

TRAINING MODULE ON AGRO-ECOLOGICAL PRACTICES (MIZO VERSION)



**MIZORAM STATE RURAL LIVELIHOODS MISSION
RURAL DEVELOPMENT DEPARTMENT
GOVERNMENT OF MIZORAM**

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MODULE- 1

AGRO-ECOLOGICAL PRACTICES (AEP)

AGRO-ECOLOGICAL PRACTICES (AEP)

Kan huan leh thlai chînte a ngelnghehna tûr atâna leilung pianken nihphung leh inrêlbâwl dân awm sa zûl-zuia huan kan enkawl hi Agro-Ecological Practices kan tih chu a ni ber âwm e. He practice hian thar chhuah lam ngaihtuah chung a ngelnghehna a dah pawimawhin thlai leh thlai inlaichîнна te, ran nêna an inlaichîнна te, ramngaw lam nêna an inlaichîнна te, lui lama nungchate nêna an inlaichîнна te, thlai inthlah punna atâna tha thawh ve thîn rannung hrang hrang pawimawhna te, lei leh a chhehvela thil pawimawh dang zawng zawngte inlaichîn tawna a huam vek a ni.

AEP hian awlsam taka hmuh theih hmanraw hrang hrangte tângkai zâwka hman lam ngai pawimawhin heng thlai, kan ran vulh thîn hrang hrang te, lei, tui, sik leh sate leh mihringte tãnhona a ngai pawimawh êm êm a ni. Hmanraw siam thar leh theih loh hman thinte tihltlem leh tualto hmanraw remchâng awm thei leh siam thar leh theih hmanraw hrang hrangte a theih ang tâwka hman tângkai chung a ngelnghehna thlen tho si hi a tum pawimawh tak pakhat a ni. Thlai leh rannung hausakna hrang hrangte hlut tak chung leh vêng him reng chung a tângkai thei ang bera hman dân dap leh mithiamte'n an la hriat fiah chiah loh tualto thiamna chi hrang hrang loneituten an hman lar êm êm si thiamnate hman tângkai leh uar zêlte a huam tel baw a ni.

Agro-Ecology lam chuan awlsam leh siam thar leh theih chin dan hrang hrangte hmanga thlai chin dan tihhmasawn a ngai pawimawh a, entirna atan; thlai chi hrang hrangte inchin chhawk/karhlak te, thing chi hrang hrang phun hmanga ran vulhte leh thing thawh duntir te, be chi (legumes) thlaihote thlai chin karhlaka hman emaw lei khuh tur atana hman emawte leh buh hmuna sangha khawi nghal mai ang chi remchang hrang hrangte a huam thei awm e. Hetianga kan thlai chinna leh hmanraw remchang hrang hrangte kan tãnhotir hian hlawkna tam leh zual zawkin kan hmu thei ang a, lei tha insiam thar zung zung kawngah te, rannung eichhetu ven kawngah te, daihzai zawka hmanraw hman kawngahte kawng tam takin kan hlawkpui dawn a ni. Leilung piankenin a ken tel sa ang maia kan huan leh lo

kan enkawl a, lei, thlai leh ranvulh te kan tan hotir hian keimahni lo/ huan ngei chu kawng hrang hrangin a mamawh hrang hrang leitha, rannung do theihna kawngah leh a dangteah a intodelh chho zel thei dawn a ni.

Diversified farming system design leh a nghawng te:

a) Crop Rotation: Thlai chin dan kan thlak kual hian thlai chin leh hun atan leia leithate chu kan renchem niin rannung (insect) te, natna hrikte leh hnimte inthlah chhawng kual pawh nasa takin a tikhaihlak thei a ni.

b) Polycultures: Thlai chin dan chikhat, thlai chi hnih emaw a aia tam pawh bi mumal tak neia phun a, chumi chuan leitha hman tangkai kawngah leh rannung eichhetu tikhiam kawnga nasa taka thawh dunna a thlen a, ngelnghehna tak tak a thlen theih phahna hi a ni.

c) Agro-Forestry System: Thing leh kum khat thlai a ruala chin hian an vel boruakte antidanglam a, chu mai piah lamah leite an ti dur tha thin, a chhan chu thingkung thenkhatte hian nitrogen siam kawngah nasa takin an puih vang a ni a, an zungte a sei avangin lei chhungril thuk taka mi leithate an hip thei a, an hnah tla leh thil tawihthei an hnutchhiahte hian lei titha lehin, lei timurte an siam tha a, leia thlaite tana chaw tha siam kawngah nasa takin an pui a ni.

d) Cover Crops and Mulching (Thlai lei khuh zau chi leh chhawlhchin): Thei kung hnuaiah thlai chi khat emaw a inchawhpawh emaw kan phun hian lei chunglang luang ral tur a ven bakah leite tithain rannung thlai eichhetute tikhiam kawngah a pui bawh thin. Thlai hniam tea to chite phun hian lei chunglang luang ral mai turte vengin, lei hnawna te, lei lum leh vawh (temperature) danglam nasa lutuk turte a veng a, chu mai piah lamah chuan lei thatnate vawng himin, hnim to turte a veng bawh a, chu chuan nasa takin thlai a tihmasawn thei thin a ni.

e) Green Manures (Thlai hring leitha): Green manures kan tih chu thlai to chak tak hneh taka lei khuh tura chin thin thlaite hi an ni. An hnahte chuan hnim to turte a dipdal a, an zungte chuan lei luang ral mai mai tur a veng bawh a ni. Heng thlaite hi an la hrin lai ngeia leia kan leh hnan hian leia leitha hrang hrangte siam thar lehin lei nihphung a siam tha leh thei thin a ni.

f) Thlai chin leh ran vulh kawp: Thlai chin leh ran vulh kan kawp hian leiṭha siam thar leh thar chhuah hlâwk zawka thlai chin hi kan kalpui kawp nghal thei ṭhin. Ran chaw chi hrang hrangte bit taka phun karah thing zai chi thing kan phun a, ran kan tlattir mai hian a hranpaa leiṭha ilo hman kher a ngaih loh phah thei a ni. Buh hmuna sangha khawi leh varak vulh kawpte hian hnim, rannung eichhetu tihrem leh hnim dip ral leh leiṭha siam thar hnate a kawp nghal vek theih a ni.

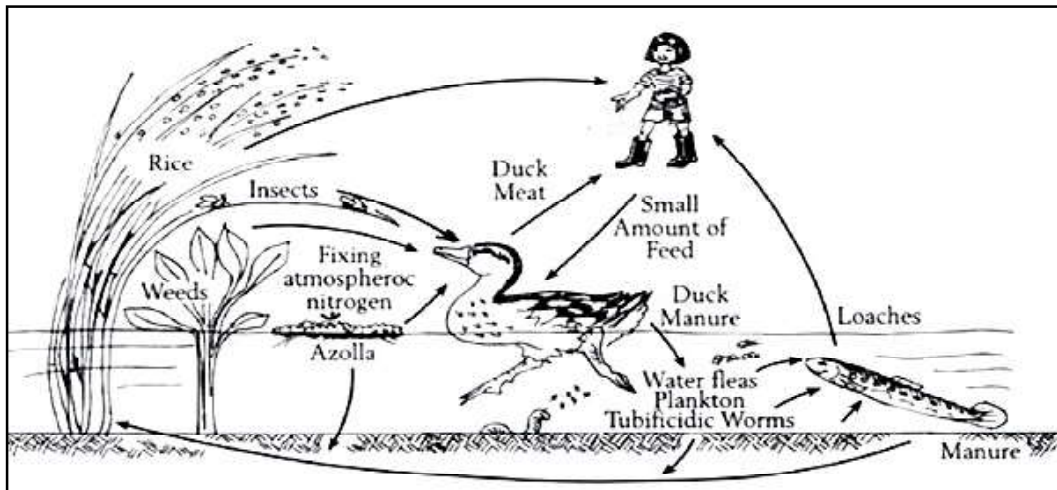


Fig: Buh hmuna buh, varak vulh leh sangha khawite kawng hrang hranga an thawhho dân.

