeds are to be moistened with clean water avoiding excess wetting and *Rhizobium* culture @ 50 g/kg of seeds and PSB @ 50 g/kg seed are to be inoculated.

Seed Rate: The optimum seed rate is 30 kg/ha or 4 kg/bigha.

Conservation agriculture practice

In zero-tilled lentil after rice, broadcast seeds @ 45 kg/ha or 6 kg/*bigha* immediately after harvest in moist loamy soil keeping 30 cm high rice stubbles. Sowing should be completed within November. Seed should be inoculated with Rhizobium (50g/kg seed) + Sodium molybdate (1 g/kg). Apply 75% N (11.25 kg/ha or 1.5 kg/bigha) along with 100% P_2O_5 (35 kg/ha or 4.7 kg/bigha) and 100% K_2O (15 kg/ha or 2 kg/bigha) at the time of sowing. Under rice utera condition, 45 kg/ha or 6 kg/bigha seed rate should be used. Lentil variety HUL 57 and KLS 218 may be used for rice utera condition.

Under rice utera condition, 5-13-0 N-P_2O_5-K_2O kg/ha (incubating with 10 parts soil for two days) should be applied at the time of sowing. After the harvest of rice, 5-13- 15 N-P_2O_5-K_2O kg/ha (incubating with 10 parts soil for two days) should be top dressed. Seed should be inoculated with *Rhizobium* and PSB each @ 50 g/kg seed. At branching and pod initiation, 2% urea should be sprayed.

Nutrients	**Requirement (kg/ha)**		**Source**	**Fertilizer requirement**			
				At sowing		**After Harvest**	
	At sowing	**After rice Harvest**		**kg/ha**	**kg/bigha**	**kg/ha**	**kg/bigha**
N	5	5	Urea	11	1.5	11	1.5
P_2O_5	13	13	SSP	81	11	81	11
K_2O	0	15	MOP	0	0	25	3.3

Spacing:

The seeds are to be sown in line at a spacing of 25 cm between rows and 5-7 cm from seed to seed.

Interculture:

Two weedings at 20 and 30 DAS or apply oxfluorofen @ 150 g./ha as pre-emergence followed by 1 hand weeding at 20 DAS.

Irrigation:

If necessary and available, one light irrigation is to be given during pod filling stage.

Plant Protection:

Disease	**Fungicide/other measures**	**Dose/ concentration**	**Mode of application**
Rust	Tebuconazole 25 EC Or	0.1% (600-700 ml mixed with 600-700 liter water/ha) (80-90 ml/80-90 liter water/bigha) 0.2% (1200-1400	Three foliar sprays just after the application of appearance of disease at 10 days interval.
	Propiconazole Or	0.2% (1200-1400 ml mixed with 600-700 liter water/ha) (160-185 ml/80-90 liter water /bigha)	
	Hexaconazole	0.2% (1200-1400 ml mixed with 600-700 liter water/ha) (160-185 ml/80-90 liter water /bigha)	
Wilt	Carboxin	2 g/kg of seed	Seed treatment
Wet rot or white blight	Infected plants are to be collected along with sclerotia & burnt. The following spray schedule may also be adopted		
	Hexaconazole	0.2% (1200-1400 ml mixed with 600-700 liter water/ha) (160-185 ml/80-90 liter water /bigha)	Foliar spray

Spray azoxystrobin 23 SC @ 1 ml/*l* at initiation of the disease and two more sprays at 15 days interval for management of *Stemphylium* blight of lentil.

Protection against storage pests:

Properly dried seeds of lentil should be mixed thoroughly with black pepper seed powder @ 3g/kg of seed for protection against bruchid infestation during storage. Treated seeds should be kept in poly bags with outer covering of gunny bags.

Harvesting:

Harvesting should be done when 70-80 % pods turn yellow to brownish in colour.

Average yield: 12.0 q/ha

Pea

(*Pisum sativum* L)

Varieties:

Varieties	Year of notification	Sowing time	Duration (days)	Yield (q/ha)	Agroclimatic zone	Pest reaction
Rachna	1980	October	120-125	10-12	All Zones	Tolerant to powdery mildew, Tall (135-138 cm)
FP-255 (Pant-14)	2004	October	108	11.49	Hill Zone	Moderately resistant to rust
AAU SHN Motor 01 (Xeuti)	2023	October	105-107	14-15	All Zones of Assam	Resistant to powdery mildew and tolerant to rust disease. Moderately resistant to pod borer, aphids and leaf minor under field conditions

Soil Type:

Peas can be grown on a variety of soils. Well drained light soils are suitable.

Liming:

After soil test to bring pH around 6.0, requisite quantity of lime is to be applied at least 21 days before sowing.

Time of Sowing:

The optimum time of sowing is mid-October to mid-November

Field Preparation:

Peas generally require reasonably deeply worked soils. The field is to be ploughed 3 to 4 times to obtain a good tilth.

Seed Rate:

60 kg/ha or 10 kg/bigha. In riverine tracts, recommended seed rate is 4-6 kg/bigha

Relay Cropping of Pea:

Pea seeds at 25-50% higher seed rate are to be broadcast in the standing crop of rice about 15-20 days before harvest provided the soil is in moist condition.

In rice + pea relay cropping, seeding of pea at 20 days after 50% flowering of rice with a seeding rate of 90 kg/ha is recommended in medium *sali* land for Hills zone. Pea seeds are to be soaked overnight before sowing.

Seed Treatment:

Seed treatment with carboxin @ 2 g/kg of seed is recommended.

Spacing:

The seeds are to be sown in lines at a spacing of 30 cm between rows and 10 cm between plants.

Fertility Management:

Compost or FYM @ 4-5 t/ha or 6 q/bigha should be applied.

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
A. Without Rhizobium culture				
N	20	Urea	45	6
P_2O_5	46	SSP	287	38
K_2O	15	MOP	25	3
B. With Rhizobium culture				
N	10	Urea	22	3
P_2O_5	46	SSP	287	38
K_2O	15	MOP	25	3

Apply all the fertilizers i.e. urea, SSP and MOP as basal followed by foliar spray of 0.5% N-P_2O_5-K_2O (19-19-19) at pre-flowering and pod initiation stages

In North Bank Plains Zones, 10 kg Borax/ha is also recommended.

Diammonium phosphate (DAP) @ 100 kg/ha or 13 kg/bigha should be applied in lieu of urea and SSP in non-inoculated crop. N-P_2O_5-K_2O may also be supplied in the form of mixed fertilizers.

Nutrient Management in Relay Cropping of Pea:

Seeds should be inoculated with *Rhizobium* - PSB consortium @ 50 g /kg + sodium molybdate @ 0.5 g/kg seed, and spray 0.5% N-P_2O_5-K_2O (19-19-19) at branching and 15 days after first spray.

Application of lime:

$CaCO_3$ in the form of dolomitic lime @ 65.5 kg/bigha should be applied 15 days before seeding and incorporate in the soil in areas where multiple cropping is practiced.

Weed Control:

Fluchloralin 45 EC @ 1.5 kg a.i./ha as pre-emergence spray one day before sowing be incorporated in the soil with light hoeing.

Suitable *Rhizobium* Culture: PAU and IARI or any other suitable strains can be used.

Irrigation: If required and available, one irrigation should be given at 40-50 days of sowing.

Plant Protection:

A). Insect Pests

To control cutworm (*Agrotis ipsilon*) in field pea, apply rice stubbles @ 3.5 t/ha (2 cm thick) as mulch just after sowing.

Spray chlorantraniliprole 18.5 SC @ 0.3 ml/*l* at reproductive stage for effective management of pod borers (*Etiella zinckenella* and *Helicoverpa armigera*) in field pea.

B). Disease:

Disease	**Fungicide**	**Dose/ha**	**Conc. (%)**	**Mode of application**
Wilt	Carboxin	2 g/kg of seeds	-	Seed treatment
Rust	Tebuconazole or Propiconazole	2 g/*l*	0.2	10 days interval starting from the appearance of disease
Powdery mildew	Wettable sulphur	2.5 to 3.5 kg in 500-700 ml in 500-700 liter of water	0.5	-do-

Harvesting:

Harvesting should be done when 75-80% of the pods turn yellow.

Protection against storage pests:

Properly dried seeds of pea should be mixed thoroughly with black pepper seed powder @ 3g/kg of seed for protection against bruchid infestation during storage. Treated seeds should be kept in poly bags with outer covering of gunny bags.

Soybean

(*Glycine max*)

Soybean is an important pulse as well as oilseed crop of the State. Short duration soybean varieties like JS-2, Moti and Pusa Soybean l can be easily fitted in between two rice crops *sali* and *ahu,* i.e. the period from January to April or first week of May in a medium land situation after harvesting of HYV rice.

Varieties:

Varieties	Duration (days)	Plant type	Grain yield (q/ha)		Percentage	
			Irrigated	Rainfed	Oil	Protein
JS-2	85-90	Erect	20-22	-	20	42
Moti	85-100	-do-	-do-	11-12	20	42
Pusa Soybean-1	90-100	-do-	-do-	-	22	43

Soil:

Soybean can be grown on a wide range of soils but it grows best on fertile and well drained loamy soils. Water logging is injurious to the crop. In acid soils where pH is below 6.0, lime is to be added @ 2 t/ha at least 21 days before sowing. Liming is necessary once in three years.

Time of Sowing:

Under irrigated condition sowing is to be done in January. When the crop is grown under rainfed condition, the optimum time of sowing is middle of January to middle of February.

Land Selection:

Medium type of land is suitable for rainfed condition, where there is sufficient moisture during January and February.

Field Preparation: Well prepared seedbed with good tilth is essential for soybean.

Fertility Management:

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
N	20(10)	Urea	45(22)	6.5(3)
P_2O_5	60	SSP	53.5	50

K_2O	40	MOP	66.6	9.0

N.B.: The figures in parentheses indicate the requirement of N where rhizobium culture inoculated seeds are sown.

The whole quantity of fertilizers are to be applied in furrow at a depth of 5-7 cm below the seeds before sowing and covered with a layer of 3-4 cm soils and make it leveled with the field. In case placement is not possible, the fertilizers should be evenly broadcast and incorporated in the soil.

Foliar Spray of MOP:

MOP can be sprayed at the flower bud initiation stage in between 30 and 35 days after sowing with hand sprayer for proper grain filling in pods.

Preparation of MOP solution for spraying with hand sprayer is as follows.

Quantity of MOP (kg/ha)	Quantity of water (*l*/ha)	Strength of MOP solution (%)	No. of sprays
12.00	400	3	1

Application of lime:

$CaCO_3$ in the form of dolomitic lime @ 65.5 kg/bigha should be applied 15 days before seeding and incorporated in the soil where multiple cropping is practiced.

Seed Treatment:

Seeds are to be treated with Phytohormone + enzyme complex to enhance germination during winter. For this purpose, seeds are sprayed with small hand sprayer @ 1 ml of the chemical in 100 ml of water for 10 kg seed one day ahead of sowing.

Seed Inoculation:

Seeds are to be moistened with clean water carefully so as to avoid excessive wetting. Rhizobium culture is to be mixed with seeds @ 50 g/kg so that a thin coat of inoculum is deposited on the seed coat. Treated seeds are to be dried under shade. Inoculated seeds should not be exposed to the sum.

Seed Rate:

A seed rate of 75 kg/ha or 10 kg/bigha is required to obtain about 5 lakhs plants/ha (66,666 plants/bigha).

Method of Sowing:

Seeds are to be sown in lines 25 cm apart and 5 cm between seeds at a depth of 2-5 cm. If the soil is dry, a pre-sowing irrigation of 2-5 cm depth is needed for proper germination at least 2 days ahead of sowing. The rows are to be covered with a thin layer of paddy straw for better conservation of soil moisture.

Interculture operation:

Weed control:

Two manual weedings, one at 15 days and another at 35 days are necessary to control weeds. Alight earthing up may be given at the time of the second weeding to keep the plants erect.

Chemical weed control:

Pre-emergence application of fluchloralin @ 1.0-1.5 kg/ha immediately after sowing controls weeds effectively. The grain yield is comparable to that of two hand weedings.

Irrigation:

Two irrigations one at flowering and the other at pod formation stage are needed for proper growth and pod filling.

Moisture Conservation:

Under rainfed culture, soil moisture can be conserved by application of straw mulch over the rows after sowing. In such a case, only one weeding is needed at 30-35 days after sowing.

Plant Protection:

Seeds are to be treated with carboxin @ 2 g/kg of seeds. Flubendiamide 39.3SC @ 72g a.i./ha or flubendiamide 20WG @ 50g a.i./ha can be used against defoliator pest of soybean.

Seed treatment with thiophanate methyl + pyroclostrobin (Combo) 500 FS @ 2ml/kg seed and thiomethoxam 600 FS @ 2ml/kg seed for management of root rot complex, pod blight disease and insect pests of soybean.

Threshing:

Paddy Thresher is the best for threshing, especially for seed purpose. Threshing by power tiller is suitable for consumption purpose.

Storage for Seed Purpose:

Seed are to be dried for 5-6 days under bright sun, packed in cloth bags and kept in 250-gauge polythene bags under airtight condition. Seeds thus stored contain about 10% moisture.

Drenching:

The trypsin inhibitor present in the soybean has to be removed before any kind of use. This can be done by boiling the seeds for 20 minutes in 0.5% solution of sodium bicarbonate @ 21g/kg of seeds and then washing 2 to 3 times with plain water.

Utilization:

Besides preparation of various foods, the crushed grains can be used as feed for cattle, poultry and fish.

Soybean milk:

1. Seeds are to be soaked in water for 12 hours, changing water at least three times. Sometimes seeds are required to be soaked for 24 hours.
2. The seed coats are to be removed by hand rubbing.
3. A paste has to be made by crushing the peeled seeds.

Water is to be added at the ratio of 1: 3 and boiled while stirring with a ladle. The milk should not be over boiled; otherwise, its nutritive value may be lost. Addition of a few drops of ginger juice/bay leaf will remove the beany odours. Soybean milk is useful for maintaining intestinal disorder. It prevents summer diarrhoea. It is easily digestible and can be used as diet for old debilitated and convalescents.

Soybean can also be used for preparation of *chapatti, kachuri, malpowa, bhujia, ladu, chutni*, cake etc.

Soybean curd:

To prepare soya curd, soya milk is to be poured in an appropriate container while it is moderately hot.

Green beans:

Green soybeans are widely used as much in the same way the pea is used. When the bean reaches its full size but yet green and tender, it is collected from the plant. It is usually boiled and taken as green vegetables. The green bean is also used in salads. In order to secure the best flavours, the bean should be cooked when they remain affixed in the pods. In such cases, they are to be soaked in boiling water for a few minutes when it becomes easy to shell them.

Rajmah or French bean (Pulse type)

(*Phaseolus vulgaris* L.)

Variety:

Uday (PDR-14): A promising variety selected by Directorate of Pulses Research, Kanpur. Plant type is erect, branched, determinate type, 35-50cm in height. It matures in 10-120 days. Grain yield is 15-20 q/ha. Pods are 10-12 cm long, 3-4 seeds per pod, 15-20 pods per plant.

New varieties recommended:

Varieties	Year of notification	Sowing time	Duration (days)	Grain yield (t/ha)	Agroclimatic zones	Remarks
HUR-301	-	Mid Oct. to mid Nov.	95-105	2.00	All zones	Resistant to wilt, leaf crinkle & BCMV
HUR- 203	-	-do-	95-105	2.00	-do-	Resistant to major insect pests
ARUN	2007	-do-	95-100	2.00	CBVZ, LBVZ, NBPZ, BVZ	-do-

Soil type: Sandy loam

Time of Sowing:

October 15 to November 30. (Best time Nov. 20-30 when temperature reaches 27.7°C)

Field Preparation:

Land should be prepared thoroughly to a fine tilth. Avoid sowing in highly moist soil.

Seed rate: 75 kg/ha or 10 kg /bigha

Seed Treatment: Seeds should be treated with carboxin @ 2 g/kg of seed before sowing.

Spacing: 30 cm x 10 cm

Manures and Fertilizers: FYM/compost @ 10 t/ha or 13 q/bigha should be applied.

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
N	60	Urea	132	18
P_2O_5	45	SSP	281	38
K_2O	40	MOP	68	9

Half of N and full doses of FYM, P_2O_5 and K_2O should be applied as basal dressing and the remaining half of N to be top dressed 30 days after sowing. Apply 2% urea spray 3 times at 45, 60 and 70 DAS.

Since no nodulation takes place, the variety "Uday" responds to high nitrogen fertilizer (up to 120 kg/ha). For better yield of rajmah, a higher fertilizer dose of 60-80-40 kg N-P_2O_5-K_2O /ha for North Bank Plains Zone is recommended.

Inoculate seeds with PSB @ 50 g/kg seed.

Application of Lime:

$CaCO_3$ in the form of dolomitic lime @ 65.5 kg/bigha should be applied 15 days before seeding and incorporated in the soil in areas where multiple cropping is practiced.

Interculture:

First weeding should be done at 20-25 days after emergence, and subsequent weeding as and when necessary. Earthing up should follow immediately after weeding.

Irrigation:

Two irrigations one at flowering (40 days after sowing) and other at early pod formation stage (65-70 days after sowing) are needed for proper growth and pod filling. Water logging should be avoided.

Plant Protection:

- For controlling aphids and jassids apply Emamectin benzoate 5SG @ 220g/ha.
- To escape leaf crinkle disease, sow Rajmah seed from 20-30th November.

Harvesting:

Harvesting should be done when 75-80% of the pods turn brownish in colour. Delayed harvesting leads to pod shattering.

Grass pea (*Khesari*)

(*Lathyrus sativus* L.)

Variety:

Variety	Year of notification	Duration (days)	Seed yield (q./ha)	Agroclimatic zone	Special features
Ratan (BioL 212)	1997	110-120	10-12	All zones (except Hills Zone & Barak Valley Zone)	Negligible ODAP content (<0.1%), suitable for utera cultivation
Newly recommended varieties					
Prateek	2006	115-120	10	CBVZ, LBVZ, NBPZ	Low ODAP (0.109%) and tolerant to wilt and powdery mildew, aphid, pod borer & bruchid
Mahateora	2008	115-120	10	CBVZ, LBVZ, NBPZ	Low ODAP (0.074%) and tolerant to wilt and powdery mildew, aphid, pod borer & bruchid

Soil type: Sandy loam and clay loam soils are suitable.

Sowing time: Mid-October to mid-November

Land preparation: The field is to be ploughed 3-4 times to obtain a good tilth.

Seed rate: 40 kg/ha or 5.3 kg/bigha for sole crop

Spacing: A spacing of 30cm between rows and 10cm between plants should be maintained.

Fertilizer: Compost @ 1 t/ha (1.33 q/bigha) should be applied.

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
A. Without Rhizobium culture				
N	15	Urea	33	4.5
P_2O_5	35	SSP	220	30
K_2O	15	MOP	25	3.3
B. With Rhizobium culture				
N	10	Urea	22	3

P_2O_5	35	SSP	220	30
K_2O	15	MOP	25	3.3

Diammonium phosphate (DAP) @ 75 kg/ha or 10 kg/bigha is to be applied in lieu of urea and SSP in non-inoculated crops. N-P_2O_5-K_2O may also be applied in the form of mixed fertilizer. $ZnSO_4.7H_2O$ @ 0.5% should be sprayed at pre-flowering and pod initiation stages of the crop.(Relay crop)

Seed inoculation:

Seeds may be inoculated with suitable Rhizobium culture @ 50 g/kg of seed. Inoculation method is same as in the case of lentil.

Interculture:

Hoeing in inter-row spaces and weeding at 20-25 days after sowing.

Relay cropping of grass pea (*Khesari*) with winter rice:

Land situation: Medium land

Sowing time: 15-20 days before the harvest of winter rice, when the soil is in moist condition

Method of sowing: Broadcast

Seed rate: 50-60 kg/ha or 6.7-8 kg/bigha

Seed priming: Soaking of seeds in water for 6 hrs.

Fertilizers:

Without rhizobium and PSP inoculation:

- Application of 7.5 kg N and 17.5 kg P_2O_5/ha at the time of sowing before rice harvest
- Application of second dose @ 7.5 - 17.5 - 15 kg N, P_2O_5, K_2O/ ha at the time of rice harvest.[The fertilizers are to be incubated for 48 hours with compost/ moist soil in 1 : 10 ratio before applying]
- Apply two foliar sprays of 2% urea at branching and pod initiation stages

With Rhizobium and PSB inoculation (50 g/kg seed each):

- Apply 5.0 kg N and 13.0 kg P_2O_5/ha at the time of sowing before rice harvest
- Apply second dose @ 5 - 13 - 15 kg N, P_2O_5, K_2O/ ha at the time of rice harvest. [The fertilizers are to be incubated for 48 hours with compost/ moist soil in 1 : 10 ratio before applying]
- Apply two foliar sprays of 2% urea at branching and pod initiation stages

Plant protection:

A. Diseases

Disease	Fungicide	Dose (g/kg of seed)	Mode of application
Wilt	Carboxin	2.0	Seed treatment

B. Protection against storage pests:

Properly dried seeds of pea should be mixed thoroughly with black pepper seed powder @ 3g/kg of seed for protection against bruchid infestation during storage. Treated seeds should be kept in polybags with outer covering of gunny bags.

Harvesting:

Harvesting should be done when 75-80% of the pods turn yellow or brown.

Chickpea
(*Cicer arietinum*)

Varieties:

Varieties	Year of notification	Maturity Duration (days)	Potential yield (q/ha)	Pest reaction	Special features
GNG 2207	2018	120-125	14-17	Resistant to collar rot	Small seeded desi type, suitable for normal and rice fallow conditions
JG 14	2008	120-125	14-16	Resistant to collar rot	Medium seed size *desi* type, suitable for rice-fallow situation
JG 16	2000	120-125	14-16	Resistant to collar rot	Medium seed size *desi* type, suitable for rice-fallow situation
Pant G 186	1996	130-135	12-15	Resistant to wilt	Small seeded *desi* type
KPG 59	1992	125-130	12-15	Tolerant to Fusarium wilt	Draught tolerant *desi* type
BG 256	1985	125-130	12-15	Tolerant Fusarium wilt	Bold seeded *desi* type

Soil type: Chickpea can be grown on a wide range of soils, but well drained loamy soils are preferable. In acid soils (pH <6.0) liming is necessary @ 2 q/ha 20-30 days before sowing.

Time of sowing: The optimum time of sowing is mid-October to end of November.

Field preparation: Chickpea is generally grown on conserved soil moisture. Field is to be ploughed 2-3 times followed by laddering.

Seed rate: A seed rate of 45-50 kg/ha or 6.5-7.0 kg/bigha is required for a good chickpea crop.

Seed treatment: Seed treatment with azoxystrobin 23 SC @ 1 ml/*l* is advocated.

Seed inoculation: With Rhizobium culture and PSB @ 50g each per kg of seed.

Spacing:

The seeds are to be sown in lines at a spacing of 40 cm between rows and 10 cm between plants.

Relay cropping of chickpea:

Seeds are to be broadcasted in standing crop of *Sali* rice at 15-20 days after 50%

flowering in soil with sufficient moisture.

Cropping sequence (Conservation agriculture)

Chickpea should be grown in rice-fallows under rain-fed condition with two harrowing followed by one planking and application of rice straw mulch @ 2.0 t/ha after sowing.

Fertility management: Compost or FYM @ 1-2 t/ha (1.5 -2.5 q/bigha) should be applied

Nutrient requirement	**Kg/ha**	**Name of fertilizer**	**Fertilizer requirement**	
			Kg/ha	**Kg/bigha**
A. Without Rhizobium culture				
N	20	Urea	45	6
P_2O_5	40	SSP	250	34
K_2O	15	MOP	25	3.3
B. With Rhizobium culture				
N	15	Urea	33	4.5
P_2O_5	40	SSP	250	34
K_2O	15	MOP	25	3.3

Diammonium phosphate (DAP) @ 100kg/ha or 13 kg/bigha should be applied in lieu of urea and SSP in non-inoculated crop. Under rainfed conditions, chickpea productivity can be increased by foliar application of 2% urea at the time of flower initiation and pod formation.

Interculture: First weeding at 30-35 days after sowing and second if needed, at 60-70 days after sowing.

Irrigation: If necessary, first irrigation should be given at pre-flowering stage (45-60 days after sowing) and the second at pod filling stage.

Plant protection:

A. Insect pests:

1. Cut worm (*Agrotis ipsilon*): An important pest of chickpea which infests the crop at seedling stage.

Management practices:

a) At sowing: Thaimethoxam 25 WG (alternative of malathion 5% dust) @ 0.3 g/l of water should be spayed as soil treatment.

b) After sowing: When cut worm infestation is noticed (ETL 5% damaged plants) following measures should be taken immediately.

i) Night spraying with chlorantraniliprole 18.5 SC @ 0.3 ml/l of water or lamda-cyhalothrin 5 EC @ 2.5 ml/l of water (alternative of chlorpyriphos 20 EC or quinalphos 25 EC)

ii) Mulching with rice straw @ 3.5 t/ha just after sowing

2. Gram pod borer (*Helicoverpaarmigera*): Most serious insect pest of chickpea. It appears at vegetative stage. Infestations gear up from flower initiation stage.

Management practices:

a) At sowing:

i) Spacing between rows should kept at 40 cm

ii) Intercropping (6:1) or border cropping with linseed.

b) After sowing:

i) Erection of bird's perches (90 cm height) @ 40 nos./ha.

ii) Spraying of chlorantraniliprole 18.5 SC @ 0.3 ml/l of water or lamda-cyhalothrin 5 EC @ 2.5 ml/l of water (alternative of chlorpyriphos 20 EC) when the pest crosses ETL i.e., 1 larva/m row length.

B. Diseases:

1.Wilt (*Fusarium oxysporum* f sp. Ciceri):

a) Treatment of seeds with azoxystrobin or trifloxystrobin @ 1 g/kg of seeds or with *Trichoderma viride* (4 g) + Vitavax 1 g/kg seeds before sowing.

b) At appearance in the field, drench the soil with 0.1% azoxystrobin or trifloxystrobin at localized patches.

c) Intercropping of linseed with chickpea in the ratio of 2 rows of chickpea with 1 row of linseed.

2. Dry root rot (*Rhizoctonia bataticola*):

a) Treat the seeds with azoxystrobin or trifloxystrobin @ 1 g/kg of seeds before sowing.

b) In field, drench the soil as in the case of wilt with 0.1% azoxystrobin or trifloxystrobin.

3. Collar rot (*Sclerotium rolfsii*):

a) In infected field, apply 0.1% azoxystrobin or trifloxystrobin by pointing the nozzle of the sprayer at the collar region.

b) Treat the chickpea seeds with *Trichoderma harzianum* (10 g/kg) + Propineb (1.5 g/kg) for the management of collar rot disease

Harvesting:

Harvesting is to be done when pods mature, indicating full yellowish colour. The moisture content of the grains should be about 12-14 per cent at the time of harvesting.

Rapeseed – Mustard

(*Brassica campestris* & *Brassica juncea*)

Varieties:

Varieties	Year of notification	#Agroclimatic zone	Duration (days)	Yield (q/ha)	Oil content (%)	Remarks
Rapeseed: (*Toria*)						
TS-36	-	All zones	90-95	10-12	41-43	MR to *Alternaria* leaf & pod blight
AAU TS-38	2021	All zones	90-95	10-12	41-44	MR to *Alternaria* leaf & pod blight
M-27	1978	All zones	90-95	10-12	44.6	-
JT 90-1 (Jeuti)	2020	All zones except Hills Zone & BVZ	89	6.97	43.0	Suitable for late sowing. MS to *Alternaria* leaf & pod blight; MS to aphids and sawfly
TS 46	-	All zones except Hills Zone & BVZ	94	9.06	42.0	MR to *Alternaria* blight
TS 67	-	All zones except Hills Zone & BVZ	90	7.01	42.0	Suitable for late sowing
Mustard:						
TM-2	1993	All zones except NBPZ & BVZ	105-115	12-16	36-40	S to *Alternaria* blight
PM 26	2011	All zones except BVZ & Hills Zone	107	12-14	30-41	Moderately tolerant to White rust, *Alternaria* blight, downy mildew, powdery mildew & *Sclerotinia* stem rot. Suitable for late sown irrigated condition
PM 27	2011	All zones except BVZ & Hills Zone	107	13.44	40-45	Suitable for early sown irrigated condition & for multiple cropping

NRCHB-101 (Notified)	2009	LBVZ, CBVZ, NBPZ, UBVZ, HZ	108	13-15	34.6-42.1	Moderately resistant to *Alternaria blight* and tolerant to aphids

Soil Type:

Rapeseed – mustard generally do well in sandy soils. However, other light soils are also equally good.

Field Preparation:

A fine seedbed is essential for rapeseed – mustard. The field should be ploughed 4-6 times followed by laddering in order to obtain a fine tilth.

Fertilizer Management:

Application of FYM or compost @ 2-3 t/ha is beneficial for the crop.

Nutrient	**Requirement (kg/ha)**	**Form**	**Fertilizer requirement**	
			kg/ha	**kg/bigha**
For Rapeseed				
(a) Plains:				
Rainfed condition				
N	40	Urea	87	12
P_2O_5	35	SSP	220	30
K_2O	15	MOP	25	3
Irrigated condition				
N	60	Urea	130	18
P_2O_5	40	SSP	250	33
K_2O	40	MOP	66	9
(b) Hills				
Rainfed condition				
N	65	Urea	140	20
P_2O_5	35	SSP	220	30
K_2O	0	MOP	0	0

Central Brahmaputra Valley Zone				
Rainfed condition				
N	60	Urea	130	18
P_2O_5	30	SSP	190	27
K_2O	30	MOP	50	6
Mustard (for All zones)				
N	80	Urea	174	23
P_2O_5	40	SSP	250	33
K_2O	30	MOP	50	7
B	-	Borax	7.5	1

Apply 75% N and P when seeds are inoculated with *Azotobacter* @ 40 g/kg seed and PSB @ 40 g/kg seed.

If SSP is not used as source of P, sulphur @ 20 kg/ha in the form of gypsum (133 kg/ha) should be used.

N-P_2O_5-K_2O may be supplied in the form of mixed fertilizers. Nutrient requirements are to be adjusted according to contents in fertilizers. Rapeseed-mustard have been found to respond well to the application of borax in some agroclimatic zones of Assam. For higher yield of rapeseed and mustard in the North Bank Plains Zone, a fertilizer dose of 60-40-40 kg N-P_2O_5-K_2O/ha is recommended. However, the earlier doses of 40-35-15 and 40-20-20 kg N-P_2O_5-K_2O /ha have also been recommended for those farmers who cannot afford a higher dose. Apply Boron as basal @ 1.5 kg/ha (15 kg borax/ha or 2 kg borax/bigha) with recommended dose of N-P_2O_5-K_2O for all zones of Assam. The crop booster 'Green Harvest' is recommended @ 25 g/10 liters of water at 30 days after planting.

FERTILIZER RECOMMENDATIONS AS PER FERTILIZER PRESCRIPTION EQUATIONS (FPE)

Fertilizer prescription equations can be used to find out the amount of NPK fertilizers required to obtain a certain yield target of the crop based on soil test values for NPK. The FPEs can be used under cultivation practices where only chemical fertilizers are used and where chemical fertilizers + FYM/Vermicompost/Enriched compost etc. are applied. The FPEs are valid for different varieties of the same crop having not more than 15% variations in yield. The amount of NPK fertilizers will vary according to yield target and soil test values. Yield target must not cross the potential yield of a particular crop.