Agro-Ecology Practice hi hmun hrang hrang; huan, lo leh len vahna hmunahte a hman theih. Huanate a ṭangkai theih dante zirchian leh enchhin phawt a, chu chu lo leh zau zawka hman ṭangkai theih tura siam rem leh ni se. AEP hi huan lian thamahte pawh a hman theih reng a. Amaherawhchu, khawtlang inkaihhruaina hrang hrang a nghawng theihthe erawh uluk taka ngaihtuah tel a pawimawh hle.

Agro-ecology leh loneitute tawn hriat thiamna:

Agro-ecosystem lo pian chhuah chhan chu kan chhehvel leh mihringte inmamawh tawna kawng hrang hrang avangte a ni. Agriculture hi kum za tam tak chhunga mihringte leh leilung thawh dunna kawng hrang hrangin a rawn chher chhuah a nih avang hian heng thiamna hrang hrangte hi mipuiten engtin nge an lo neih theih

tih leh eng tak hian nge heng thiamna paw chhuak thei tura mipuite chu fuihtu tih kan hriat chian a pawimawh hle a ni. Tuipui aṭanga 4000mts laia sanga vur khal laka him taka thlai ching tur chuan tuiin a hual pap chhunga thlai chinna tur lei chhûn pâwna thlai chin a him em em, a chhan chu chhûn lamah tuite chuan lumna lo hipin zan lama boruak vawt lutuk tur a veng thei a ni. Hmun eng emaw zatah chuan thlai chi hrang (species)-te hi hnam nena inzawm tlat a ni ṭhin a, chuvang chuan agro-biodiversity hi ram leh hnamin nasa takin a chhawm nung fo ṭhin a ni.

Agro-Ecological System-te hi hnam ziarang leh chin danah nasa takin a innghat a, lo zim te te neitute hian thlai chin dan ngelnghet leh tlo chi hrang hrangte lo ching chhuakin an chhawm nung chho zelin khawtlang ei leh bar mamawh hrang hrangte an lo phuhru ve ṭhin a ni. Heng chin dan hrang hrangte rawn irh chhuah dan chu loneituten anmahni huam chhunga leilung, thlai leh ran- te an lo zirchian leh hriat fiah dan aṭangtein a ni ṭhin. Hetianga thingtlang mite thiamna hi chu anmahni tawnhriat leh hmuh an hlawhtlinpui ngeite an chhinchhiaha an inhlan chhawn zelte aṭanga lo inṭan a ni ṭhin.

Agro-ecological thiamna chher chhuah reng rengte hi hotu leh hruaituten a hranpaa an hrilhhriat ni lovin loneituten anmahni mamawh taw ang zela, an awmna hmun ṭheuha chin dan hrang hrangte a ṭha thei leh ziarang mil thei ang ber tura an chher kual a ni ṭhin. Hetiang mite thiamna hman ṭangkai theihna leh hlawkna kawng hrang hrangte chu:

- Tualchhunga thlai thar chhuah theihna tura hmanrua leh sik leh sa awm dan chiang tak hriatna atan (lei chungchang te, thlai ṭo chungchang te, ruahsur ṭhin dante).
- Hun rei tak chhunga enchhin leh a taka lo kalpui tawh thiamna thuk tak, tualchhung dinhmun mil ngei agro-ecological chin dan hriatna atan.
- A chhehvela hrilh darh tura lo neih dan kawng ṭha leh hlawk ber hriat chhuahna atan.
- Tualchhung mil thei ber tur thlai chin leh ran vulh a nih theihna atan.
- Thiamna tihmasawn tura kawng hrang hranga hmalakna tur tehfung atan.

- Thiamna thar hman tlak dan leh tualchhung dinhmun nena a inmil dan behchhanna atan.

Loneitute hian an ram dinhmun leh ziarang hi an hre chiang em em a, kawng tam takah chuan heng thiamna hrang hrangte hi kan hloh nasa em em tawh thung si a ni.

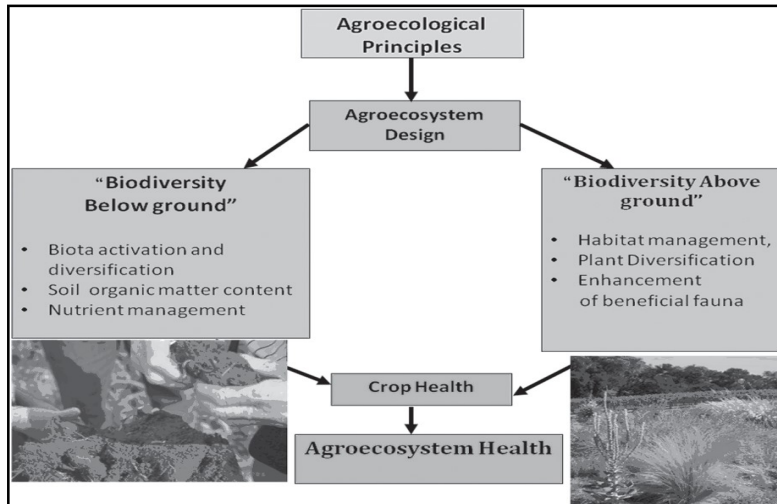


Fig 2 Basic Principles of Agro Ecological Systems

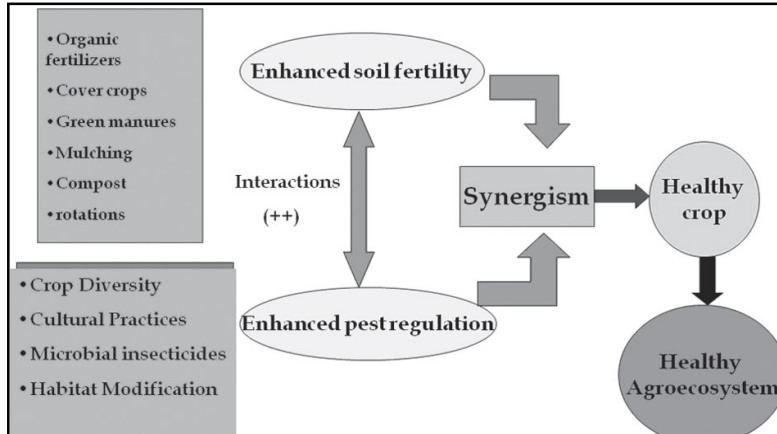


Fig 3 Leilung vawn that hna leh thlai hriselna ven dan thawh kawp dan leh inkungkaih tawn dan

Thlai thar chhuahna kawnga Agro-ecological practice hman dan:

- **Lei thatna tihmasawwna kawngah** – Thlai chin thlak kual te, Poly-culture te, FYM, thil tawih leiṭha siam te – NADEP, Changpat leiṭha, Legumes, Agro-forestry systems, lei khuh tura thlai chin te, ran vulh leh thlai chin kawpte.
- **Tui chhekkhawl kawngah** – Chhawlchhin, ruahtui khawl.
- **Thlai chi leh ran chi awmte vawn him leh hman tṅangkai** - Tualṭo thlai chi hman te, thlai chi dah that te, hybrid thlai chi hman loh te, tualto thlai chi tihlarte.
- **Thlai natna leh eichhetu rannung enkawl** - Damdawi hmang lova enkawl, hnimhnah thlai aṭanga damdawi siam hman ṭhin, eichhetu rannung hip/bum tura thlai dang chin tel (trap crop), thlai chinna hmun ri hunga thlai dang chin (border crop), Indigenous Technical Knowledge hman.