FERTILIZER PRESCRIPTION EQUATIONS (FPE) FOR RAPESEED

A. For Normal Sowing:

Fertilizer Prescription Equations without IPNS (Fertilizer alone)

FN = 10.37* T - 0.39* STVN

FP = 1.86* T – 1.07* STVP

FK = 4.47* T – 0.74* STVK

Fertilizer Prescription Equations with IPNS (Fertilizer + FYM)

FN = 10.37* T - 0.39* STVN - 0.58*M

FP = 1.86* T – 1.07* STVP - 0.10*M

FK = 4.47* T – 0.74* STVK- 0.21*M

where, FN,FP,FK-Fertilizer N,P_2O_5, K_2O; STVN, STVP, STVK-Soil test values for N, P_2O_5, K_2O, T-Targeted yield, M-IPNS component

B. For Late Sowing

Fertilizer Prescription Equations without IPNS (Fertilizer alone)

FN = 8.71* T - 0.27* STVN

FP = 5.90* T – 3.13* STVN

FK = 9.42* T – 0.78* STVN

Fertilizer Prescription Equations with IPNS (Fertilizer + FYM)

FN = 8.71* T - 0.27* STVN - 0.22*M

FP = 5.90* T – 3.13* STVN - 0.08*M

FK = 9.42* T – 0.78* STVN- 0.18*M

where, FN,FP,FK-Fertilizer N,P_2O_5, K_2O; STVN, STVP, STVK-Soil test values for N, P_2O_5, K_2O, T-Targeted yield, M-IPNS component

Integrated sulphur management in Rapeseed (toria)-summer black gram sequence

Apply sulphur @15 kg/ha as gypsum (100 kg /ha or 13 kg/bigha) to rapeseed only plus 25% recommended dose of N-P_2O_5-K_2O in form of urea, diammonium phosphate (DAP) and muriate of potash (MOP) + biofertilizer (azotobacter and PSB for rapeseed and *rhizobium* and PSB for black gram @ 50 gm each /kg seed) +2ton FYM/ha (3q FYM/bigha) to each crop in rapeseed-black gram sequence (Zones*:* All Zones).

Application of Lime:

$CaCO_3$ in the form of dolomitic lime @ 65.5 kg/bigha should be applied 15 days before seeding and incorporate in the soil in areas where multiple cropping is practiced.

Seed Treatment:

Seed treatment with metalaxyl 35WS @ 6 g/kg of seed is recommended for eliminating downy mildew and White rust.

Seed Rate:

Seed rate of 10 kg/ha (1.3 kg/bigha) for *toria* has been found to be optimum.

For TM 2, TM 4 and Varuna, seed rate will be 8 kg/ha and plant population should be maintained at 3 to 3.5 lakh/ha. Aseed proportion of 75:25 of toria + lentil mixed is recommended for Hills Zone only. As pure crop, a seed rate of 6-8 kg/ha is recommended for Hills Zone. After sowing, the land is lightly laddered.

Seed rate of rain fed late sown *toria* after s*ali* paddy (rice-*toria* sequence) should be 13 kg/ha, i.e. 33% higher than normal recommended rate of 10kg/ha.

Time of Sowing:

The optimum time of sowing is middle of October to middle of November. Early sowing helps in escaping the attack of aphids.

In Barak Valley Zone, rapeseed and mustard can be sown as late as November 30 in upland condition and up to the third week of November in medium upland condition. However, the seed rate of rainfed late sown *toria* grown as succeeding crop in rice (Sali)- Toria sequence should be 33% higher than normal recommended rate, i.e. 13.0kg/ha.

Irrigation:

One Irrigation of 6 cm depth of water may be applied either at 50% flowering or at early siliqua formation stage. In case a rainfall of 20-25 mm is received during this period, no post sowing irrigation is essential. Pre-sowing irrigation is normally not required for timely sown crop. However, in dry areas one pre-sowing irrigation may be applied.

As moisture conservation tillage practice for rapeseed after *sali* rice, one cross ploughing by power tiller incorporating rice stubbles is recommended. The situation for this practice should be medium land with medium textured soil, field capacity 23-25%, soil moisture at the time of land preparation around 22.5%, and time of sowing 4th week of November to 1st week of December.

Irrigation management and crop geometry in rapeseed:

Apply two irrigations of 4 cm depth at pre-flowering (20 DAS) and flowering (40 DAS) stages. Spacing: 25 cm x 25 cm

Foliar spray of urea :

Two foliar applications of 1% urea at flowering and pod filling stages along with basal application of recommended fertilizer dose, *i.e.* 60 kg N, 30 kg P_2O_5 and 30 kg K_2O/ha.

Interculture:

Normally no weeding is required. Whenever necessary, one weeding at 15- 20 days after sowing is sufficient to keep the field weed free.

A). Insect pests: Thiamethoxam 25 WG @ 12.5g *a.i.*/ha or 0.2g/*l* can be applied against aphids.

B). Diseases:

i) Alternaria blight (*Alternaria brassicae*):

Organic management of Alternaria blight of Rapeseed: Seed treatment with Biogreen (AAU product) @ 5% + Soil treatment with Biogreen @ 2.5 kg/ha (incubate1 part of Biogreen with 50 parts of FYM for 7 days) + Foliar Spray with Biogreen @ 5% at 45 DAS.

Spray tebuconazole 50% + trifloxystrobin 25% (ready mix) WG @ 1 g/l or azoxystrobin 23 SC @ 1 ml/l at appearance of *Alternaria* blight disease, followed 2 sprays at 20-25 days interval**.**

ii). Wet rot or white blight (*Sclerotinia sclerotiorum*):

For control of this disease the infected plants are to be collected along with the sclerotia and should be burnt. The following spray schedule should also be adopted:

Fungicide	**Concentration**	**Quantity (kg/ha)**	**Volume of water (l/ha)**
Hexaconazole 5 EC	0.2 %	1.2 - 1.4 l/ha	600 - 700

C). Weed management: In *Orobanche* endemic areas continuous cropping of *toria*-mustard should be avoided. Crop rotation with cereals and legumes may be followed to reduce attack of the parasite.

Bee pollination:

For enhancing yield through increased pollination, 5 honey bee colonies/ ha is recommended in rapeseed-mustard.

Harvesting:

The crop is ready for harvest when 75-80% siliquae turn yellow. The crop is harvested by pulling out whole plants or cutting by sickle.

Yellow sarson

(*Brassica campestris* L. Var. yellow sarson)

Variety: Benoy (Duration: 95-100 days)

Sowing time: mid-October - end of November

Seed rate: 8 kg/ha (line sowing) and 10 kg/ha (broadcasting)

Spacing: 25 cm x 10 cm (line sowing)

Fertilizer dose:

- 60:30:30 kg/ha N:P_2O_5:K_2O (for rainfed)
- 75:50:50 kg/ha N:P_2O_5:K_2O (for irrigated)

Time of fertilizer application: half of N and full quantity of P_2O_5 and K_2O should be applied as basal and rest half at 30 DAS (after thinning and intercultural operation).

Irrigation:

Two irrigations of 4 cm at flowering (40 DAS) and at pod formation stage (60 DAS)

Linseed

(Linum usitatissimum)

Variety:

Variety	Year of notification	Duration (days)	Yield (kg/ha)	Oil content (%)	Agro.Zone	Situation/ Condition
T-397	1984	125-130	500-600	44	LBVZ,CBVZ & NBPZ	Rainfed/*Utera*
Shekhar	2001	130-135	500-600	43	do	*Utera*
Padmini	1999	125-130	600-700	42	do	*Utera*
RLC-153	2019	125-130	700	44	do	*Utera*

Soil Type: Loamy soils are preferred.

Field Preparation:

The field is to be ploughed 3-4 times, followed by 1-2 laddering to obtain a fine tilth.

Fertility Management:

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
N	40	Urea	88	12
P_2O_5	20	SSP	125	18
K_2O	10	MOP	16	2

N-P_2O_5-K_2O may also be supplied in the form of mixed fertilizers.

Application of Lime:

$CaCO_3$ in the form of dolomitic lime @ 65.5 kg/bigha should be applied 15 days before seeding and incorporate in the soil in areas where multiple cropping is practiced.

Time of sowing:

Optimum time of sowing is from middle of October to middle of November. In Barak Valley Zone sowing can be done in December after harvest of *sali* paddy.

Seed Rate: 15-20 kg/ha

Spacing:

A spacing of 25 cm between rows and 10 cm between plants should be maintained.

Weeding:

One weeding at 20-25 days after sowing is needed.

Plant Protection:

i). Wilt: For control of wilt disease:

- Seeds should be treated with carboxin @ 2 g/kg of seed before sowing.
- Suitable crop rotation should be followed in the affected fields.

Harvesting:

The crop is ready for harvest when plants become dry and the leaves fall off completely.

Niger (*Gujitil*)

(Guizotia abyssinica)

Varieties: Local (NG-1)

GA-5 and KEC-3 (for Central Brahmaputra Valley Zone).

Duration: 100-110 days

Soil Type: Silt loam to sandy loam

Land Preparation:

Land should be prepared thoroughly by giving 3-4 ploughings followed by laddering to obtain a fine tilth.

Time of Sowing:

October (September to middle of October for Lower Brahmaputra Valley Zone).

Seed Rate:

- **For line sowing**: 8 kg/ha (1.1 kg/bigha)
- **For broadcasting**: 12 kg/ha (1.5 kg/bigha)

Spacing: 25 cm between rows and 5-7 cm between plants

Method of sowing:

Furrows of 5 cm depth are to be prepared at 25 cm apart. Seeds are to be placed in furrows preferably at 3-5 cm depth. Then laddering should be done along the furrows to cover the seeds with a soil layer of about 3-5 cm. This ensures compacting of soil resulting in quick and uniform germination.

Fertility Management:

Nutrient	**Requirement (kg/ha)**	**Form**	**Fertilizer requirement**	
			kg/ha	**kg/bigha**
N	20	Urea	44	6
P_2O_5	10	SSP	63	9
K_2O	10	MOP	17	2

Plant protection:

As no serious pests and diseases have been observed, plant protection measures are not required.

Bee pollination:

For enhancing yield through increased pollination, 5 honeybee colonies/ ha area of

Niger is recommended.

Harvesting:

Harvesting should be done when leaves die out and turn blackish in colour. At maturity, the grains also turn black.

Average Yield: 5 q/ha

Groundnut *(Rabi/Summer)*

(*Arachis hypogaea*)

Variety: JL-24

Soil Type:

Well drained, light textured, loose, friable, sandy loam soil with medium organic matter content is suitable. The desirable pH range is 5.5 to 7.5.

Land Preparation:

The soil should be prepared thoroughly to get a fine tilth which helps in obtaining good germination.

To get rid of water logging, broad bed and furrow system should be adopted. In this system, raised bed of 15 cm height and 1.2 m width should be prepared.

Time of Sowing:

Rabi groundnut:

Mid-September to Mid-October (if sowing time is delayed, crop duration will be increased)

Summer groundnut: Mid-January to February.

Seed Selection and Treatment:

Bold and well filled pods should be selected and shelled just before sowing since the viability in the stored kernels deteriorates fast. The small shriveled, damaged and broken kernels should be treated before sowing with carboxin @ 2 g/kg kernels.

Seed rate: For bunch type 120 kg/ha

Method of Sowing: Seed should be sown in line at 5-6 cm depth of soil.

Spacing:

Row to row: 30 cm Plant to plant: 10 cm

Manures and Fertilizers: Compost of FYM @ 10 t/ha should be applied. The following amounts of fertilizer should be applied basal.

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
N	20	Urea	44	6
P_2O_5	40	SSP	250	33
K_2O	30	MOP	50	7

Interculture:

Weeds should be controlled manually 30-35 days (flower initiation stage) after sowing.

Water Management:

Groundnut crop requires on an average 400-500 mm of water. The critical stages are flowering, pegging and pod development. If the crop does not receive rain during the critical stages, lifesaving irrigation is to be given.

Plant Protection:

A). Disease:

The most common diseases occurring on groundnut are: *Cercospora* (Tikka) leaf spots, rust, collar rot, dry root rot, stem rot and bud necrosis. These diseases can be effectively controlled by adopting the following control measures:

- ***Tikka* and rust:** Hexaconazole 5EC @ 0.2% should be given as soon as the initial symptoms are detected followed by a second spray after 15-20 days.
- **Collar rot, stem rot and dry root rot:** The seeds should be treated with carboxin @ 2g/kg of kernels.
- **Bud necrosis:** Since this is caused by a virus, no control measure is available. To minimize infestation, thrips (the vector transmitting the disease) should be controlled. Cultural methods like early planting, closer spacing and intercropping with tall crop which act as a barrier for the migration of vector, will reduce the disease.

B). Insect Pests:

Insect pests which cause economic losses are jassids, thrips, leaf miner, aphids etc. These insect pests can be controlled by application of lambda-cyhalothrin 5EC @ 10g a.i./ha or 150-250 ml/ha.

Harvesting:

The prominent symptoms of maturity are yellowing of foliage and dropping of old leaves. The pod is mature when it becomes hard and there is dark tannin discolouration inside the shell. The seed becomes unwrinkled and the testa develops colour. A common method used to predict optimum time for harvesting is to dig plants when 75% of the pods are fully mature. Generally, *rabi* groundnut (bunch varieties) matures at 125-130 days, while summer groundnut (bunch varieties) matures at the age of 115-120 days.

Drying and Storage:

Rabi/summer groundnut loses viability if dried in the open sun. The pods could safely be preserved for the next year as follows:

1. If the crop is irrigated, delay harvest (at least one week) after giving the last irrigation to lower the pod moisture level.
2. After uprooting the plants tie them up with pods intact into small bundles and keep the

bundles in a small layer with pods upward under shade.

3. When the bundles are dried, the pods may be detached from the plants and spread in a thin layer under shade for further lowering the pod moisture level to 7-8%.
4. The drying of the pod can be judged from the following tests.
   - **(a)** The pods should give a rattling sound when shaken.
   - **(b)** When a karnel is pressed between thumb and index finger, it should easily split into 2 cotyledons.
   - **(c)** When the surface of the kernel is rubbed hard a portion of the testa should come off.

(d) The dried pods may be stored in airtight containers so as to prevent entry of moisture inside the pods during the monsoon period.

TUBER CROPS

Potato

(*Solanum tuberosum*)

Varieties:

Name	Duration (days)	Yield (q/ha)		Plant characters	Tuber characters	Tolerance to diseases
		Rainfed	Irrigated			
Kufri Chandramukhi	80-100	85-100	150-160	Medium tall, erect	Oval, slightly curved, skin white, eyes flat	Leaf roll & virus Y
Kufri Jyoti	110-120	85-100	150-160	Tall, erect	Oval, flat, skin white, eyes flat, flesh dull white	Late blight
Kufri Megha	100-120	120-150	175-200	Tall, erect	White round oval tubers of medium size, white eyes, Flesh dull white, good keeping quality & no tuber cracking	Late blight resistant
Kufri Pukhraj	60-75	145	200-250	Medium, erect	Easy to cook; Texture-waxy texture; Free from after cooking discolouration	Moderately resistant to Late blight & tolerant to viruses
Kufri Khyati	60-75	200-250	250-350	Tall (80-85 cm), erect,	Oval, pale yellow, medium compact, vigorous	Moderately tolerant to late blight, tolerant to viruses

Potato variety Kufri Megha can be grown late (up to Mid-December) in Upper Brahmaputra Valley Zone.

Soil Type:

Well drained sandy loam and loam soils, rich in organic matter are suitable. A pulse crop should preferably be included in the rotation to improve the soil condition.

Field Preparation:

Field should be thoroughly ploughed to obtain a good tilth. It should be leveled for uniform distribution of irrigation water or to maintain soil moisture uniformly under rainfed situation. The furrows should be prepared at 50 cm apart.

Time of Planting:

The optimum time for planting is mid-October to mid-November. In case of Kufri Sindhuri planting may be extended up to middle of December.

The optimum planting time for white and red eyed local potato is 15-30th October in Assam.

Method of planting:

The sprouted tubers should be planted in furrows with sprouts facing upward. Care should be taken to avoid sprout damage handling the tubers.

Seed Selection:

Virus free, healthy, medium sized sprouted tubers are to be selected for planting. Ideal size is about 2.5 cm in diameter (25-40 g). Bigger sized tubers may be cut into pieces longitudinally with 2-3 eyes in each piece.

Seed Sources:

Certified seeds of the recommended varieties are to be procured from Govt. or other recognized agencies.