MODULE- 2

**LEI CHUNGCHANG
LEH
A TIH THAT DAN**

LEI CHUNGCHANG LEH A TIH-THAT DAN

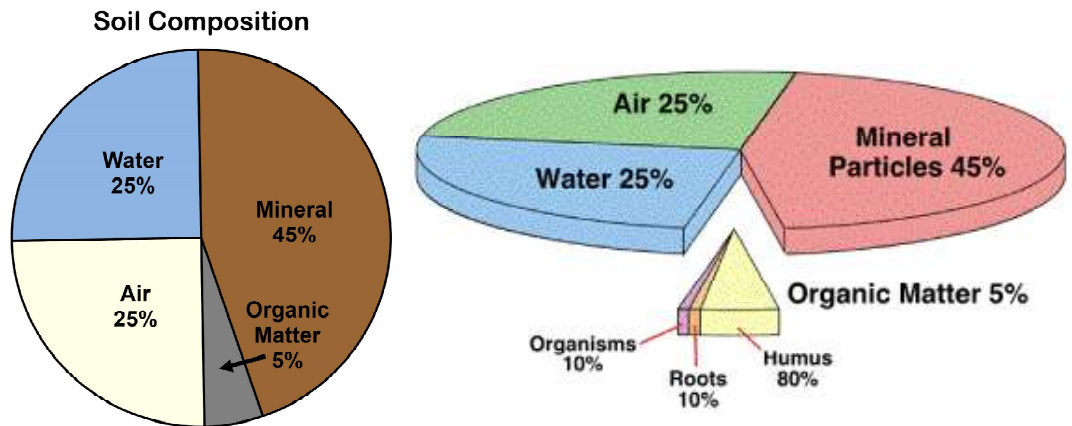
Lei kan tih hi eng nge ni :

Lei kan tih hi thil chi hrang hrang heng; thil tawih (organic matter), minerals, boruak, tuiril chi hrang hrang, nunna atana tangaite inchawhpawlhin a siam a ni a. Lei hian hna pawimawh tak tak chi 4 thawh a nei a, chungte chu – Thlai tona (medium) atan te, tui lo chhek khawl a, thlifima pe chhuak lehtu pawimawh tak a ni a, leilung leh a chhehvel chenna tlaka siamtu a nih bakah lei thatna atana thawktu nungcha leh thilnung chi hrang hrangte chenna lo siamsaktu pawimawh tak a ni bawk.

Lei chuan eng hna nge a thawh ber :

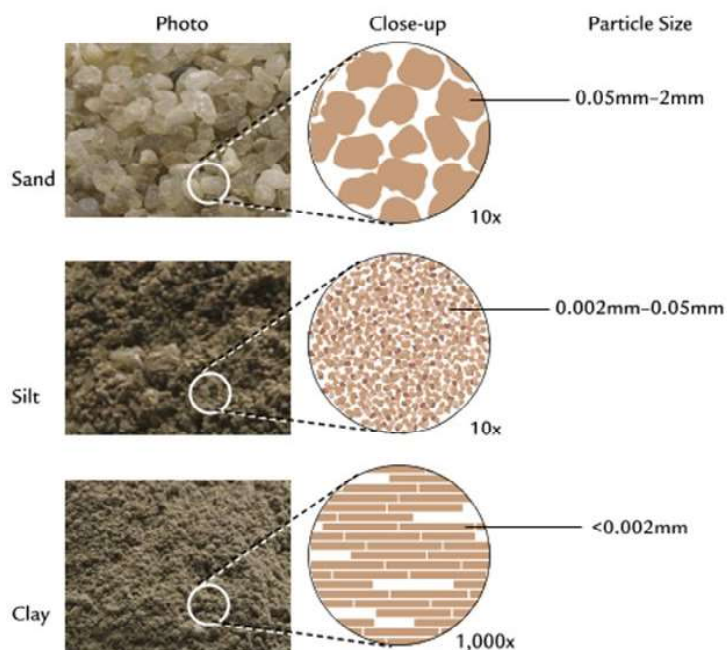
Lei hi kan chenna khawvel (earth ecosystem) siamtu pawimawh ber pakhat a ni a. Lei hian heng hna pawimawh tak tak; leilunga nungcha hrang hrang chenna siamsak te, lei tha (nutrients) leh bawhlawh tawih theite lo siam thar leh te, tui nihna/that dan (quality) lo ven him te, kan chhehvel boruak lo tihdanglam te, thlai tona (medium) lo siamsak te leh kan chhehvel leilung leh boruakte hna hrang hrang lo thawhte a ni. Lei hian nunna awm theihna atana tangaite thil chi hrang hrang a pai hnem em avang hian leilunga nunna (genetic diversity) tam tak a kuah khawm a ni. Lei gram khat (1 Gram) lekah hian mita hmuh tham loh rannung (microbial) kan la hriat chian vak loh chi hrang sangkhat zet mai vaibelchhe 1 bawr vel lai a inbeng khawm a ni. Ram thenkhat chuan ruah an dawn mumal loh em avangin leiin tui a pawm theih dan hian thlai dam khawchhuah theihna nasa takin a hriil a ni. Lei hian thlai thite chu lei tha (nutrients) chi hrang hrangah a lo siam danglamin thlai leh rante tan ei tur tha a lo chhawp chhuahsak thin a ni.

Lei chu engin nge siam (Soil composition) :



Lei hi heng thil chi hrang hrangte hian a siam a ni: tuihil 25%, boruak lam chi 25%, balu lam (sand) 18%, lei dip (Silt) 18%, hlum lam chi (clay) 9%, thlai tawih (Organic matter) 5%. Lei kan han tih hi a tlangpuiin a zatve (50%) hi a sakhat (solid) niin chutah chuan 45% hi minerals niin 5% hi thil tawih (OM) nia ngaih a ni, a zahve dang leh 50% hi boruak emaw kar-awl (pores) emaw a ni thung (Leia kar awl kan tih hi a chanve tui leh a chanve dang chu boruakin a luah khat tlangpui). Leiin mineral leh organic matters a paite hi hun rei lo te chhung atan chuan danglam vak ngai lo anga ngaih a nih thin laiin, leiin tui a pai leh boruak a paite erawh hi chu danglam foin a pakhat zawk zawk (boruak emaw tui emaw) a san hlek chuan a inbuk tawk turin a pakhat zawk luah chin hi a rawn hniam/tlem vat thin a ni. Lei kua (pore space)-te hian lei chhunga boruak leh tui chet vel theihna atan remchang siamin heng thil pahnihte (boruak leh tuite) hi leilunga nunna awm theihna atana thil pawimawh tak an ni a. Lei a muk viau hian lei chhunga kua awmte chu titlemin thlai zungte leh rannungte tana boruak leh tui lakna kawngah harsatna a siam thei a ni.

Sand, Silt, and Clay



Loam : Leiin balu lei leh lei dip (silt) inzatzawktakapai a, tlak lei (clay) tlem te chauhapai hian hlum lei/sawntlung lei (loam) an ti thin. Heng leiinapai thin pathumahte hian balu lei mur hi a hrawber a ni. Balu leite hian tui an pai thei vak lo nain boruak chet velna awm theihna atan an tangkai em em a ni. Chutih rual erawh chuan tlak lei (clay) murte hi an sinin an muk duh em em a, chumi avang chuan tlak leite hi leirawhchan siamna atan a that em em laiin tui, boruak leh thlai zungte chet vel zung zung theihna atan erawh a tha lem lo leh viau bawktung.

Tlak lei (Clay) : Tlak lei hi chu lei mur sin te te, sak leh muk sam takin a siam niin, a muk duh em avang hian thlai phunna atana sawngbawl pawh harsa khawp a ni thei. Tlak leite hi sawngbawl harsa deuh mah se, thlai thenkhat tona atan erawh chuan a tha leh hle thung. Nghet taka thlai zung a chelh theih avang hian thlai thenkhat tona atan chuan a tha hle thung a ni.

Clay loam : Heng lei hi lei dur pangngai tak, a tlang a tihkeh mai theih, a ro erawh chuan chang ve tak a ni. Heng lei hi a hnawna kuta han hmeh sawr chuan kut kar ațangin ribbon ang deuh a rawn put chhuakin sei tak a nih hmain a chhum ve leh mai țin a ni
Silty clay : Silt-te hi chu tlak lei aiin a lei mur a hraw hret a, thlai țin a pai lo tlangpui bawk a ni. Silty clay-te hian zaah silt aiin tlak lei an pai tam zawk țin a ni
Sandy loam : Sandy loam-te hian balu lei an pai tam avangin han hum hian a mur hraw deuhin a hriat a, huan leh kawt velah heng lei hi a awm a nih chuan tuihawk/tuitling te a put ral zung zung thei. Amaherawhchu, thlaite hman ținakai turin tui leh leița (nutrients) erawh a pai thei meuh lo thung. Hetiang chi leia (sandy loam) thlai kan ching a nih chuan tui leh leița kan pek zin deuh a ngai țin.
Loamy sand : Heng leite hi a tlangpuiin silt leh tlak leiin a siam an ni, mi ținkhat chuan loamy sand leite hian tui an pai theih vak loh avangin thlai chinna atan an duh zawk țin a ni.
Balu lei (Sand) : Heng leiah hi chuan thlai chin a awlsam em em a. Amaherawhchu, tui a pai theih loh em avang hian a bik takin nipui laiin tui pek ngun a ngai hle țin. Balu leiin tui a pai rei theih loh avang hian zung țin a awlsam deuh thlai phunna atana lei hman tur duhawm tak a ni.

Kan lei chu eng ang chi nge a nih tih engtin nge kan hriat ang:

Lei nih phung a thap leh thap loh dan (texture) hian eng ang nge lei mur (balu lei emaw silt emaw tlak lei emaw)-in nge siam tih hi a hriat theih țin a ni. Lei nih phung (texture) hian lei hman ținakai theih dan turte a hrilin, tui leh boruak a pai theih dante a hril bakah engtiang ang takin nge lei chhunga tui a luha a chet kual theih tih thlengin a hril a ni.

Lei nih phung (texture) hre tur chuan kan lei lak ațang khan lung nawi leh lei tlang lian deuhte kan thliar hrang phawt tur a ni (2mm aia lian chu thliar hran vek tur a ni). Lei dūr țin tak chu balu lei, silt leh tlak lei inpawlh tawh tak hi a ni. Heng test ti tur hian lei dūr țin tak hman tur a ni.



Lei nih phung hre tura enchhin dan awlsam (Field test) :
 Awlsam taka lei nih phung hre thei tura enchhin dan mawlmang
 tak chi hnihte chu :

Lei tlang vawrh nelh nelh(Throw-the-ball test): Lei hnawng thum
 khat lak a, hrual/hmer mum tur a ni.



Lei hrual/hmer mum chu boruakah 50 cm (1ft aia sang hret)
 vawrha lo dawn leh tur a ni.



Lei chu kutphaha a tla darh/pherh/sawm a nih chuan lei chuan
 balu lei a pai hnem tihna a ni ang.



Lei chu a la inhlawm reng thei a nih chuan tlak lei a tawh chiahin a awm a ni thei ang.



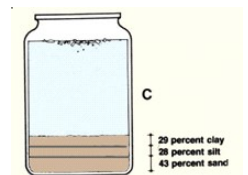
Saidawium test (Bottle test) : He enchhinna hi leiin balu lei, silt leh tlak lei a pai zah tlangpui hriat theih dan mawlmang tak a ni.

Saidawiumah lei (soil) 5cm-a chhahin dah la, tui chung khat rawh.

Tha takin chawhpawlh la, darkar khat vel che loin hung rawh. Darkar khat hnuah chuan tui chu a lo fimin thil nawi lian deuhte chu a lo tla khawm tawh ang.



- Tui chunglangah chuan Organic Matters thenkhatte chu an lo lang i hmu thei ang.
- A mawngnawi tla khawm chung berah chuan tlak lei i hmu ang.
- Tui chu a la fim lo a nih chuan tlak lei mur sin tak tak leh tuite chu an la inpawlh a ni thei ang;
- A tla khawm thuah laihawlah chuan silt a awm ang.
- A tla khawm thuah mawng berah chuan balu lei a awm thung ang;
- Balu lei, silt leh tlak lei tling thuah chhah lam theuh chu tehin kan lei laka an (Balu lei, silt leh tlak lei) awm zat theuh (proportion) tlangpui chu a chhut theih tawh dawn a ni.



A chung a kan han tar lan tak lei chi thum; balu lei, silt leh tlak leite khi lei siamtu mur tlanglawn ber an ni a. Amaherawhchu, khing lei chi thum zinga a tam ber khian lei awm dan (properties) chu a hril ber thin thung a ni.

Hetianga lei timur awm len dan a zir zel hian lei nih phung chu a lo danglam mai thin a ni; tlak lei, loam, clay-loam, chutiang zelin. Thlai chinna atana lei timur inchawhpawlh tawk tlangpui chu; 40% balu lei, 40% silt leh 20% tlak leite hi a ni. Hetiang taka lei mur inchawhpawlh tawk awmna lei hi sawntlung lei/hlum lei (loam) tiin an sawi thin a ni. Loam lei hian lei then chi hrang hrang atanga an nih phung tha lai lai theuh kha a rawn chhawmin tui leh boruak awlsam taka chevel thei tho siin a tawk chiah tui a fawm thei a. Tin, silt leh tlak leite ang bawkin thlai tana chaw tha a pai tho bawk si a ni.

Lei pH (lei thur lam sawina):

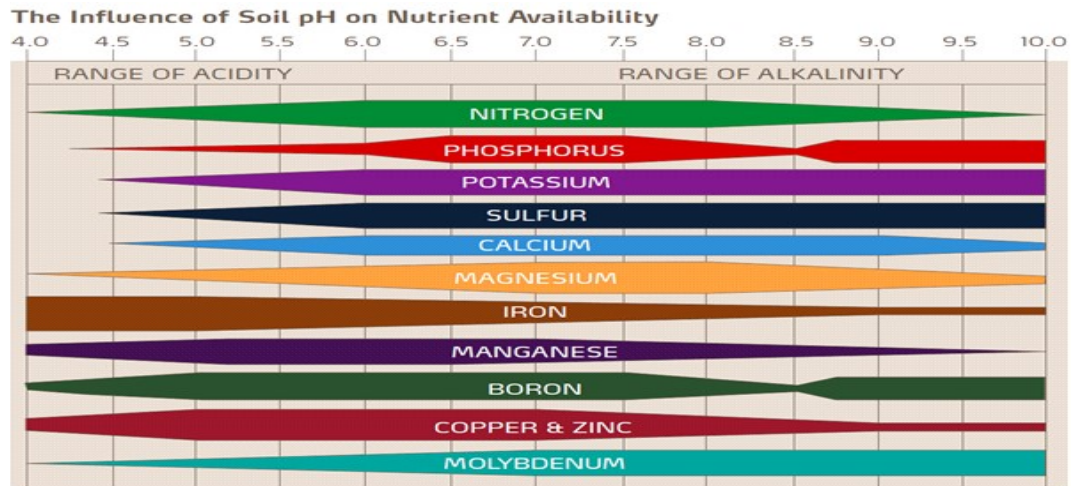
Lei pH kan tih chu lei thur leh thur loh (basicity/ alkalinity) sawina a ni ber a. Lei thur leh thur loh hi lei nih phung pawimawh ber zinga chhiar tel a ni a, a chhan chu lei chhunga chemical inchawhpawlh (chemical reaction) dan kawngah nasa taka nghawng a neih vang a ni. Lei chhunga heng chemical inchawhpawlh te hian leiin thlai tana chaw tha a paite thlai tana ei theih tura chhawp chhuah kawngah awmze thui tak a neih avangin a pawimawh em em a ni. Thlai tam zawk hi chu lei thur lam tehna (pH) 5.5 atanga 7.5 inkarah hian an tha duh ber a. Amaherawhchu, thlai eng emaw zat chu hemi pH inkar aia lei thur emaw thur lo zawk emawa tha duh zawk an awm ve bawk a ni.