Seed Treatment:

In case of cut seeds, the pieces are to be dipped in carboxin @ 2 g/liter of water for about 10 minutes. After treatment, the seeds are to be spread thinly and dried under shade for 48 hours, or should be covered with moist gunny bags for 2-3 days for tuberization.

Seed Rate:

The seed requirement is 22.5-25 q/ha when size of the tubers are about 2.5 cm in diameter (about 25 g) and planted with an intra row spacing of 15 cm. Intra row spacing is increased with bigger sized tuber.

Fertility Management:

Ten tonnes or 5 truckloads or 20 cart loads of well decomposed FYM should be applied per hectare in the furrows before planting.

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
Rainfed				
N	60	Urea	133	19
P_2O_5	50	SSP	312	45
K_2O	50	MOP	83	12
Irrigated				
N	60	Urea	133	19
P_2O_5	100	SSP	624	90
K_2O	100	MOP	168	24

Entire quantity of fertilizers should be applied in furrows as basal application and be covered with a thin layer of soils so that tubers do not come into direct contact with the fertilizers.

The crop booster 'Green Harvest' is recommended @ 25 g/10 liters of water at 30 days after planting.

Mulching:

Adoption of mulching under rained situations increases tuber yield. Water hyacinth plant materials are applied to cover the entire field after planting of tubers under flat method. Of course, skin of the tubers may turn green due to exposure to sunlight or shrinkage of mulching materials on drying.

Tubers become unsuitable for consumption on greening, however, quantities may be reduced by applying mulching materials in furrows just after planting of tubers, immediately followed by light soil cover. Such practices also reduce rodent damage of tubers considerably.

Irrigation:

The furrow method of irrigation has to be adopted. Three irrigations should be applied, first at 25 days (stolon formation stage), second at 60 days (tuber formation stage) and third at 80 days (tuber development stage) after emergence of sprouts. In case of application of mulching materials in furrows, only two irrigations are to be applied at 25 and 60 days after emergence of sprouts. At the time of application of irrigation, care should be taken not to submerge the ridges completely.

Weeding and Interculture:

Earthing up is to be done just before first and second irrigation. Under rainfed condition, this should be done at stolon and tuber formation stages. One or two interculture operations may be necessary when weed infestation is high.

Apply metribuzine @ 0.75 kg/ha (100 g/bigha) at 10% plant emergence (about 10 DAP) to get optimum weed control.

Plant Protection:

A). Insect Pests:

In areas where infestation of red ant and other soil insects are common, application of thiamethoxam 25WG @ 26 g a.i./ha and clothianidin 50 WDG @ 80 g a.i./ha is effective.

Application of mustard oil cake @ 150 kg/ha at the time of earthing up reduces red ant and white ant infestation to a great extent.

B). Diseases:

i). Against late blight, six spraying with copper oxychloride 50WP @ 2 g commercial formulation /liter at an interval of 12 days. Or spraying with dimethomorph 50WP @ 1g commercial formulation per liter of water followed by copper oxychloride 50WP @ 2g commercial formulation per liter in alternate application (3 sprays with the dimethomorph & 3 with copper oxychloride) at an interval of 12 days give very good control if used at the following rates with high volume sprayer.

Early stage (1st month): 600 liters of water/ha

Mid stage (2nd month): 800 liters of water/ha

Late stage (3rd month): 1000 liters of water/ha

The first spray should be given 40-45 days after planting (canopy closure stage). Use of sticker Triton (0.5 ml/*l*) will be essential in the spray solution for spraying during rainy weather.

Depending upon weather conditions, particularly in cloudy weather, copper oxychloride should be sprayed as a prophylactic measure. If disease appears, spraying should be done at an interval of 7 to 10 days depending upon weather conditions. While spraying, care should be taken to ensure wetting of the lower sides of the leaves.

Under organic cultivation of potato eight sprayings of 0.2% copper oxychloride at 5 days interval starting from 40 days after planting for effective management of late blight of potato .

Practices for On-farm storage of seed potatoes:

- The seed tubers for preservation in on-farm storages should be harvested from fully

matured potato crop.

- Among the different tuber grades, small sized (5-15g) tubers can be kept suitably in on-farm stores as compared to big sized tubers (>20g).
- Loading density of 75g/m^2 proved beneficial than higher loading density for stored tubers under traditional stores.
- Seed potatoes collected from the main field should be cured properly for 10-15 days in cool place and then treat the healthy tubers with 3% boric acid for 30 min followed by 0.2% copper oxychloride for 20 min. After shade drying, the tubers should be loaded in the bamboo rakes fitted in the store.
- Use 4cm thick layer of shade dried 'Neem' or *Eucalyptus* leaves under and over stored tubers help in controlling potato tuber moth.
- Stored potatoes should be covered with mosquito nets in PTM endemic areas.
- Frequent inspection of the tubers in the store is essential. Remove the rotten tubers periodically.
- Sprout breaking during August is essential in order to minimize over-shrinkage and shriveling of tubers.

PACKAGE OF PRACTICES FOR GROWING OF POTATO CROP FROM TRUE POTATO SEEDS

The potato crop can be grown from True Potato Seeds (TPS). The three methods are as follows:-

1. **Transplanted crop**: Seedlings are transplanted in the field after raising in the nursery. About 70% of the total produce is marketable and the remaining quantity of small sized tubers is used as seedling materials in subsequent seasons.
2. **Tuberlet production**: TPS are sown in nursery beds and 70-80% is produced as tuberlets, which are used as planting materials.
3. **Planting of Tuberlet**: Mainly commercial tubers are produced on planting of tuberlets, though tuberlets can be used as planting material during subsequent years.

Varieties:

Varieties	Transplanted crops (q/ha)	Tuberlet production From direct seeding (q/ha)	Tuberlets as planting Materials (q/ha)
HPS 1/13	229	265	314
HPS 7/67	251	276	282
HPS 11/13	220	231	294
TPS C-3	257	290	308

Characteristics of the varieties:

i) Resistant to Late Blight disease
ii) Reduced pathogen transmission
iii) Higher yield potential
iv) Tuber space may be round and oval
v) Skin smooth with fleet and medium deep eyes.

1. Transplanted Crop:

Preparation of nursery bed for raising seedling:

I. Make the nursery beds of one meter breadth and of convenient length (preferably 3 m)

II. Prepare a raised nursery bed by filling 7-8 cm with soil, FYM substrate. Prepare the substrate for the seedbed by mixing sterilized soil and well rotten and dried FYM or compost or biogas slurry in 1:1 ratio. Apply fertilizer @ 4-5 g N, 6-8 g P_2O_5 and 10 g

K_2O/ sq.m in the substrate and mix thoroughly. After 2-3 days, the bed is ready for sowing of TPS. The soil could be sterilized by drenching the soil with 4% formalin followed by covering with ploythene or locally available materials (like banana leaf/ straw etc.) for 72 hrs and then remove the cover.

III. Cover the top of the nursery beds with 2-3 cm thick layer of finely sieved FYM. Thus the nursery bed is raised to about 10 cm. from the field level.

Seedling Raising:

a. Prepare the seeds for sowing in nursery during the 1st week of October (TPS germinate well when the daily minimum temperature touches 20°C and maximum temperature is 30°C)

b. Soak the TPS in water for 24 hrs and then incubate in FYM + soil mixture (1:1) for 2-3 days. Pre-germinated seeds are to be sown in nursery bed.

c. Lightly irrigate the nursery beds a day before TPS sowing to keep the bed in moist conditions.

d. Sow the pre-germinated TPS in 0.5cm deep furrows drawn 10cm apart across the breath of the bed @ 2 g seeds/sq.m and cover these with 0.5cm layer of finely sieved FYM. Seedling raised per 10 sq. m nursery can cover 1500-1600 sq. m area. About 120g TPS and a nursery bed area of 75 sq. m are required for raising seedlings for transplanting in one hectare. Sprinkle water on the seedbeds 2-3 times a day for about a week after sowing the TPS using a sprayer or a gardeners water can to keep the seedbed moist (avoid excess water). Care should be taken so that seeds are not distributed during irrigation and to avoid run-off waters. Subsequently sprinkle water once or twice a day.

e. Protect the nursery beds from direct bright sun light by providing thatch grass shade during mid-day for 10-12 days after sowing. Remove the cover in the late afternoon and put it by morning (8-10 am). However, shade should be provided to protect the seedlings from rain, whenever necessary.

f. Nursery bed should be weed free.

g. After the germination is completed and the leaves start emerging (around 10 days) spray on the seedlings every 4-5 days interval with 0.1% urea (prepared by dissolving 1g urea in 1 liter of water), till these are ready (4-5 leaf stage) for transplanting. The seedlings are ready for transplanting after 25-30 days of sowing.

Field preparation and seedling transplanting:

a. Prepare the field as per normal recommended practice.

b. Basal application (broadcasting) of N, P_2O_5 and K_2O (60:100: 100 kg/ha) at the last round of field preparation. Apply FYM @ 10 t/ha during field preparation.

c. Prepare the ridge at 50 cm apart in the East-West direction. Irrigate the furrows one day before transplanting of seedlings. However, irrigation may not be applied if sufficient

moisture (around field capacity) remains in the soil, particularly on ridges.

d. Carefully uproot the seedlings from nursery beds and carry them to the field in a basket. Transplant one seedling per hill in north facing ridges at 10 cm. spacing. Transplanting should be done preferably in the afternoon.

e. Irrigate the furrows after transplanting to keep the soil moisture in root zone (ridge) at

f. field capacity. While irrigating, care should be taken not to submerge the seedlings. Irrigate the crop every third/fourth day subject to the moisture condition of the soil, till the seedlings get established. Thereafter, frequency of irrigation can be restricted to one in 8-10 days.

g. Gap filling should be done within a week of transplanting.

h. Spray 0.2% dursban on the 4th day after transplanting to protect the seedlings from cutworms.

i. Light manual interculture operation (using *khurpi*) to be performed at about 10 days to loosen the soils in the root zone.

j. Earthing up should be done 20-25 days along with the application of 25 kg of N/ha. Care should be taken during earthing up so that seedlings come to lie in the center of the ridges and maximum nodes are covered with soil leaving open the top 5-6 upper leaves.

k. Second earthing up should be done at tuborization stage (45-50 days). The remaining cultural operations to be followed are similar to standard cultivation practices for potato crop. However, fungicides should be applied only when disease symptoms are visible on the leaves.

l. De-haulm the crop after 105-110 days of transplanting.

m. Harvesting is done 10-12 days after dehaulming.

2. Seedling Tuber Production:

To produce seedling tubers, the procedure to be followed for nursery bed preparation are identical to the methods recommended in raising seedling for transplanted potato crop, except the practices mentioned below :

a) Add N-P_2O_5-K_2O fertilizers @ 60-100-100 kg/ha to the FYM substrate and mix properly.

b) Irrigate the nursery beds a day before sowing of TPS.

c) Mark the rows in the nursery beds at 10 cm. inter row distance. Sow 2-3 seeds at 10 cm intra-rows distance at a depth of 0.5 cm and cover them with 0.5 cm. thick layer of fine sieved FYM.

d) Irrigate the seedbed twice or thrice a day or as needed for a week after sowing, using water cane or sprayer, ensuring that the soil is kept moist (field capacity) without any run-off water. Subsequently, irrigate once or twice in a day to keep the beds moist.

e) Provide shade initially as mentioned in earlier methods to protect from rain, bright sunshine etc.

f) After 10 days of emergence, spray the seedlings with 0.1% urea on every third or fourth day for boosting up the growth and vigour of the seedlings. Spraying of urea solution should be stopped when the seedlings become vigorous.

g) When the seedlings attain a height of 15cm, cover the lower-most three internodes of the seedlings with additional quantities of substrate mixture and repeat the earthing up

h) three times at an interval of 7-8 days.

i) Proper and timely weeding is essential. Follow the usual cultural practices like irrigation, plant protection etc.

j) Cut haulm at the age of 90-95 days.

k) Harvest the seedling tubers after 12-15 days of haulm cutting.

Cultivation of Potato crop from Tuberlets:

The seedling tubers produced either by direct seeding of TPS or from transplanted potato crop are planted in the field in the next season. The method is similar to the recommended conventional cultivation practices of potato crop, except the variation in spacing according to seed rate and seed size.

Tuberlet size (g)	Inter-row spacing (cm)	Seed rate (q/ha)
20-40	20	25
10-20	15	17
5-10*	10	12

*In case of 5g size, two tuberlets should be planted. Moreover, seedling tubers (tuberlets) can be used for 3-4 successive years if seed plot technique is followed appropriately.

Tobacco

(Nicotiana spp.*)*

Variety: Hemti, Bitri, DD437 and HD 65/40

Soil type: Sandy to sandy loam

Raising of seedlings:

a) **Seedbed preparation**: Raised seedbeds about 15cm above ground level, 90cm wide with convenient length are to be prepared.

b) **Manure**: Well-rotten and semi-dry powdered FYM @ 2kg/sq.m (2t/ha) is to be applied. After preparing the beds, application of super phosphate @ 35g/sq.m (350kg/ ha)is needed.

c) **Time of sowing**: End of September to make the seedlings ready for planting in the middle of November.

d) **Seed rate:** 0.6g/sq.m

e) **Method of sowing:** Seeds are to be mixed with fine sand and sown evenly. After sowing, the topsoil has to be worked with fingers and leveled. The beds should be covered with bamboo strip mats or jute sticks. Whenever there is bright sunlight, the cover should be removed.

f) **Interculture:** Stirring the soil around the seedlings with a sharp-edged bamboo poker to break the soil crust is necessary. Seedlings can be removed in three instalments, rejecting all weak and diseased seedlings.

g) **Age of seedlings:** 35-40 days.

Field Preparation:

The field should be ploughed 3-4 times followed by laddering.

Fertility Management:

Nutrient	Requirement (kg/ha)	Form	Fertilizer requirement	
			kg/ha	kg/bigha
N	50	Urea	108	15
P_2O_5	50	SSP	312	46
K_2O	50	MOP	83	11

FYM should be applied @ 10 t/ha (13.3 q/bigha).The entire quantity of SSP and MOP and 3/4th of urea should be applied before planting and remaining 1/3rd urea should be applied 45 days after planting.

Time of Transplanting: November

Spacing: 75 cm x 60 cm

Gap filling:

The gap should be filled within 15 days after transplanting

Interculture:

Use of hand plough at weekly intervals after the establishment of transplant is essential. One or two weeding cum clod crushing is required.

Irrigation:

Depending upon the irrigation facilities and moisture content in the soil two to three light irrigations or pot watering are required.

Topping and De-suckering:

When some flowers have opened, the terminal floral buds are to be topped leaving 8 leaves on the plant excluding the sand leaves. After topping, the auxiliary buds starts emerging and develop as sucker rapidly, which are to be removed when needed.

Harvesting and Curing:

Fully matured leaves which develop yellowish tinge and copper/ brown coloured spots, are to be harvested by priming in 3-4 installments. The primed leaves are to be left in the field for about 8-10 hours for wilting under sunlight. The wilted leaves are tied into bunches of 8-10 leaves and cured for 4-6 weeks. Then they are to be arranged in bulks and fermented.

Yield: Average yield of dry leaf 7 q/ha.

Tea

(Camellia sinensis)

Soil and Climate:

Tea can be grown on a wide range of soils but well drained sandy loam to clay loam soils having pH 4.5-5.5 are most suitable for tea cultivation. Water-logging is injurious to the tea plant. Hot and humid climate with a high and even distribution of rainfall (2000 mm to 40000 mm/annum) throughout the year is beneficial for tea cultivation.

Some Recommended Planting Materials:

Clone: TV 1, TV 18, TV 20, TV 21, TV 22, TV 23, TV 24, TV 25, TV 26, PL 26A, S3A/I, Tin Ali-17/1/54 etc. and other clones approved by the Tea Board.

Seed: TS 450, TS 462, TS 464, Betjan Jat, Tingamira Jat and other seed stock and Jats approved by the Tea Board.

Selection of suitable planting material for a locality should be made, however, by judging the performance of the material in the adjoining tea plantations.

Nursery:

a) **Seed Nursery**: Before sowing in the nursery, seeds are to be placed in a germination pit filled with a thin layer of clean moist sand. On cracking, seeds should be transferred to the nursery. Seedling may be raised in "beds" (1.2m wide and of convenient length laid in East-West direction in fertile soil) or in 'polythene sleeves' (20-25 cm long, 17 cm (lay flat) wide & 150-gauge thickness). Sleeves should be filled up with a mixture of good jungle soil and well rotten cattle manure (3:1 ratio) along with super phosphate @ 500 g/cubic meter soil mixture at least 3-4 weeks before sowing.

i) **Sowing Time**: November-December. Seeds, as soon as received, should be placed in the germination bed as delay in sowing impairs germination.

ii) **Spacing and Depth of Sowing:** Seeds should be sown at a spacing of 20 cm x 20 cm in the bed and at a depth equal to the diameter of the seeds. While sowing the scar (eye) should face downwards.

iii) **Shade:** The nursery is to be protected from strong sun and wind. For this an overhead is to be erected with enclosure on all sides. The roof should be slanting towards the South (height 2.1 m on the northern side and 1.5 m on the southern side) and covered with a thin layer of thatch or other suitable material. Similar material may be used to construct the enclosure.

iv) **Manuring** : One Young Tea Dose (YTD), i.e. a mixture of N-P_2O_5-K_2O (10-5-15) mixed with dry soil at 1: 9 ratio should be applied around the collar (5 cm away from the collar) per 30 running meters of 1-2 m wide nursery bed, from June to August, at fortnightly interval. In addition, 2% urea solution as foliar application may be sprayed 4 times in that period to ensure health and vigour of nursery plants, wherever necessary.

v) **Irrigation:** Irrigation should be provided on alternate days depending on the moisture status of the soil.

b) Clonal Nursery:

i) **Cutting**: 2.5 cm long single leaf internode cuttings of correct maturity should be used for propagation.

ii) **Time** : April – May of September – October

iii) **Planting:** Cuttings should be raised in "beds" or polythene sleeve as stated earlier.

iv) **Spacing:** 15 cm x 15 cm.

v) **Shade, Manuring and Irrigation:** As practiced in seed nursery.

Land Preparation:

(a) Virgin land: The field should be cleared by cutting down or uprooting unwanted big trees leaving the litters *in situ* at least one year ahead of planting. The stump and roots should be completely uprooted. Leveling should be done with minimum soil disturbances. In undulating lands, topographical survey should be done for planning proper drainage and planting.

(b) Area previously used for other cultivation: Area debilitated due to previous cultivation should be rehabilitated properly. Rehabilitation should be done by deep ploughing, harrowing, leveling followed by growing grasses like Guatemala, Hybrid Napier, Citronella and legumes like *Mimosa invisa, Crotalaria anagyrioides* for at least one year or suitable pulses may be grown.

Drainage:

Subsidiary drains should be dug 15 m – 25 m apart (depending on soil type) before planting tea. In undulating area, graded contour drains should be dug based on contour map. Drains should be 90 cm deep and 60 cm wide with slopping sides and they should be connected with natural outlet like *'nallahs'* or paddy fields.

Planting:

Field planting should be done in March-April or September – October.

(i) Age of the plant: Vigorous plants about one year old having a girth of near pencil thickness (0.7 cm approx.) should be used for planting. Weak nursery plants should not be used.

(ii) Spacing (double hedge-staggered) :

120 cm x 60 cm x 60 cm (18518 plants/ha)

or

120 cm x 75 cm x 60 cm (14814 plants/ha)

(iii) Method: 45 cm deep and 30 cm wide trenches should be dug along the row; plants with *'bheti'* should be placed in the trench and rammed properly. To avoid water stagnation, top of the '*bheti'* should remain 1 cm above the ground level.

(iv) Manuring: Super phosphate @ 1 kg/16 running meter (of the trench) should be applied after thoroughly mixing with the excavated soils along with dry well rotten cow dung @ 65 kg/16 m trench.

(v) Mulching: After planting, the area should be mulched with green materials like Guatemala, water hyacinth, spent Citronella grass etc. Paddy straw may be used as mulching material. When paddy straw is used for mulching, it is essential to apply 20 kg nitrogen per hectare, preferably in the form of ammonium sulphate over the mulch. Mulching should be done 10cm away from the collar of the plant.

Green Cropping:

For the initial two years, 'Bormedelua' *Crotalaria anagyroides* may be grown in between two alternate hedges of tea by line sowing. Lopping the tops and sides of the green crop should be done and the litters be kept *in situ*. During gestation period, some pulses may be grown in between the hedges.

Shade:

Temporary shade tree species like *Indigofera teysmanii* should be planted at a spacing of 3.6 x 3.6 m in between the two lines of a hedge immediately after planting of tea. Lopping should be done to avoid over shading and temporary trees should be removed when permanent shade trees attain maturity. Permanent shade tree species like *Albizzia odoratissima*. *A. lebbek* etc. should be planted at 12 m x 12 m spacing along the tea rows. Thorny species like *Acacia lenticularis* should be used in elephant infested areas.

Manuring:

(a) Young Tea :

Manuring should be started when plants establish in the field.

0 year – 5g YTD/plant, 3 times at 8 weeks interval by ring method, leaving 10cm around the collar.

+ 1 year – 10 g YTD/plant as above

+ 2 year – 16 g YTD/plant as above

+ 3+4 year – 900 kg YTD/ha in single application in strip method leaving 15 cm from the collar of the plant on either side.

(b) Mature tea :

From fourth year onwards, 90-135 kg N, 40 kg P_2O_5 and 60 kg K_2O/ha should be broadcast in single dose in clean ground in April when the monsoon rain moistens the soil down to a depth of about 45 cm.

N should be applied in the form of urea for two years followed by ammonium sulphate in every third year.

Bush formation of young tea:

Year	Month	Planting pruning and centering operations	Plucking
0	Sept./Oct.	Planting	
+1	Jan./Feb.	Cut across at 35 cm and decentre below 18 cm. Single stemmer plants are to be 'lung' pruned at 12-15 cm	Tip at 50-35 cm
+2	Jan./Feb.	Cut across at 40 cm (first frame formation prune) and decentre if necessary	Tip at 60 cm. Raise table by leaf when plucking table is full.
+3		-	-do-
+4	December	Cut across at 45 cm (final frame formation prune). Thereafter follow normal cycle	Tip at 65 cm

Pruning and Tipping:

(a) Time: For light pruning –December 1 to 15. For skiffing –December15 to January15.

(b) Pruning cycle: 3 or 4 year pruning cycle may be followed.

(i) 3 yr. cycle: Light prune (LP) – Level-off skiff (LVS) - Deep skiff (DS) –LP.

(ii) 4 yr. cycle: LP-Medium skiff (MS) – DS light skiff (LS)-LP.

(c) Height of Pruning and Tipping :

(i) LP-Prune at 2 cm above the previous pruning height. Tip leaving 5 newly grown leaves above the pruning level.

(ii) DS-Skiff at 8-10 cm above the LP mark. Tip leaving two leaves.

(iii) MS-Skiff at 12-15 cm above LP mark. Tip leaving one leaf.

(iv) LS-Skiff at 20 cm above the LP mark. Tip at the same height leaving the *janam*.

(v) LVS-Skiff-removing the projecting shoots above the plucking table. Tip at the same height leaving the *janam*.

Plucking:

Pluck should be done up to *'Janam'* in 7 days plucking round. Care should be taken to maintain the table as even as possible.

Green Leaf Handling:

Plucked leaves should not be kept in sun or be compressed in the busket tightly to avoid leaf damage due to generation of excessive heat and bruising of the leaves. All care should be taken to avoid 'reddening' of leaves.

Weed Control:

In the first year, hand weeding around the collar region of the plant and cheelin between the hedges should be done. Herbicide sprays at appropriate @ 350 to 500 liter per hectare (depending on weed infestation) may be used at suitable intervals to control weeds in mature tea fromApril to September. Care must be taken to avoid herbicide sprays falling on the tea plants.

(i) Grass weed infested area : Spray glyphosate (2-2.5 liter in 300 liters water)

(ii) Broad leaf weed infested area: Spray bispyribac sodium (25 kg a.i./ha).

(iii)Mixed weed infested area: Spray glyphosate (2.25 liters in 300 liters water).

Pest Management:

A). Mite & Insect Pests:

For all Mites including red spider, spray ethion in 1:400 dilution, from mid February onwards or spiromesifen 22.90 SC @ 96.0 ga.i./ha. Depending on the intensity of infestation 4-6 applications are necessary. Two sprays of etoxazole 10 SC @ 40 g*a.*i. /ha (5.33 g ai/bigha) at 15 days interval is highly effective to manage the red spider mite in the tea ecosystem or spray tebufenpyrad 20 WP @ 200 g a.i/ha against tea red spider mite, *Olygonychus coffeae*.

Termites: Soil drenching with clothianidin 50 WDG @ 250 g/ha (125 g a.i./ha or 0.5 g/liter of water) is effective against termite in tea.

B). Diseases:

(i) For Nursery Diseases like brown root rot or collar rot, the infected plants must be removed, 0.25% suspension of copper oxychloride should be applied as preventive measure, before onset of rain and repeat spray after one month. For damping off disease, which is mainly caused due to heavy soil condition and over watering, copper oxychloride be applied @ 1.5 kg/ha after first shower, followed by a repeat spray after 3 weeks (1:400 dilution).

(ii) Primary root diseases like brown root rot, charcoal stump rot, terry root rot or purple root rot are incurable. In case of incidence of such diseases, an isolation trench should be dug enclosing 3.5 m radius around the infected plant. All plant parts along with their root systems should be thoroughly removed and burnt. The pit so formed, should be rehabilitated properly before replanting.

(iii) For secondary root diseases like violet root rot, diplodia, thorny blight etc., the infected bush along with its root system should be removed. Improvement of drainage and other cultural practices, thereby increasing the bush vigour, will reduce the possibility of such diseases.

(iv)Leaf and Stem Diseases: Blister blight infected plants should be sprayed with copper-oxychloride @ 625 g/ha in 1:800 dilution by a high-volume sprayer. Six to 8 repeat sprays, each at 7 days interval (after each plucking) ensure better control.

For black rot or red rust, the same fungicide should be sprayed @ 1.5 to 2.5 kg/ha (depending on the prevalence of the disease) by a hand sprayer in 1: 400 dilution. Four repeat sprays each at 2 weeks interval (during March/April) should be given.

Construction of low cost vermicompost unit

Design and specification of Low-cost vermicoposting unit

1. Dimension: 2.5 m (L) x 0.91 m(B) x 0. 76m (D)

2. Materials to be used:

   a. Bamboo structure for the shed over the tank and construction of vermicomposting unit

   b. Roof: UV stable silpulin/Thatch

   c. Sides: Locally available material e.g. Dried banana leaves/ agroshed Net

d. Pit: A pit connecting the vermicomposting unit . A half-inch diameter PVC pipe may be used.

e. Inside the pit: Bamboo made vermicomposting tank and Wash collection tank should be laid with Black polythene sheet(Best Quality)

f. The bottom should have a mild slope towards the Wash collection tank.

g. A layer of fine pebble and layer of sand should be placed over the plastic sheet in the vermicomposting tank.

h. The vermicomposting tank should be filled with Semi-decomposed (pre-decomposed) and subsequently, earthworm of proven species is to be released. The dried cow dung should be free of local earthworm species.

i. A side drain may be laid out around the vermicomposting unit to prevent ant problem.

Size of each tank	: 0.91m (B) x 0.91m (D) x 2.5m (L)
Annual Production capacity	: 900 Kg/ one cycle x 3 cycle = 2700 Kg
Duration of each cycle	: 3 months during summer and 4 months during winter
Duration of the structure	: 3 years

TECHNOLOGIES FOR INTENSIVE CROPPING IN DIFFERENT AGROCLIMATIC ZONES OF ASSAM

SITUATION: UPLAND

A) UPPER BRAHMAPUTRA VALLEY ZONE

i) Annual crop

Sugarcane (spring) + Cowpea Sugarcane (autumn) + *Toria* Pigeonpea + Ginger/turmeric Summer rice/vegetables

Blackgram/greengram (Sept)/Pea/*Rajmah* (Oct)/Vegetables (Chilli + French bean + Cucumber)

Cowpea/maize (fodder) + Soybean/*Toria*

ii) Perennial crop

Arecanut + Banana + Pineapple

Arecanut + Black pepper + Banana + Pineapple

B) NORTH BANK PLAINS ZONE

Summer green gram - Groundnut/Potato/Pea/*Toria* Summer rice - Vegetables/lentil/Pea /*Rajmah*

C) CENTRAL BRAHMAPUTRA VALLEY ZONE:

Summer green gram - *Kharif* vegetables Lentil/pea/*Toria*

Summer rice - *Kharif* vegetables/*Rabi* vegetables Vegetables - *Kharif* vegetables/*Rabi* vegetables Rice - *Kharif* vegetables/*Rabi* vegetables Sesamum + Blackgram (1: 1)

Pigeonpea + Sesamum

LOWER BRAHMAPUTRA VALLEY ZONE:

i) Annual

1) As in CBV and Rice-Blackgram-Potato Rice-Sesamum-Wheat.
2) Vegetables+vegetable; Vegetables+flower intercropping. Brinjal+Frenchbean/Knolkhol/*Methi*

Pea + Tuberose Coriander + marigold

ii) Perennial crop

1) Coconut + ginger + Turmeric

Coconut + betelvine + Assam lemon + banana + Pineapple + Ginger.

E) HILLS ZONES (SLOPES OF 20-25%)

Rice (DS) - Blackgram/greengram Rice (DS) - Cotton

Rice - Greengram – *Toria* Pigeonpea + Sesamum/blackgram/greengram Rice (DS) + Greengram/Blackgram (2 : 1)

F) CROPPING SYSTEM FOR FORAGE CROP PRODUCTION

A) Sequential cropping:

i) Intensive forage production

1) Cowpea – Teostine/Maize/Dinanath – Oats
2) Cowpea/Rice bean – Cowpea/Rice bean-Oats/Maize
3) Maize+ Cowpea-Teostine+Cowpea-Oats
4) Maize + Cowpea – Dinanath – Oats

ii). With food/commercial crops:

5) Rice – Oats
6) Cowpea – Rice – Oats
7) Rice (S) – Cowpea/Ricebean-Maize
8) Rice + Ricebean/Cowpea-Rice-Oats/Maize

B) Mixed/intercropping

i) Forage crop mixture

1) Oats +Pea
2) Oats + *Khesari*(*Lathyrus*)
3) Maize + Pea/ *Khesari*(*Lathyrus*)
4) Maize + Cowpea/Rice bean
5) Toestine+Cowpea/Rice bean
6) Sorghum + Cowpea

ii). Food-Forage mixture

D) Pea (grain) + Oat (F)

7) Rapeseed/Niger + Oats (F)
8) Lentil/Gram + Oats (F)
9) Rice + Cowpea (F)
10) Green gram - Cowpea (F) – Rapeseed
11) Maize-Cowpea (F)-Sesamum-Rapeseed
12) Rice (direct seeded) – Cowpea (F) - Oat

iii). With perennial grass

1) Guinea/Setaria+Ricebean/Cowpea-Dinanath/Cowpea/Ricebean-Oats/Pea/*Khesari*

2) Hybrid Napier + Cowpea-Cowpea-Oat

SITUATION: MEDIUM/MEDIUM LOWLAND:

A) UPPER BRAHMAPUTRA VALLEY ZONE

i) March-June	**June-Oct** Early rice)T) Early rice(T)	**Nov- Feb/March** *Toria*/Niger/lLinseed Potato/Pea/Vegetables (for light textured soils)
Rice (DS)	Rice (T)	*Toria*/Relay pea/Pat (F)
ii) April-July	**July – Nov**	**Nov/Dec – Feb.**
Rice (T)	Rice (T)	Oat (F)/Wheat (irrigated)
Vegetables	Rice (T) Maize (Kharif)	Vegetables (Chilli / Radish + French bean/Tomato / Potato Tomato Maize

First rice crop of sequence is of 100-110 days duration *viz*., Luit, Kapilee, second rice of 130-140 days duration, *viz*., Mahsuri, Jaya, Satya.