Lei thur lam (pH) tehnaa 7.3 - 7.5 inkarte hi neutral pH tia sawi an niin 7.5 aia pH sang lei chu lei al (alkaline) an ti a, 7.3 aia a hniam leh thung erawh chuan lei thur (acidic) tiin an sawi ve leh thung thin a ni.

Lei thurin a nghawng pawl theih te:

- Lei a lo thur avang hian leiah aluminium, iron, manganese leh zinc-te thlaiin an mamawh aia tam (excess) a lo awm ta thin a, hei hi thlai tan a pawl thei a ni.
- Lei thur hian thlai tan chaw tha thenkhat (Macro & micro-nutrients) phosphorous leh a dangte kha thlai tan hman tangkai theih lohah (unavailable) a lo chantir thei thin a ni.
- Lei thurah reng reng hian thlai thite lo ei tawih thintu rannung (microbial)-te an tamin, chu chuan leia thlai tana chaw tha pawimawh em em Nitrogen awmte a tihlem phah thei thin a ni.

- Lei thurah chuan leia rannungten thlai leh thil thite an ei tawih zung zung thei lo thin a ni.
- Leiin calcium, magnesium leh potassium a tlakchham phah thei bawh a ni .



Thlai hming	pH Range*	Thlai hming	pH Range*
Maize (Vaimim)	5.5 - 7.5	Pineapple***	5.0 - 6.5
Millet (Buhtun)	5.5 - 8.0	(Lakhuihthei)	
Sorghum	5.0 - 8.0	Banana (Balhla)	5.5 - 7.5
Rice (Buh)	5.0 - 7.0	Potatoes*** (A lu)	5.0 - 7.0
Wheat (Chhangphut buh)	5.5 - 7.5	Sweet Potatoes (Kawl bahra)	5.0 - 7.0
		Tomato	5.5 - 7.0
Beans (Be)	5.8 - 7.5	Cabbage (Zikhlum)	6.0 - 7.0
Soyabeans (Bekang)	6.0 - 7.0	Lettuce (An tam hel ei)	6.0 - 7.0
Peanuts	5.3 - 6.6	Onions (Purun sen)	6.0 - 7.0
Cotton (La)	5.5 - 6.5	Peppers (Hmarcha)	5.5 - 7.0
Tobacco** (Vaihlo)	5.5 - 7.5	Cucurbits (Fanghma)	5.5 - 7.0
Sugarcane (Fu)	6.0 - 8.0	Watermelon (Dawnfawh)	5.0 - 7.0
Coffee	5.0 - 7.0	Alfalfa	6.2 - 7.8

- * A chung a tarlan thlaite hi a chi leh a chinna lei azirin pH tarlan inlarah a tha duh tlangpui.
- ** pH 5.5 hnuai lam hian potato scab leh tobacco black rot a veng
- *** Lalkhuihthei hian pH of 4.5 - 5.5 a mamawh.

Lei thatna leh thlai tan chaw tha vawng him tura agro-ecological practices:

Lei thur siam thar/enkawl dan:

Chinai lung (Limestone) pawlh hian lei thur hi a siam tha lehin a pH-te pawh a rawn tisang ve leh thin a ni.

Lei thur siam thar lehna tur atana chinai lung hman thin hrang hrangte chu : dolomitic limestone, quicklime, hydrated lime, marl, chalk, tuikep kawr, vut (thing tuahna vut), fluid lime-te an ni. Lei thur siam tharna atana chinai pawlh (liming) hian thatna leh that lohna kawng hrang hrang hengte hi a nei. A hnathawh that tawh danah te, a man (price) kawngahte leh a him dan kawngahte. Lei thur siam thatna tura chinai/chinai thi hnathawh thei tura hman dan tha ber chu lei chhung (1ft) vel tala thuka leh hnan (plough) tur a ni.

Lei thur siam thatna atana chinai hman:

A tlangpuiin ram tin khat hmun enkawl na atan hian chinai thi 15-20 kg hman a ni thin a, hetiang a chinai hmanga sawngbawl (liming) a nih hnu hi chuan kum 3 hnuah chiah tih nawn leh a ngai thin. Mamawh ang taka pH siam tha tur leh leia zawp ral tura hun a duh rei avang hian thlai chin tak tak hma thla 3 atanga thla 6 vel talah liming hi tih thin tur a ni. A nihna takah chuan thlai seng zawh chiah hian liming hi ti ila a tha ber. Amaherawhchu, thlai to tawh hnua liming tih hian kawng eng emaw takin thlaiin lei atanga chaw tha a hipna kawngah puiin thlai seng dawn hnaihah pH siamthat hna hi a thawk ve leh thei bawh a ni. Liming kan tih zin dan tur hi chu kan lei awm dan enfiah/hriat chian hmasak (soil test) hmangin kan enchiang pawt thin tur a ni. Chinai kan hman hnathawh hriltu pawimawh tak mai chu chinai kan dah thuk zawng leh leia kan pawlh dan hi a ni. Chinai kan phul in kan thlai phun zung thuk dan a zir emaw kan lei

leh thuk dan azir a chinai chu phul thin tur a ni. A tlangpuiin chinai hi 15-25 cm-a thuk lei chhunga phul thin ni se, a chhan chu buh lam pang chi (grain crops) tlangpui zung thuk dan a nih vang a ni.

Lei chunglang luan ral chhan, harsatna a thlen leh a ven dan:

Chhan eng emaw avanga lei chunglang leitha a kal ralna dan hi lei chunglang luang ral (Soil erosion) an ti thin. A chhan hrang hrang awm theite chu : Ramngaw thiah chereu vang te, ran tlat nasat lutuk vang te, lui tuiin a kam a lak hek vang te, mihringin lei chunglang eng emaw vanga an tihrial vang te, tlangram lo neih vangte a ni thei. Soil erosion hian nghawng hrang hrang a nei thei a, chungte chu : thlai chin theihna hmun/ram a tihzim phah thei, lei thatna (fertility) a titem, lei chhunga tui put luh theihna a titemin chu chuan lei chung tui insiam thar leh tur a titem thei a ni.



Leilung ven him (Soil conservation) :

Lei chunglang luang ral zel tur ven leh lei thatna tlahniam zel tur ven hnathawh hi leilung ven him (soil erosion) kan tih chu a ni.

Leilung ven him dan hrang hrangte:

1. Chhawlchhin (mulching).
2. Terrace-a thlai chin.
3. Huam chin bik neia leilung luang ral tur ven.
4. Thli dal siam.
5. Lei khuh tur thlai chin (cover crop) leh thlai chin thlakthleng (crop rotation).

6. No till farming (Lei leh loa thlai chin).
7. Green manure (Thlai hring leiṭha atana hman chi).
8. Lei al enkawl.
9. Stream bank protection (Lui dung ven him).
10. Crop rotation (Thlai chin thlak kual).

1. Chhawlchhin (mulching) :

Chhawlchhinna hmanrua hi chi hrang hrang a awm; Thlai hnah leh siam chawp ni lo hmanraw hrang hrang te, sahar lam te, petroleum lamte leh hmanraw dang hrang hrang, organic leh organic ni lote a huam a ni. A tlangpui erawh chuan chhawlchhinna hmanrua hi chi hnihah an then a; organic chhawlchhin leh organic lo chhawlchhinnate an ni. Organic chhawlchhinna kan han tihte hi chu leilunga rannung awmtan an ei ṭawih ral thei mai ṭhin a, organic lo chhawl chhinna erawh hi chu mihringin an siam chawp niin an ṭawih ral thei ve lo thung a ni. Organic chhawlchhinnate hi organic lo chhawlchhinnate ai chuan an ṭangkai zawka ngaih a ni. Organic chhawlchhinna emaw organic lo chhawlchhinna emaw hman hi chu a hmangtu duhthlanna a zir a ni a, amaherawhchu, organic-a chhawl kan chhin hian kan lo/huan leh a chheh vel a hmanraw remchang awmte kan hman mai theih avang leh a ṭawih ral mai theih avang hian ṭangkai zawka ngaih a ni. Organic chhawlchhinnate hian leiah leiṭha an hnutchhiahin lei ṭhatna an tipung thei a ni. Organic lo chhawlchhinna heng, sahar (plastic)-te hi a hman leh deh vel a awlsam zawkin duhawm tak angin a lang na a, an ṭawih ral ve thei loin kan chheh vel leilung tan harsatna an siam thei thung a ni.