B) NORTH BANK PLAIN ZONE:

March-July	**July/Aug-Nov**	**Nov/Dec -Feb**
Green gram	Rice (T)	Potato
		Toria (with low input level)
	Rice (T)	*Rajmah*/pea
	Rice (T)	Wheat/vegetables
	Rice (T)	Oat (fodder)
	Maize	Rajmah

First rice crop of 100-110 days duration, 2nd one of long duration 150 days in two crop sequences.

C) CENTRAL BRAHMAPUTRA ZONE:

March-June	**July – Nov**	**Nov-Feb/March**
Jute	Rice (T)	*Toria*/Wheat

Summer moong	Rice (T)	Pea/vegetables
	Early Rice (T)	Vegetables
Cow pea	Rice (T)	*Toria*
(Fodder)	Rice (T)	Rice (T) (Irrigated Lowland)
Lady's finger	Rice (T)	*Toria*
Jute	-	Wheat/*Toria*/Pea/Potato

D) LOWER BRAHMAPUTRA VALLEY ZONE:

March-July	**July/Aug-Oct/ Nov**	**Oct/Nov-Feb**
Rice (DS)	Rice (T)	Potato
Greengram	Rice (T)	*Toria* Rice (T)
Vegetables/Pea	Jute	Rice Potato

E) BARAK VALLEY ZONE:

Rice (T)	Rice	-
Early rice (T)	-	Pea/*Toria*/Niger
Rice (T)	Rice (T)	*Toria*/Pea

Post-rice mustard can be sown till late November, while niger/linseed can be sown till December.

F) HILLS ZONE:

Maize	Greengram/Blackgram/Pigeon pea	
Rice (DS)	Greengram	*Toria*
Rice (DS)	Blackgram	Wheat
	Maize (Kharif)	Cabbage

SITUATION: FLOOD PRONE AREAS

Flood prone areas are spreading along the river systems are found in all the districts of the state. Though the advent of flood differs in different areas and the intensity differs from year to year in the same area, the features of the areas are almost identical; hence the recommended technologies apply to all the areas.

Feb-May	**Late Aug-Nov**	**Dec- Feb**
Early summer rice (DS)	Late winter rice (T)	-
Summer vegetables	-do-	Pea-potato
Summer vegetables	-do-	Groundnut/Pea
Summer rice/	Fallow	Potato/Vegetable/
Summer pulse		*Toria*/ Wheat/Pea
Groundnut/melons	Fallow	Early pulse/Vegetables
Summer rice (Feb-June)	-	Sweet potato (Sept-Feb)

For late planting seedlings of 50-55 days of age can be used in closer spacings of 15 cm × 15 cm and 20 cm × 15 cm for semi-dwarf and tall varieties, respectively.

Rice varieties of short duration for pre and post flood situations are – Luit, Kapilee, (100-110 days duration) and also Lachit, Govind (120 days duration), Kalinga 3, Sonamukhi, Heera. In post flood situation sprouted seeds to be sown in wet condition.

TECHNOLOGIES FOR MANAGEMENT OF SPECIFIC SYSTEMS

Rice (T) –Wheat:

Rice transplanting – Mid July, Wheat sowing – Mid Nov Recommended fertilizer for both the crops

Need based irrigation for wheat Rice (T) – *Toria*/*Rajmah*/Pea Rice-Mid duration variety

Toria- Sowing to be completed by early November, varieties –TS-36, TS-38, M-27

Application of organic manure at 5 t/ha and 25% of recommended level of fertilizers to both the crops increase yields.

Rajmah/Pea – Sowing to be over by early November.

Rice – relay pea

Pea to be sown 7-10 days before rice harvested with 25-50% higher seeding rate.

(In Upper Brahmaputra Valley Zone, pea and *Rajmah* to be harvested by the end of February.

Rice – relay Lathyrus

Without rhizobium and PSP inoculation:

- Application of 7.5 kg N and 17.5 kg P_2O_5/ha at the time of sowing before rice harvest
- Application of second dose @ 7.5 - 17.5 - 15 kg N, P_2O_5 , K_2O/ ha at the time of rice harvest.[The fertilizers are to be incubated for 48 hours with compost/ moist soil in 1 : 10 ratio before applying]
- Apply two foliar sprays of 2% urea at branching and pod initiation stages

With rhizobium and PSB inoculation (50 g/kg):

- Apply 5.0 kg N and 13.0 kg P2O5/ha at the time of sowing before rice harvest
- Apply second dose @ 5 - 13 - 15 kg N, P_2O_5 , K_2O / ha at the time of rice harvest. [The fertilizers are to be incubated for 48 hours with compost/ moist soil in 1 : 10 ratio before applying]
- Apply two foliar sprays of 2% urea at branching and pod initiation stages

Rice (T) – Oat (fodder):

Oat can be sown after rice till late December. Two cuttings can be taken from early sown oat.

Rice (T) – Rice (T):

Substitution of 25-50% of inorganic N in one of the crops through Azolla/FYM or straw helps cutting down fertilizer requirements. FYM/cut residue is to be applied @ 270-540 kg/bigha at the time of puddling. Azolla @ 22-44 kg/ha is to be inoculated one week after

transplanting.

Closer spacing of 15 × 15 cm or 15 × 10 cm for short duration varieties like Luit/ Kapilee.

Second rice var. is to be of long duration (150-160 days) for low land, *viz*., Ranjit, Bahadur, Kushal, Moniram to be transplanted in July.

Direct seeding of the first rice crop in wet condition with application of (pre-emergence) herbicide, *viz*., pretilachlor @ 0.75 kg kg a.i./ha and with supplementary irrigation is recommended.

Rice – Pulses/Oilseed:

Green manuring with *S. aculeata, S. rostrata* or green leaf manuring for the rice crop is beneficial in the establishment of *rabi* crops after rice.

Use 60 kg P_2O_5 as rock phosphate 20 days ahead of planting the 1st rice crop and no phosphatic fertilizer for the second crop.

APICULTURE

Honeybees are essential for pollination of many cross-pollinated crops, and also for production of honey which generates income to the farmers. There are four major honeybee species *viz*., Rock bee (*Apis dorsata*), little bee (*Apis florea*), Indian bee (*Apis cerena*) and Western bee (*Apis mellifera*). Out of them, the former two are wild and the latter two are domesticated species. Indian bee is a brownish black, locally available domesticated Asiatic species. The beekeeping practice of North-East India is mainly based on this species. This is indigenous to India with average honey yield of 12 kg per hive per annum and the foraging range is 0.8-1 km. Western bee is an exotic golden yellow species most widely and commercially reared in the world. This is larger in size than Indian bee having average honey yield of 35-40 kg per annum with aforaging range of 2 km. The species is successfully introduced in Northern India and effort is being made to introduce it in Assam including North East India.

Apiary site:

An apiary is a place where honeybee colonies are reared. Site with proper sunlight, air circulation and shade should be selected for the apiary. Good apiary location is one with abundance of nectar and pollen producing plants. Commercial beekeepers generally migrate their colonies from one place to another for flora and produce more than one api crop of several types. Some of the important bee foraging crop-plants are rapeseed- mustard, niger, buckwheat, sunflower, safflower, sesamum, bottle gourd, pointed gourd, pumpkin, ridge gourd, sponge gourd, maize, soyabean, *jamun, litchi*, mango, drumstick, guava, citrus, coconut, areca nut, date palm, pummelo, ironwood, tamarind, mayflower, pomegranate etc.

Beehive and other equipment:

Honeybees are reared in the modern beehive based on the principle of bee space. Beehive is composed of brood chamber and honey chamber. The brood chamber is meant for rearing progeny and the super or honey chamber is used for secreting honey. The following beekeeping equipment are required for honeybee rearing.

i) Beehive**:**

- **a)** ISI A type 8 frames for Indian bee, ISI B type 10 frame for Indian bee.
- **b)** Langstroth 10 frame for Western bee.

ii) Smoker to produce smoke for effective handling of the colony

iii) Bee veil to prevent bee stinging during handling of the colony

iv) Hand gloves for effective handling of the colony

v) Swarm-catcher for collection of colony from natural source

vi) Honey extractor for extraction of honey

vii) Uncapping knife

Rearing Season:

Seeds or colonies are normally available during spring i.e. February to March as this is a peak-breeding season for the honeybees. Colonies can be collected from the natural sources or may be procured from the beekeepers. Rearing can be started with three or four frame worker bees having one-year mated queen. During winter (December to January) and in spring (February to March) are the best seasons to start beekeeping.

Seasonal Management:

There are generally three seasons for bee management.

Spring Management:

Beekeepers calendar starts with the activity of honeybee colonies after prolonged rain and winter cold. As this is a major flowering season, worker bees become busy for collecting nectar and pollen from flowers and thereby help in building the colonies. This is known as honey-flow season and in this season mostly extraction operations are done. However, there is a problem with swarming, which is acute in Indian species but less in western species. Swarm prevention can be done by frequent inspection of the colony, removing the queen cell, dividing the strong colony and helping the week one.

Summer and Rainy season management:

In the summer management, honeybee colonies should be kept under shade just to protect from scorching sun. As there is continuous rainfall in Assam during the rainy season, honeybee colony should be provided with artificial diet, composed of carbohydrate, protein and water. Effective artificial diet comprises of sugar (as carbohydrate); black gram or green gram or soybean powder (as protein source) and water @ 1 kg of sugar and 100 gm protein powder mixed in 1 liter of water. It should be administered as per requirement of the colony.

Winter management:

The honeybee colonies should be taken out from the shade and exposed to the sunlight.

Migration of the colony:

During winter, honeybee colonies should be migrated to the oilseed crop fields (mainly rapeseed-mustard crop) and then to spring blooms of fruit, forage crops and forest plantations. In this practice both the beekeepers and farmers will be mutually benefited in terms of honey and crop production. Migration is essential for getting substantial yields of crops as well as honey.

Disease and Enemy Management

Several diseases, *viz*., and fungal, bacterial, viral and protozoan diseases infect honeybees. Out of these, viral and protozoan diseases are the most serious ones in Assam.

a). Sac-brood disease:

This is a viral disease caused by Thai-sac strain. The symptoms of this disease are.

- The larvae become pale; then turn brownish-black and gradually dry up.
- The punctured capping with dead pupa within the cell.
- The infection is usually in worker, seldom in drone and spread by drifting nurse bees.

Control:

Dequeening and Requeening: Create broodlessness for some time by dequeening and requeening through production of new queen cell. Infected colony should be treated with antibiotics like Teramycin, 250 mg @ 1 tablet per 4 liters of sugar syrup.

b). Nosema disease:

Nosema disease is found in adult Western bee colony. The infected bees show the symptom of crawling, disjointed wings and the mid-intestine becomes swollen with pale colour.

The treatment with hydroxy quinoline mixed with sugar @ 250 mg/4 liters of sugar syrup will give effective control. Against fungal disease, proper aeration and exposure to the sunlight prove to be effective.

Natural Enemy: Almost half a dozen natural enemies such as lizard, wasp, wax moth, cockroach, birds, ants and mites infest honeybee colonies. Out of them, wax moth and predatory wasp are most serious enemies.

c). Wax moth, *Galleria mellonella:*

Wax moth lays eggs on the stored combs or on the spare combs in the colony. Larvae develop by feeding on wax and pollen in comb cells. Wax moths are most active in summer and rainy seasons. To manage this pest; store combs by removing extra combs from the colony. Fumigate stored combs in air-tight space (in hive chambers, sealed between with mud or dung) and treated with acetic acid or formalin. But fumigation with sulphur smouldering is most effective. Removal and destruction of the infected portion of the comb is also recommended. The biocontrol practice of treatment with *Bt* formulation var. kurstaki @ 0.5 gm/100 ml. of water per hive gives effective control of the pest.

d). Predatory wasp:

Among the wasps, the burrowing (*Vespa magnifica.*) and aerial wasps (*Vespa cinta*) are two common species in Assam, which predate on honeybees. To protect the colonies from the wasp, practices such as destruction of wasp nests in the vicinity of the apiary and artificial net covering (with nylon net of 1 cm mesh size) over the beehive colonies are found to be effective.

For controlling bee mites, honeybee colonies should be exposed to the sunlight and in acute cases chlorbenzilate fumigation gives effective control. Sulphur dusting @

200 mg/hive on top bars of frames is also effective.

Honeybees in crop production

Honeybees are essential for pollination of all the cross-pollinated crops. It has been clearly demonstrated through experimentation at AICRP on Honeybee, AAU, Jorhat that honeybee colonies enhance crop yield to the tune of 1.5 to 2 times as shown below:

Crop	Colony requirement	Yield (q/ha)	Percent yield increase over open pollination
Mustard	5	12.2	157.65
Niger	6	6.1	146.98
Buckwheat	5-6	14.2	152.68
Litchi	5-6	66.7	142.75
Assam lemon	4	-	-

Hence honeybee colonies are considered as essential input for increasing productivity of cross-pollinated crops. Migration of honeybee colonies is necessary for both crop and honey yield.

Pesticidal Poisoning to Honeybees:

In order to protect the honeybees from pesticide poisoning eco-friendly pesticides, which are less toxic to honeybees should be recommended. Moreover, the application of pesticide on flowering crops should be done in the afternoon when the bee activity stops in the field. Some of the bee friendly pesticides with inorganic and organic compositions are oxydemeton methyl and botanicals. Biopesticides such as *Bt.* formulation, NPV, etc. which are having less or no residual toxicity should be incorporated in the Integrated Pest Management Packages.

Recommendation of Bt. Formulation against Wax moth:

Wax moth, *Galleria mellonella* is one of the most serious pests of honeybee causing severe damage to the colonies. Various remedial measures such as cultural, chemical were adopted without having any full proof effect. In order to have effective management of this pest, biocontrol experiments with *Bt*. Formulation, var. *kurstaki* @ 0.5 per cent controlled the wax moth effectively. Hence, *Bt* var. *kurstaki* 0.5 g/hive/liter of water has been recommended against wax moth.

APPENDIX I

Micronutrients and their use

High yielding varieties of crops are fertilizer responsive, and hence lead to removal of both major and micronutrients from soil proportional to the production of crops. Commercially available high analysis fertilizers supply enough of major nutrients and little of micronutrient required for the crop. Replenishment of micronutrients removed by crops to soil is not generally practiced and as such crop derives micronutrients from native source. Due to continuous cropping, the soil is depleted of available micronutrients and thereby the productivity of the land gradually declines.

The studies on micronutrients status in Assam soils and crop responses to application of different micronutrients (straight chelated and blended forms) revealed beyond doubt that the application of micronutrients, particularly zinc and boron are necessary to enhance the yields of various field and horticultural crops in the state. Since molybdenum contents in Assam soils are below the critical limit, responses to Mo is also conspicuous on leguminous crops as it is essential for efficient functioning of *Rhizobium* spp. for nitrogen fixation.

Zinc sulphate, borax and sodium or ammonium molybdate are common sources for supplementing Zn, B and Mo, respectively. However, there are large numbers of micronutrient products available in the market for soil application and foliar spray as given below. But considering the possibility of developing residual toxicity in some specific situations due to continuous soil application and taking the price of micro-nutrient and labour wages together, foliar spray is advantageous. Although the use of micro-nutrient should be based on soil test values, a generalized recommendation of its use particularly Zn and B appears to be useful for enhancing the crop yield.

Micronutrient	**Products with trade name***
Zn (chelated form as Zn-EDTA 12%)	Zincmax, Chelamin, Estazine
Zn and B	Boromax (9.3% B and 13% Zn)
Mo	Molymax (50% Mo)
Zn, B, Cu, Mn, Fe and Mo	Multiplex, Polymax or Anusar, Shaktyapray, Tracel, Agromin, Microphate, Agroma, Agrimic (a substitute for organic manure)

*Mentioning trade name(s) does not mean promoting the product(s)

APPENDIX II

Use of lime for integrated management of acid soil

Application of liming material @ $1/10^{th}$ of lime requirement (LR) of soil (Based on SMP method) in furrows integrated with FYM @ 2t/ha together with 50% recommended dose of N-P_2O_5-K_2O is recommended for soils of pH < 5.5 under rainfed/irrigated upland and medium land. The recommendation is meant for seasonal application of lime as a fertilizer, but not as an amendment, for various pulses/oilseeds/vegetable crops of the region.

The liming material of 60-80 mesh size used to correct the rhizosphere soil acidity should be applied in furrows with a thin cover up with soil to serve as a barrier to the fertilizer to be applied over it, followed by seeding over a thin layer of soil.

Integrated use of lime and fertilizer may be done with the help of seed-cum-fertilizer drill. For very dry soil, water should be sprinkled to get the best use of lime.

Seasonal application of lime should be done based on soil tests for pH measuring less than 5.5.

APPENDIX III

IPM Module for managing insect pests of rice in Assam

The IPM module recommended for insect pest management in rice crops of Assam is as follows-

Varietal Resistance:

- Any resistant/ tolerant variety

Chemical control:

- Seed treatment with carboxin @ 2.0 g/kg seed
- Need based application of pesticide based on Economic Threshold Level (ETL) (Table1)

Cultural control:

- Timely planting (as per recommendation)
- Optimum plant population (as per recommendation)
- Balanced fertilizer application and split application of N (as per recommendation)
- Clean cultivation
- Regular pest monitoring (use of pheromone traps @ 8 traps/ha for YSB)

Biological control:

- Release of egg parasitoids *Trichogramma* spp. @ 50,000 Nos. /ha (six releases) on observing the moths of YSB
- Application of *Beauveria bassiana* impregnated Rice Husk Saw Dust Rice Bran (RHSDRB) medium @ 3 kg/ha in 600 liters of water (10^7 spores/ml)

ITKs:

- Use of bamboo perches to encourage predatory birds. Remove the perches as the crop reaches milky grain stage.
- Use of *Eupatorium odoratum* twigs and leaves in the field to repel insects like case worm
- Use of neem leaf (soil incorporation) against case worm and stem borer

APPENDIX IV

Technical and Trades Names of Insecticides & Acaricides, Rodenticides and biopesticide formulation

Technical Name	Trade name
A. Insecticides	
1. Neonicotinoids	
Imidacloprid 17.8 SL	Confidor, Seamer, Josh, Imidastar, Imiden, Courage, Midas 2000, King Dor , Jumbo
Imidacloprid 70 WG	Admire , Tatamida 70WS , Josh 70 , Dzire , Global 777 , Ad-Fyre , Victor Plus , Tagmyre& Tropical Magic , Pactus , Sumida
Clothianidin 50WDG	Dentotsu
Acetamiprid 20SP	Manik , Ekka , Rapid Crytal, Rekord t, Active , Award , King Prid , Acetacel , Aceta , Echo 797 , Stona , Lift , Dhan Preet , Crop Pride , Sharp , Proud
Thiamethoxam 25WG	Actara , Kri-Oxm , Battalion , Theme , King Tara , Maxima , Wonderex , Renova , Devitara , Maestro 707 , Maxtara , Giltara , Click , Areva , Arrow , Actor
2. Synthetic pyrethroids	
Bifenthrin 2.5 EC	Superflex , Biflex TC
Bifenthrin 8 SC	Relstar Plus ., Wilstar
Bifenthrin 10 EC	Talst, Buland
Lambda cyhelothrin 5EC	
3. Phenyl pyrazole	
Fipronil 5SC	Regent SC , Ruler , Stargazette , Sonic Flo , Devigent Plus , Fipro King , Vizent , Sonic Flo , Rabid
4.Avermectin	

Abamectin 1.9 EC	Vertimec , Tagmec
Milbemectin 1EC	Milbeknock
Emamectin benzoate5SG	Proclaim , Missile , Emstar 5 , Starclaim , Robot , Spolit , Empower , Tatkal , Wegon, EM-1 , Xplode , Benzer ,
5. Diamide	
Chlorantaniliprole 20SC	Rynaxypyr, Coragen
Chlorantaniliprole 18.5SC	ver Liq
Flubendiamide 39.35 SC	Fame , Superzite , Voter
6. Benzoylureas	
Nuvaluron 10EC	Remostar , Pedestal
Buprofenzin 25 SC	Jawaa , Flotis , Trust , Irvy , Devifezin , Buprostar , Hillblaze , PI Bupro , Applaud , Braun 111 , Apple , Phentom
7. Organophosphorous	
Ethion 50EC	Tafethion , Krithion , Mit-505 , Mitkill , King Mite , Fosmite , Deviastra , Vithion , Fighter , Sumite , Hilmite , Shakti Acaron, Dhanumit
Profenofos50EC	Curacron , Celcron , Jashn , Kriphos , Proven , King Cron , Carina , Devi-soldier, Banjo , Maxcron , Jashn ,
Oxydemeton methyl 25 EC	Metasystox
B. Acaricide	
Tetranoic acid derivatives Spiromesifen 22.9 SC	Oberon , Voltage
Diphenyloxazole Etoxazole 10.00 SC	Borneo ,
Pyrazole Tebufenpyrad 20WP	Pyranica,Karia

Sulfite ester Propargite 57.00 EC	Omite , Simbaa
C. Rodenticide	
Zinc Phosphide 80.00% Powder	Ratox, Ratol, Commando ,
Bromadiolone 00.25 CB	Kalrat CB , Ratcon CB
Bromadiolone 00.005 RB	Dr.Pest , Racumin Sure
Aluminum Phosphide 56.00% 3g Tablet, 10g Pouch	Celphos , Quickphos ,Phostoxin
D. Biopesticide	
Bacillus thuringiensis var. *kurstaki*	Delfin, Halt

APPENDIX V

Technical and Trade Names of Fungicides/Antibiotics/Plant Products/ Antagonists

Technical name	Trade name and formulation
A. Inorganic copper compounds	
Copper oxychloride	Akomin, Blitox-50, Fytolan, Kilex, Fycop, Nagcoper, Dhanucop, Fycop, Blue Copper 50, COC 50WP, Copsaan, Coprex, Copsin, Cupravit, Hondacop
B. Elemental inorganic sulphur compounds	
Wettable sulphur	Hexasul, Thiovit, Sulfex, Akrisulf, Appu, Cosavet-DF, Microsulf, Mitex S, Pesto Sulfur 80WP, Sulfasaan, Sulphur 85WP
C. Systemic fungicide	
Carboxin	Vitavax, Hiltavax
Edifenphos	Hinosan
Pyroquilon	Fongoren
Tricyclazole	Beam, Trooper
Propiconazole	Tilt, Radar
IBP	Kitazin 50 EC
Hexaconazole	Sitara, Hexazole, Montaf, Contaf
Propineb	Antracol
D. Antibiotics	
Streptomycin sulphate	Streptocycline +Tetracycline
Hydroxyquinoline	Entakon-M
E. Fungal antibiotics	
Validamycin	Sheathmar
K. Plant derived products	
Neem products	Achook, Neemazal, Neem Gold, Nimin
Cymbopogon product	Wanis

L. Antagonists

Pseudomonas fluorescens	Biofor-PF (Jaiva Kiran), based product Pseudocon
Trichoderma spp. based	Bicure F, Trich-X-P, Viricon-L, products Bioderma, Trichostar

APPENDIX VI

Technical and Trade Names of Herbicides

Technical name	Trade name and formulation
Fluchloralin	Basalin
	Isoproturon Graminon, Arelon, Taurus, Delron, Agrolon,Avonil, Bilron 75WP, Dararon 75WP, Dhar, Gold Medal, Haragron 75, Hilproturon 75WP, Iso 50, Isocin, Isof\guard 75WP, Isokil 75, Isomol 750, Isopar, Isoveer, Isovip, Nocilon 75
Methabenzthiazuron	Tribunil
Pretilachlor	Rifit
	Anilofos Arozin,Aninoguard,Anilokil 30, Anilotaf,Anilveer, Avail 30EC, Dhanumon, Sardar Guard, Strong 30EC, Surya, Weedonil

APPENDIX VII

Technical and Trades Names of Micronutrient formulation

Technical Name	Trade name and formulation
Micronutrient formulation	Tracel, Agromin, Borax Sulphate, Zinc Sulphate

APPENDIX VIII A

Conversion Table (Nutrient-Fertilizer)

1 Kg N	2.17 Kg Urea
1 Kg P_2O_5	6.25 Kg SSP
1 Kg K_2O	1.66 Kg MOP
1 Kg DAP	2.875 Kg SSP and 400 g
Urea 1 Kg N + 1 Kg P + 1 Kg K	6.66 Kg Sulphala (15-15-15)

APPENDIX VIII B

Conversion Table (Area)

1 hectare	=7.5 bigha	=10,000 sq.m
1 katha	=0.2 bigha	=267 sq.m
1 bigha	=0.13 hectare =1333 sq.m	=5 katha

APPENDIX IX

Micro Preparation and Measurements for Agrochemicals Micro Preparation

1 milligram of substance in 1 liter of water = 1 parts per million (ppm) solution

Measurements for agrochemicals

1 tea spoonful of liquid chemical = 5 ml (approx.)

1 matchbox full of powdered chemical = 7-9 g (approx.)

APPENDIX X

Pesticide calculation formulae

$$1)\ \text{Pesticide required} = \frac{RR \times A}{\%\ \text{a.i.}} \times 100$$

Where-RR = Recommended rate

A = Area in ha

% a.i. = Per cent active ingredient in the formulation

$$2)\ \text{Milliliter of pesticide to be mixed per liter of water} = \frac{DC \times 100}{\%\ \text{a.i.}}$$

Where-DC = Desired concentration (%)

% a.i. = Per cent active ingredient in the formulation

APPENDIX XI

Ready recokner for milliliter or grams of a commercial pesticide to be added to one liter of water in order to obtain the required concentration of spray solution

Toxicant in the pesticide(%)	**Concentration (%) of the spray solution required**													
	0.01	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**	**0.10**	**0.20**	**0.30**	**0.40**	**0.50**
10	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	20.00	30.00	40.00	50.00
15	0.67	1.33	2.00	2.67	3.33	4.00	4.67	5.33	6.00	6.67	13.33	20.00	26.67	33.33
20	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	10.00	15.00	20.00	25.00
25	0.40	0.80	1.20	1.60	2.00	2.40	2.80	3.20	3.60	4.00	8.00	12.00	16.00	20.00
30	0.33	0.67	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	6.60	9.90	13.33	16.67
45	0.22	0.44	0.89	0.88	1.11	1.33	1.56	1.78	2.00	2.22	4.44	6.66	8.89	11.11
50	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	4.00	6.00	8.00	10.00
55	0.18	0.36	0.55	0.73	0.93	1.10	1.27	1.45	1.64	1.81	3.64	5.45	7.27	9.09
60	0.17	0.33	0.50	0.67	0.83	1.00	1.17	1.33	1.50	1.67	3.33	5.00	6.67	8.33
65	0.15	0.31	0.46	0.61	0.77	0.92	1.08	1.23	1.38	1.54	3.08	4.62	6.15	7.69
70	0.14	0.29	0.43	0.57	0.71	0.86	1.00	1.14	1.28	1.42	2.85	4.28	5.71	7.14
75	0.13	0.27	0.41	0.53	0.67	0.80	0.93	1.07	1.20	1.33	2.67	4.00	5.33	6.67
80	0.13	0.25	0.38	0.50	0.63	0.75	0.89	1.00	1.13	1.25	2.50	3.75	5.00	6.25
85	0.12	0.24	0.35	0.47	0.59	0.71	0.82	0.94	1.06	1.18	2.35	3.53	4.71	5.88
90	0.11	0.22	0.33	0.44	0.56	0.67	0.78	0.89	1.00	1.11	2.22	3.33	4.44	5.55
95	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.84	0.95	1.05	2.11	3.16	4.21	5.26
100	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	2.00	3.00	4.00	5.00

APPENDIX XII A

Pesticides banned for manufacture, import and use in India

Source: Central Insecticides Board & Registration Committee, Directorate of Plant Protection, Quarantine & Storage, Ministry of Agriculture, Faridabad

(Web site: http://www.cibrc.nic.in/list_pest_bann.htm)

A. Insecticides/ Acaricides/ Rodenticides

1. Aldicarb
2. Aldrin
3. Benzene Hexachloride
4. Calcium Cyanide
5. Carbaryl
6. Chlorbenzilate
7. Chlordane
8. Chlorofenvinphos
9. Copper Aceto arsenite
10. Diazinon
11. Dieldrin
12. Endosulfron (vide ad-Interim order of the Supreme Court of India in the Writ Petition (Civil) No. 213 of 2011 dated 13th May, 2011 and finally disposed of dated 10th January, 2017)
13. Endrin
14. Ethyl Parathion
15. Ethylene Dibromide
16. Fenthion
17. Heptachlor
18. Lindane (Gamma-HCH)
19. Maleic Hydrazide
20. Menazon
21. Methyl Parathion

22. Metoxuron
23. Pentachlorophenol
24. Phenyl Mercury Acetate
25. Sodium Cyanide (banned for Insecticidal purpose only vide S.O 3951(E) dated 8th August, 2018)
26. Tetradifon
27. Thiometon
28. Toxaphene(Camphechlor)
29. Trichloro acetic acid (TCA)

B. Fungicides

1. Ethyl Mercury Chloride
2. Pentachloro Nitrobenzene (PCNB)
3. Fenarimol
4. Tridemorph
5. Methoxy ethyl mercuric chloride
6. Benomyl

C. Herbicides

1. Nitrofen
2. Paraquat di-methyl sulphate
3. Metoxuron
4. Linuron
5. Sodium Methane assonate

D. Nematicides

1. Aldicarb
2. Diazinon
3. Dibromochloropropane
4. Ethylene Dibromide

E. Others (Growth regulators)

1. Maleic hydrazide
2. Trichloroacetic acid

APPENDIX XII B

Pesticides/ pesticide formulations banned for use but their manufacture is allowed for export

A. Insecticides/ Acaricides/ Rodenticides

1. Nicotin Sulfate

B. Fungicide

2. Captafol 80% Powder

APPENDIX XII C

Pesticides withdrawn

A. Insecticides/ Acaricides/ Rodenticides

1. Formothion
2. Nickel Chloride
3. Paradichlorobenzene (PDCB)
4. Warfarin

B. Fungicides

1. Ferbam

C. Herbicides

1. Dalapon
2. Simazine
3. Sirmate

APPENDIX XII D

Pesticides restricted for use in India

A. Insecticides/ Acaricides/ Rodenticides

1. **Aluminium Phosphide** (The Pest Control Operations withAluminium Phosphide may be undertaken only by Govt./Govt. undertakings / Govt. Organizations / pest control operators under the strict supervision of Govt. Experts or experts whose expertise is approved by the Plant Protection Advisor to Govt. of India except [1]Aluminium Phosphide 15 % 12 g tablet and [2]Aluminum Phosphide 6 % tablet.)
2. **Cypermethrin** (Cypermethrin 3 % Smoke Generator is to be used only through Pest Control Operators and not allowed to be used by the General Public.
3. **Diazinon** (Diazinon is banned for use in agriculture except for household use.)
4. **Dichloro Diphenyl Trichloroethane (DDT)** (The use of DDT for the domestic Public Health Programme is restricted up to 10,000 Metric Tonnes per annum, except in case of any major outbreak of epidemic. M/s Hindustan Insecticides Ltd., the sole manufacturer of DDT in the country may manufacture DDT for export to other countries for use in vector control for public health purpose.)
5. F**enitrothion** (The use of Fenitrothion is banned in Agriculture except for locust control in scheduled desert area and public health.)
6. **Fenthion** (The use of Fenthion is banned in Agriculture except for locust control, household and public health.)
7. **Methyl Parathion** (Methyl Parathion 50 EC and 2% DP formulations are banned for use on fruits and vegetables.)
8. **Monocrotophos** (Monocrotophos is banned for use on vegetables.)