Organic chhawlchhin :

Organic chhawlchhin kan han tih hi chuan mihring thil siam chawp ni lo, ṭawih ral leh mai thei, heng: hnim leh thlai lam chi eng pawh, thing kâwr leh hâr te, phuai te, phul te, favai, buhpawl leh adangte a huam thei a ni. Heng chhawlchhinnate hi rei lot e hnuah ṭawih ral maiin leiin tui a fawm theihna nasa taka a tihpun mai bakah lei ṭhatna a tipung tel thei bawh. Tin, thlaiin tui a hman ṭangkai theihna a tipungin lei hnawnna kal ral mai mai tur kha a veng bawh a ni. Heng chhawlchhinnate hian hnimin ni zung an hmu tur kha dalin an ṭo tur kha a lo dîp thei bawh a, hnim an tlem chuan tui lo ei hektu an tlemin thlai tan a ṭha leh thung a ni. Kan thlai chin tur leh leiṭha kan mamawh azirin chhawlchhinna hmanrua kan thlan tur pawh hi a

dang ve leh thei baw a ni. Mihring, ran leh thlaite aţang hian kum tin, khawvel pumah bawlhhlawh  awih ral thei metric ton vaibelchhe 38 leh nuaih 600 aţang nuaih 700 metric ton vel (metric ton nuaih 272 thlai hnawmhnawkw telin) India ramah hian siam chhuah  thin anga chhut a nih laiin a tam zawk hi chu hman tangkai loha kal ral mai mai  thin anga ngaih a ni. Chhawlchhinna atana hman  thin langsar zualte chu a hnuaiah hian tar lan a ni :

a. Thlai hawng/pil :

Hengte hi chuan anmahniin tui pai an neih ve mai bakah lei hnawnna vawn  that kawngah an thawh hlawk em vang hian an  tha bik em em a ni. Thlai kumhlunah hman chi deuh a ni a, an  awih ral hian lei a tihthur theih avang hian chuktuah huanah chuan hman chi vaka ngaih a ni lo. Thlai chinna (beds) inkara phaha hman fo a ni bawkw.



b. Di/Phul hnah (Grass clipping) :

Di/phul hnah hi India ramah chuan chhawlchhinna atan hmanraw hmuh awlsam leh tam ber a ni. Phul/Di hnah tharlam tak hman anih pheih chuan a  awih ral chakin leiah nitrogen lei ha tam tak a hnutchhiah thei a ni. Hnah ro leh a hring pawh awlsam takin a hmuh mai theih reng a ni. Awlsam taka zung kaia thlai tan hnawksak a nih theih avangin fur laia di lam pang chi kan hmang dawn a nih chuan fimkhur deuh a  tha hle. Hnah hring kan hmang a nih chuan a  awih ralna kawngah lumna pe chhuakin thlai tan thil pawh thleng thei a ni

a, chuang chuan hnim ro hman hram hram theih ni se. A tlangpuiin lei 2-3 inches-a thuka dah theih ni se.



c. Hnah ro :

Chhawlchhinna atana hnim hnah hman hi lei tan a ðhain leiah leitha eng emaw zat a hnutchhiah thei a. Thing tamna hmunah leh ramngawahte hian a takin kan hmu fo ðhin a ni. Thing hnah rote hi hmuh mai a awlsamin ðawih ral mai thei a nih vang hian a hman chi hle a ni. Amaherawhchu, fur lai/favang lai hian hnah ro hi a vang deuh ðhin a, thlasik leh khaw ro lai taka hmanraw pawimawh tak a ni thung. Thliin hnahro kan dah te a chhem darh mai lohna turin thing ðang leh thing hâwngtein kan delh bet ðhin tur a ni, hnah roa chhawlchhin hi 3-4 inches-a chhah tih ðhin a ni.

d. Buhpawl :

Chhawlchhinna atan hian hman tlanglawn ber a ni a, a chhan chu hmuh a awlsamin thliin a len sawn awlsam ve lo a. Tin, ni êng a kah let ðhat avang hian thlai ðhenkhat chuan rah an lo chhuah ðhat phah thei a ni. Thlasik laiin an hmang tlangpuiin chawhmeh, thlaiho atan chuan nipuiah pawh hman fo a ni bawk. Buhpawl hian ni zung a dal ðhain ruahtui a tlang zung zung thei lo a, hnim a dip nat em avang hian hnim vengtu ðha tak a ni bawk a ni. Buhpawl hman a nih

hian hnim chi/ṭiak a tel ve ngai meuh loh avang hian a ṭha hle bawk. Kangmei a man awlsam em avangin kangmei chhuah awlsamnaah erawh chuan hman fimkhur hle tur a ni. A tlangpuiin 6-8 inches-a chhahin phah ṭhin a ni.



e. Compost/Manure :

Compost leiṭha hi chhawlchhinna atana hmanraw ṭangkai tak niin hman lai aṭanga an lo hman fo ṭhin a ni. Mahni in lama hnawmhaww ṭawih, hnahtel tla, hnim leh buhpawl hmang pawha awlsam taka siam theih niin lei nih phung kawng hrang hranga tihmasawntu a ni bawk. Lei carbon nasa taka tipungin leiin tui a fawm theihnaah nasa takin a ṭanpui thei bawk a ni. Compost hi lei hriselna tihmasawntu ṭha tak ni bawk mah se nitrogen a pai tam em avang leh hnim chi a pai tel ve theih ṭhin avang hian chawhmeh huana hmanah chuan duhthu a sam vak lo thung. Compost hman hun ṭha tak nia lang chu thlai chinna tur hmun siam lai leh thlai chin tirh lai vela a chungah chapah a ṭha a ni. Leiṭha mamawh deuh thlai ṭhenkhat heng rose-ahte hian an hmang fo ṭhin bawk a ni. 3-4 inches-a thukah hman ṭhin tur a ni.

Organic chhawlchhin that biknate :

Chhawlchhin hian nasa taka niin lei a chhun tur lo dangin, lei sa chak lutuk tur a vengin lei lum leh vawh lam a lo vawn dikpui thei a ni. Niin lei direct-a a chhun tur lo dalin chu chuan leia tuihu awmte an chhuak ral zung zung tur a veng thei a, hei vang hian khaw lum leh khaw vawhna hmunah pawh lei chhawlchhin thin hi a tangkai em em a ni. Chhawlchhin hian ni zungin lei a chhun tur a dal thin avang hian hnim to mai tur pawh kawng tam takin a lo dip ve fo thin. Thli leh tuihawk satliahin lei chunglang a len riral mai tur lakah pawh a hum him thei bawk a ni. Ruah a sur tumin ruahmalte chu lo tikhawmuangin tuihawka luang ral nghal mai lovin lei chungah an put luhna hun a lo titam a, hei hian lei chhunga tui put lut titamin thlai tana tui hnianghnar taka a awm theihna kawngah nasa takin tangkaina a nei bawk. Lei chhawlchhinna hmanrua (organic bik)-te chu an lo tawih ral hian leiin organic leiṭha a pai hrang hrangte tihpun belhin lei a tidur tha sawt thin. Tin, hei bakah hian kawng hrang hrangin lei nih phung a siam tha nasa thei hle bawk a ni. Lei chhunga rannung leh hrik awm thenkhatte tan chaw tha remchang tak a ni thei bawk. Sawi tawh angin chhawlchhinna hmanraw tawihthe hian leia organic leiṭha awmte nasa taka tipungin hei hian lei nih phung a tihmasawn a, thlai zungten awlsam taka lei an tawn tlang zung zung theihna atan te, awlsam taka thlai zung a inzam darh theihna atante leh lei thua thuk zawka leiṭha awmte thlaiin a chhawr tangkai theihna tur atan a tangkai hle a ni. Lei a lo dur that chuan lei chhungril zawkah awlsam takin tui pūt tlang theiin leiin tui a paite a ti pung a, chu chuan lei chhunga thilnung awm ve hrang hrangte chu tipungin leia thil tawih thei awm hrang hrangte a tawih raltir zung zung theih phahin, leia leiṭha awmte a lo pun chak phah ve leh chhawng bawk thin a ni.