B. Fungicides

1. **Captafol** (The use of Captafol as foliar spray is banned. Captafol shall be used only as seed dresser. The manufacture of Captafol 80 % powder for dry seed treatment (DS) is banned for use in the country except manufacture for export.)
2. **Dazomet** (The use of Dazomet is not permitted on Tea.)
3. **Methoxy Ethyl Mercuric Chloride** (MEMC) (The use of MEMC is banned completely except for seed treatment of potato and sugarcane.)

C. Herbicides

1. **Dazomet** (the use of Dazomet is not permitted in tea)

2. **Methyl bromide** (under strict supervision of experts in non crop situation)
3. **Trifluralin** (only in wheat but not to be used near the water basin)

D. Nematicides

1. **Dazomet** (The use of Dazomet is not permitted on Tea)
2. **Diazinon** (Diazinon is banned for use in agriculture except for household use)
3. **Methyl Bromide** (Methyl Bromide may be used onlyby Govt./Govt. undertakings/ Govt. Organizations / Pest control operators under the strict supervision of Govt. Experts or Experts whose expertise is approved by the Plant Protection Advisor to Govt. of India.)

APPENDIX XII E

MINISTRY OF AGRICULTURE AND FARMERS WELFARE

(Department of Agriculture and Farmers Welfare)

(CG-DL-E-16022023-243654)

NOTIFICATION

New Delhi, the 2nd February, 2023

List of Prohibited Insecticides

SN	Name of insecticide	Decision of Central Government
1	Dicofol	The registration, import, manufacture, formulation, transport, sale is prohibited and its use is completely banned from the date of publication of this order.
2	Dinocap	The registration, import, manufacture, formulation, transport, sale is prohibited and its use is completely banned from the date of publication of this order.
3	Methomyl	The registration, import, manufacture, formulation, transport, sale is prohibited and its use is completely banned from the date of publication of this order.
Names of crops to be omitted from approved usage		
1	Carbofuran	All other formulations of Carbofuran except Carbofuran three percent Encapsulated granule (CG) along with the crop labels may be stopped from use.
2	Malathion	Sorghum, Pea, Soybean, Castor, Sunflower, Bhindi, Brinjal, Cauliflower, Radish, Turnip, Tomato, Apple, Mango and Grape.
3	Monocrotophos	All other formulations of this pesticide except Monocrotophos fifteen percent Water soluble granules (SG) may be stopped from use in respective label crops.
4	Quinalphos	Jute, Cardamom and Sorghum.
5	Mancozeb	Guava, Jowar and Tapioca.
6	Oxyfluorfen	Potato and Groundnut
7	Dimethoate	Label deletion of fruits and vegetables that are consumed as raw food items.
8	Chlorpyriphos	Ber, Citrus and Tobacco.

APPENDIX XIII

Pest Management Rating of Commonly Used Insecticides

Insecticide	**Mammalian Toxicity rating**	**Non-target Toxicity rating**				**Environmental Persistence rating**	**Overall Rating**
		Fish	**Bird**	**Bee**	**Average**		
Azinphos-methyl	4	3	2	4	3.0	3	10.0
Bt	1	1	1	1	1.0	31	3.0
Carbaryl	2	1	1	4	2.0	2	6.0
Carbofuran	5	2	5	5	4.0	3	12.0
Carbophenothin	4	2	4	4	3.3	2	9.3
Chlorpyriphos	3	3	3	5	3.7	3	9.7
Cryolite	1	1	1	2	1.3	4	7.3
Demeton	5	2	5	2	3.0	2	10.0
Diazinon	3	2	5	4	3.7	3	9.7
Dicofol	2	1	2	1	1.3	4	7.3
Dischlorvos	-	Toxic	-	Toxic			
Diflunenzuron	1	1	1	4	2.0	4	7.0
Dimethoate	3	1	4	5	3.3	2	8.3
Endosulfan		4	4	2	22.7	3	9.7
EPN	4	2	3	4	3.0	4	11.0
Ethion	3	2	3	-	-	2	7.0
Fenvalerate,	2	4	2	5	3.7	2	7.7
Permethrin							
Malathion	2	2	1	4	2.3	1	5.3
Methomyl	4	4	3	4	3.7	2	9.7
Methoprene	1	1	1	2	1.3	2	4.3
Methoxychlor	1	3	2	1	2.0	2	5.0
Mevinphos	5	3	5	4	4.0	1	10.0

Naled	2	2	3	4	3.0	1	6.0
Ovex	1	2	1	1	1.3	4	6.3
Oxydemeton	3	2	4	2	2.7	2	7.7
methyl							
Phorate	5	4	5	2	3.7	3	11.7
Quinalphos	-	Safe	-	Toxic	-	-	
Phosphamidon	4	1	5	3	3.0	2	9.0
Stirofos	1	4	1	4	3.0	1	5.0
TEPP	5	2	5	5	4.0	1	10.0
Trichlorfon	2	1	2	1	1.3	1	4.3

A. Lower the rating safer the insecticides.

B. The insecticides *viz.*, endosulfan, phorate, stirofos, fenvalerate, methomyl are highly toxic to fish; hence their use should be restricted in fish cum paddy culture.

C. Insecticides such as azinphos-methyl, carbaryl, carbufuran, carbophenothionm, chloropyriphos, diazinonm, fenvalerate, diflubenzuron, dimethoate, mevinphos, EPN, methomyl, malathion, naled, stirophos, TEPP, dichlorovos and quinalphos are highly toxic to bees, hence their use should be restricted in the oilseeds, vegetables and fruit orchards.

D. All insecticides mentioned in the list do not necessarily constitute our recommendation and the rating is based on available literature.

APPENDIX-XIV(A)

Ready Reckoner for Fertilizer Recommendation for Summer Green Gram for Target Yield of 10 q/ha

Sl. No.	STV N	STV P	STV K	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	Kg/ha			Kg/ha			Kg/bigha		
1	175	9	100.5	10.56	12.33	8.11	1.4	1.6	1.1
2	177	11	105.5	10.05	10.93	6.66	1.3	1.5	0.9
3	179	13	110.5	9.54	9.54	5.21	1.3	1.3	0.7
4	181	15	115.5	9.03	8.14	3.76	1.2	1.1	0.5
5	183	17	120.5	8.52	6.75	2.31	1.1	0.9	0.3
6	185	19	125.5	8.02	5.36	0.86	1.1	0.7	0.1
7	187	21	130.5	7.51	3.96	0	1.0	0.5	0.0
8	189	23	135.5	7.00	2.57	0	0.9	0.3	0.0
9	191	25	140.5	6.49	1.17	0	0.9	0.2	0.0
10	193	27	145.5	5.98	0	0	0.8	0.0	0.0
11	195	29	150.5	5.47	0	0	0.7	0.0	0.0
12	197	31	155.5	4.96	0	0	0.7	0.0	0.0

APPENDIX-XIV(B)

Ready Reckoner for Fertilizer Recommendation for Summer Green Gram for Target Yield of 12q/ha

Sl. No.	STV N	STV P	STV K	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	Kg/ha			Kg/ha			Kg/bigha		
1	210	9	120.5	14.02	16.34	12.35	1.9	2.2	1.6
2	212	11	125.5	13.51	14.95	10.9	1.8	2.0	1.5
3	214	13	130.5	13.00	13.55	9.45	1.7	1.8	1.3
4	216	15	135.5	12.49	12.16	8.00	1.7	1.6	1.1
5	218	17	140.5	11.98	10.76	6.55	1.6	1.4	0.9
6	220	19	145.5	11.47	9.37	5.10	1.5	1.2	0.7
7	222	21	150.5	10.96	7.97	3.65	1.5	1.1	0.5
8	224	23	155.5	10.45	6.58	2.20	1.4	0.9	0.3
9	226	25	160.5	9.95	5.18	0.75	1.3	0.7	0.1
10	228	27	165.5	9.44	3.79	0	1.3	0.5	0.0
11	230	29	170.5	8.93	2.4	0	1.2	0.3	0.0
12	232	31	175.5	8.42	1	0	1.1	0.1	0.0

APPENDIX-XV(A)

Ready Reckoner for Fertilizer Recommendation for Normal Sown Rapeseed for Target Yield of 10 q/ha

Sl.No.	STV N	STV P	STV K	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	Kg/ha			Kg/ha			Kg/bigha		
1	150	5.5	40	30.4	10.63	9.74	4.1	1.4	1.3
2	152	7.5	45	29.6	8.48	6.03	3.9	1.1	0.8
3	154	9.5	50	28.8	6.33	2.32	3.8	0.8	0.3
4	156	11.5	55	28.0	4.18	0.00	3.7	0.6	0.0
5	158	13.5	60	27.3	2.03	0.00	3.6	0.3	0.0
6	160	15.5	65	26.5	0	0	3.5	0.0	0.0
7	162	17.5	70	25.7	0	0	3.4	0.0	0.0
8	164	19.5	75	24.9	0	0	3.3	0.0	0.0
9	166	21.5	80	24.1	0	0	3.2	0.0	0.0
10	168	23.5	85	23.3	0	0	3.1	0.0	0.0
11	170	25.5	90	22.6	0	0	3.0	0.0	0.0
12	172	27.5	95	21.8	0	0	2.9	0.0	0.0

APPENDIX- XV(B)

Ready Reckoner for Fertilizer Recommendation for Normal Sown Rapeseed for Target Yield of 12 q/ha

Sl.No.	STV N	STV P	STV K	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	Kg/ha			Kg/ha			Kg/bigha		
1	150	5.5	40	51.12	14.35	18.68	6.8	1.9	2.5
2	152	7.5	45	50.33	12.2	14.97	6.7	1.6	2.0
3	154	9.5	50	49.55	10.05	11.26	6.6	1.3	1.5
4	156	11.5	55	48.77	7.9	7.55	6.5	1.1	1.0
5	158	13.5	60	47.99	5.75	3.85	6.4	0.8	0.5
6	160	15.5	65	47.2	3.6	0.14	6.3	0.5	0.0
7	162	17.5	70	46.42	1.46	0	6.2	0.2	0.0
8	164	19.5	75	45.64	0	0	6.1	0.0	0.0
9	166	21.5	80	44.85	0	0	6.0	0.0	0.0
10	168	23.5	85	44.07	0	0	5.9	0.0	0.0
11	170	25.5	90	43.29	0	0	5.8	0.0	0.0
12	172	27.5	95	42.5	0	0	5.7	0.0	0.0

APPENDIX-XVI(A)

Ready Reckoner for Fertilizer Recommendation for Late Sown Rapeseed for Target Yield of 10 q/ha

Sl. No.	STV N	STV P	STV K	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	Kg/ha			Kg/ha			Kg/bigha		
1	150	5.5	60.5	32.34	41.1	37.5	4.3	5.5	5.0
2	152	7.5	65.5	31.8	34.83	33.59	4.2	4.6	4.5
3	154	9.5	70.5	31.27	28.56	29.69	4.2	3.8	4.0
4	156	11.5	75.5	30.74	22.29	25.79	4.1	3.0	3.4
5	158	13.5	80.5	30.21	16.03	21.88	4.0	2.1	2.9
6	160	15.5	85.5	29.67	9.76	17.98	4.0	1.3	2.4
7	162	17.5	90.5	29.14	3.49	14.07	3.9	0.5	1.9
8	164	19.5	95.5	46.03	9.03	29.02	6.1	1.2	3.9
9	166	21.5	100.5	45.50	2.76	25.11	6.1	0.4	3.3
10	168	23.5	105.5	44.96	0.00	21.21	6.0	0.0	2.8
11	170	25.5	110.5	44.43	0.00	17.31	5.9	0.0	2.3
12	172	27.5	115.5	43.90	0.00	13.40	5.9	0.0	1.8

APPENDIX-XVI(B)

Ready Reckoner for Fertilizer Recommendation for Late Sown Rapeseed for Target Yield of 12 q/ha

Sl. No.	STV N	STV P	STV K	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	Kg/ha			Kg/ha			Kg/bigha		
1	150	5.5	60.5	49.75	52.91	56.34	6.6	7.1	7.5
2	152	7.5	65.5	49.22	46.64	52.44	6.6	6.2	7.0
3	154	9.5	70.5	48.69	40.37	48.54	6.5	5.4	6.5
4	156	11.5	75.5	48.16	34.1	44.63	6.4	4.5	6.0
5	158	13.5	80.5	47.62	27.83	40.73	6.3	3.7	5.4
6	160	15.5	85.5	47.09	21.57	36.83	6.3	2.9	4.9
7	162	17.5	90.5	46.56	15.3	32.92	6.2	2.0	4.4
8	164	19.5	95.5	46.03	9.03	29.02	6.1	1.2	3.9
9	166	21.5	100.5	45.50	2.76	25.11	6.1	0.4	3.3
10	168	23.5	105.5	44.96	0.00	21.21	6.0	0.0	2.8
11	170	25.5	110.5	44.43	0.00	17.31	5.9	0.0	2.3
12	172	27.5	115.5	43.90	0.00	13.40	5.9	0.0	1.8

ANNEXURE XVI (A)

Ready reckoner for targeted yield of 60 q/ha hybrid rice without FYM

Sl. No.	STV N (kg/ha)	STV P (kg P_2O_5/ha)	STV K (kg K_2O/ha)	N	P_2O_5	K_2O	Urea	SSP	MOP
				----------Kg/ha----------					
1	250	18	180	58	37	44	130	231	73
2	252	20	185	57	32	38	127	199	64
3	254	22	190	56	27	32	123	166	54
4	256	24	195	54	21	27	120	134	45
5	258	26	200	53	16	21	117	102	35
6	260	28	205	51	11	15	113	70	26
7	262	30	210	50	6	10	110	38	16
8	264	32	215	48	1	4	107	6	6
9	266	34	220	47	0	0	103	0	0
10	268	36	225	45	0	0	100	0	0

ANNEXURE-XVI (B)

Ready reckoner for targeted yield of 60 q/ha hybrid rice with 5t FYM/ha

Sl. No.	STV N (kg/ha)	STV P (kg P_2O_5/ha)	STV K (kg K_2O/ha)	N	P_2O_5	K_2O	Urea	SSP	MOP
				----------Kg/ha----------					
1	250	18	180	42	31	29	93	196	49
2	252	20	185	40	26	24	90	164	40
3	254	22	190	39	21	18	87	132	30
4	256	24	195	37	16	12	83	100	20
5	258	26	200	36	11	7	80	67	11
6	260	28	205	34	6	1	77	35	1
7	262	30	210	33	1	0	73	3	0
8	264	32	215	31	0	0	70	0	0
9	266	34	220	30	0	0	67	0	0
10	268	36	225	29	0	0	63	0	0

APPENDIX-XVI(C)

Ready reckoner for targeted yield of 70 q/ha hybrid rice without FYM

Sl. No.	STV N (kg/ha)	STV P (kg P_2O_5/ha)	STV K (kg K_2O/ha)	N	P_2O_5	K_2O	Urea	SSP	MOP
				----------Kg/ha----------					
1	250	18	180	99	51	86	221	317	143
2	252	20	185	98	46	80	217	285	133
3	254	22	190	96	41	74	214	253	124
4	256	24	195	95	35	68	211	221	114
5	258	26	200	93	30	63	207	189	105
6	260	28	205	92	25	57	204	157	95
7	262	30	210	90	20	51	201	125	85
8	264	32	215	89	15	46	198	92	76
9	266	34	220	87	10	40	194	60	66
10	268	36	225	86	4	34	191	28	57

APPENDIX-XVI(D)

Ready reckoner for targeted yield of 70 q/ha hybrid rice with 5t FYM/ha

Sl.No.	STV N (kg/ha)	STV P (kg P_2O_5/ha)	STV K (kg K_2O/ha)	N	P_2O_5	K_2O	Urea	SSP	MOP
				----------Kg/ha----------					
1	250	18	180	83	45	71	184	283	119
2	252	20	185	81	40	65	181	251	109
3	254	22	190	80	35	60	177	218	100
4	256	24	195	78	30	54	174	186	90
5	258	26	200	77	25	48	171	154	80
6	260	28	205	75	20	43	167	122	71
7	262	30	210	74	14	37	164	90	61
8	264	32	215	72	9	31	161	58	52
9	266	34	220	71	4	25	157	26	42
10	268	36	225	69	0	20	154	0	33