Organic chhawlchhin that tawh lohnate :

Organic chhawlchhin hian thatna tamtak nei bawk mah se lei sakhat tui put ral zung zung theih lohna chi-ah erawh chuan lei tihdawng nasa lutukin thlai zung leh a chhehvela oxygen awm tur a tihlem phah theih avangin harsatna a thlen thei thung. Thlai kung nena insia chhawlchhinna hmanrua a awm hian hnawng insiamin

natna leh rannung awm theihna remchang a siam theiin rannung (pest) thenkhat inthlah chhawnna hmun remchang takah a chang ve thei baw. Fimkhur taw loh vangin chhawlchhinna hmanruate hian hnim chi lo paiin hnim lo awm theihna chhan a lo ni thei baw a ni. Organic chhawlchhinna te hi awlsam taka tawih ral thei mai an nih avang hian an pawimawh chung a rei lo thei hle baw a ni.

Chhawlchhinna tur hmanraw thlan dan :

Hmanraw man : Chhawl chinna atana hmanraw man tlawm leh man neihlo chi a awm a nih chuan a hranpaa chhawlchhinna tur hmanraw lei hi a tul lem lo, awlsam taka kan hmuh theih hmanraw hman mai hi a finthlak zawk fo a ni.

Chhawlchhinna tur atana hnim/thlai hman tur thlan:

Thlai chin lai meka natna leh rannung kai chhawng thei tur chi thlai/hnim reng reng chhawlchhinna hmanrua atan hian hman thin loh tur a ni. Tin, hnim chi keng tel thei awm tur reng reng pawh chhawlchhinna atan hian hman loh hram hram baw tur a ni.

A hun azira chhawlchhinna hmanraw thlan :

Nipui lai chuan chhawlchhinna hmanrua rawng lar lam deuhte hian lum an lo kah let theih avangin hman a tha a, favang intan chhoah erawh chuan hmanraw thim/dum lam deuh hman a tha thung, a chhan chu heng rawng thim/dum lam hian lum a pawmin chu chuan lei lo tilumin thlai a phun hma theih phah bakah thlai a tithang duang bawka ngaih a ni

Chhawlchhin hun tha leh a hman dan tha :

Ruah bawhawk a tlak zawh tawh, lei a hnawn that viau leh niin lei a tihlum deuh tawh hnuah hian chhawlchhin thin hi a tha hle. Favang tawp lam pawh hi chhawlchhin hun tha tak a ni baw. Fur tan tir/ruah sur tirh teah hian lei a hnawngin a lum fo thin a, hetih hun laia chhawlchhin kan tih mai chuan lei a thaw tha thei loin leia boruak lum a chhuak tha thei lo thin a, chu chuan rannung leh natna hrang hrangte a awm awlsamtir thei a ni. Natna lo awm palh thei tur venna atan leh lei tana tha turin fur tan hma thla 2-3 vela chhawlchhin kan ti a nih chuan tui tha taka pek/leih theih hi duhthusam a ni. Fur tawp lama chhawlchhin pawh hi a tha hle baw.

Hetih hunah hian lei chu a lo hnawng thain lei hu a chhuak tlangpui tawh a, lei hnawng tha tak chuan chhawlchhinna hmanruate awlsam taka tawih theih nan a lo pui zung zung bawh a ni. Thlai chinna tur hmun (bed) siam zawh hnua chhawlchhin hi a tih chi hle bawh. Organic chhawlchhinna kan hmang dawn a nih chuan hnim fai taka thlawh phawt thin tur a ni. Tin, kan hmanraw hman turah chuan hnim chi a awm lo ngei bawh tur a ni. Chhawlchhinna reng reng thlai natna leh rannung keng tel thei awm chi hman reng reng loh tur a ni, hetiang hmanrua kan hmang a nih chuan kan thlai chin laia rannung leh natna darh theihna remchang a awm thin a ni. Leikhakhawng, chanchinbu 4-6-a chhah huan vela han phah maite pawh hian hnim to tur a ven theih avangin chhawlchhin dân tha tak a ni bawh. Hmanraw hraw deuh chhawlchhinna atana kan hmang dawn a nih chuan kan tihchhah deuh hlek a pawimawh. Thuah 3-6 vel hian hnim satliaho hi chu a dang thei. Chhawlchhinna atan hian hmanraw phawkphawhraw tak tak ai chuan felfai leh senghawi nuam tak hman hi a tha zawk a ni.

Thlai thanna kawnga organic chhawlchhin nghawng theihthe :

Organic chhawlchhin hian kawng hrang hrangin thlaiah thatna a thlen thei a, a par hmatir thei a, a rah hma phah thei a, thlai seng hun chhung a tirei a, tomato-ah bik chuan a par leh a rah a ti tam sawt a, buhpawl 4 inch-a chhawlchhin thlai chinna hmunah chuan thlai san lam leh a hnah ngah lam a tha bik hle. Drip hmanga thlai chawm satliah ai chuan drip leh chhawlchhin hmanga thlai enkawlte chu an thang thain an rah pawh a tha zawk, kumtlwana enchhinnaah pawh tuia chawm leh chhawlchhin hmanga enkawl thlaite hi an thang duang ber a ni. Polythene dum leh lang tlang thei hmanga badam (Groundnut) chhawlchhinna enkawl hian chhawlchhin loh aiin, a bulbawk (pod) 17-24% laiin a insiam tha zawk a, a bulbawk rah pai (haulm yield) a tha zawk a, (16% laiin) lei lum leh vawh lam a that em avangin, a tiakte an thang tha a, a par hmain a par tha hle a, a bulbawk puitling a tam zawkin hnim to pawh a tlem zawk fe bawh a ni. Bawrh Saiabe thlaiah thing zaina phuai chhawlchhin, hnim chhawlchhin leh chhawlchhin lohte an khaikhin chuan hnah ngah

lamah (no. of leaves) 43, 36 leh 27 a ni a, a kung lian lai ber hawlh tlanga tehin chhawlcchhinah (phuai leh hnim) chuan 37 mm a nih laiin chhawlcchhin loah chuan 26 mm a ni thung, a rah hnem lamah chuan 7.6 tonnes/ha, 7.5 tonnes/ha leh 5.2 tonnes/ha-te an ni.

Thlai thar chhuah kawnga organic chhawlcchhin nghawngte :

Alu chhawlcchhina enkawl leh chhawlcchhin loh khaikhinnaah chuan starch an pai tam lam chu chhawlcchhinah hian 27.9% a nih laiin a pakhat zawkah chuan 18.18% chauh a ni thung. Tomato leh bawrhsaiabe bikah hian buhpawla chhawlcchhin (6 t/ha) chhawlcchhin loh aiin a thar chhuah 100% leh 200% laiin a tam zawk a ni. Bawrhsaiabeah hian phuaia chhawlcchhin aiin buhpawla chhawlcchhin a thar hlawk zawk lehchhawng a ni. Chhawlcchhinna hmanraw hrang hrang, heng; fu kawr leh fe, buh pawl, bekang kung leh chhawlcchhin lohte an thar chhuah khaikhin chuan an inthlahna chu hetiang hi a ni - 12.64%, 9.06%, 7.46% leh 3.74% tein a inthlau a ni. Fu kawr leh fea chhawlcchhin leh drip-a tui pek bawh hian 53% laiin thlai thar a tipung thei a ni.

Chhawlcchhin-in lei a nghawng theih dan :

Chhawlcchhin awmna lei aiin lei lawngah hian tui tuihuah a chang (evaporation) rang zawk a. Lei hnawn that lam leh a tui fawm theih lam hi lei nih phung hrang hrangah a inngat a, hei hi organic chhawlcchhin hmangin a tihhmasawn theih bawh a ni. Lei chhawlcchhin a that poh leh lei chhung huh theih thui lam (soil wetting rate) a tha sawt thin a ni. Zir chianna atanga a lan dan chuan hnawng tlem te awm atang pawhin buhpawl hian lei hnawna nasa takin a ti pung thei a ni. Chhawlcchhin miah lohna lei aiin buhpawl hmanga chhawlcchhin hian 55% laiin lei hnawna a vawng him zawk thei a ni. Hetiang ang deuh bawh hian alu chinnaah chhawlcchhinin lei kawng hrang hranga tihthat avangin thlai an hrisel zawkin a thar pawh a hlawk zawk a ni tih fiah a ni bawh. Lei 1.5 m-a thuka hnawna (moisture) awm pawh buhpawl (6730 kg/ha)-a chhawlcchhin hi lei lawng tawp aiin a tha zawk a ni tih hriat a ni bawh, Sorghum (thlasik thlai) thlai chin atanga seng thlenga lei chhung 15cm, 30cm leh 45 cm atanga lei hnawna kiam dan chu 9.14%, 11.33% leh 11.92% a

ni. Heng chhawlchhinna hmanraw hrang hrang hman aṭangte hian hetiang hian lei hnawnna pun dan chhinchhiah a ni bawk a ni; fu kawr leh fe, buhpawl, bekang kung leh chhawlchhin lohahte hian 28.19%, 17.81%, 12.26% leh 7.54% te an ni. Heng chhawlchhinna hmanraw hrang hrang hman aṭangte hian hetiang hian lei lum leh vawh lam tlangpui (average) lak khawm chhinchhiah a ni bawk. Fu kawr leh fe, buhpawl, bekang kung leh chhawlchhin lohahte hian 19.58°C, 20.04°C, 20.37°C, 20.73°C and 21.33°C te an ni. Phul lam pang hmanga chhawlchhinah hian lei lum leh vawh lam hniam ber record a ni. Plastic chhawlchhina hman hian lei lumna a vawn ṭhat leh tihpun em vang hian thlasik laia nipui thlai thar duh tan chuan a hman chi hle a, chutih laiin phul leh di lam hian lei an vawn daih ṭhat avangin nipui lai chuan an hman chi hle thung a ni.

Chhawlchhinin hnim ṭo dan a nghawng theihthe :

Hnim ṭiak tur leh ṭhang duang tur hi chhawlchhin hmang hian nasa takin a ven theih a, chhawlchhinna hmanruate hian hnim ṭona tur lo dalin a ṭiak tur pawh an lo dip ral thei a ni. Chhawlchhin loh leh hlotur hmanna aiin polythene leh buhpawl hmanga chhawlchhinah hian hnim ṭo a tlem zawk daih a ni.

2. Terrace-a thlai chin :

Tlang pang awih laia hmun zawl lo laih emaw dawh zawl emaw hi terrace kan tih chu a ni. Chhawrdawh siama kan lo dawh zawl hian tuihawk luang riral mai mai tur leh leiṭha luang ral tur nasa takin kan lo veng thei a ni. Terrace-ahte hian khawl hmanraw hman a harsat deuh ṭhin avangin ram changkang vak loahte terrace siam hi an ching bik deuh.

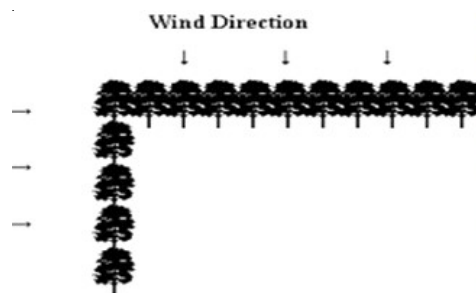


3. Perimeter runoff control (Hung bik neia leilung luang ral tur ven) :

Tuihawk leh chhan dang vanga leilung leh leiṭha luang ral tur venna atana kan huan ri kuala thing, thingbukte leh thlai ṭawih chite kan phun kual ṭhin hi Perimeter runoff control an ti. Phul lam pang chi hmanga leilung leh leiṭha luang ral tur ven hi chin dan ṭha tak leh pawh khawih nep zawka tuihawk senghawi dan ṭha tak a ni.

4. Windbreak (Thli dal) :

Thli thaw vanga leilung luang ral tur venna atana huana ri hunga zing leh bit taka thing phun tlar hi Windbreak (thli dal) an ti. Thing hnah tla kawlh lo chi (evergreen)-te hian kum tluanin thli vanga leilung luang ral tur an ven theih avangin an hman tlak hle a, thing hnah tla kawlh chi (deciduous)-ho pawh hnim ṭo loh laia hnah an nei tho a nih chuan a hman tlak hle tho a ni.



5. Cover crop (Leilung lang tur veng tura thlai chin) :

Kum tluana lei khuh a nih theihna atan leh green manure te, nitrogen leh leitha pawimawh dang hrang hrangte pe thei turin sum chang thlai leh cover crop thenkhat heng buluih leh bulbawkte hi chin chhawk kual a tha hle.

6. No till farming (Lei leh loha thlai chin) :

Heng hi lei hmelhmang tidanglam lo leh lai phut loa kum tluana thlai chin dan thin hi a ni. Heng chin dan hian lei chhunga tui put lut a tipungin leia organic matter awmte a tipung a, chu chuan lei thatna nasa takin a belhchhah a ni.

7. Green manure (Thlai hring lei tha atana hman chi) :

Thlai thenkhat, ei atan leh hralh atan ni lo hmun leh huan titha tura kan chin thinte hi green manure an ni. Heng thlai chinte hian lei an ti tha mai ni lovin hnim to tur pawh an dip theih avangin chin dan tha tak a ni.

8. Lei al enkawl :

Leia tui awmte a hua an kal ral hian leia chi awmte chu a hnutchhiah thin a, hengte hian lei an tichhiain leithate pawh thlai tana hman theih lohin a awm phah thei thin a ni. Humic acid hman hian hetiang a lei al awm thei hi a veng thei a, tin, thlai thenkhat heng; saltbush chin hian lei al vanga harsatnate chu a siam thain lei a titui ve leh thei thin baw a ni. Tuikhuah vang emaw, chhan eng emaw vanga tui chim chin (water table) a danglam hian lei al vanga harsatna hi a awm fo thin a ni.

9. Stream bank protection (Lui dung ven him) :

Tui len vang hian lui kamte hi a puk dek duk thei thin a, lung rem emaw thing tangkai thei tur chi phun hmangtea lui dung ven him hian leilung kal ral zel tur nasa takin a chhan him thei thin a ni.

10. Crop rotation (Thlai chin thlak kual) :

Hun indawta hmun ngai reng a thlai chi hrang leh chi inang lo chin kual thin hi crop rotation kan tih chu a ni. Hetiang tih a nih thin chhan chu hmun pakhata leitha awmte kha thlai chikhatin a ei dâk vek mai lohna atan tih thin a ni. Hmun ngai renga thlai chikhat kan chin reng hian leia leitha (nutrients) te kha hek leh thlain ei nasat

bik an nei thuai mai ṭhin a, thlai chinte kan thlak kual a nih chuan thlai chikhatin a ei loh leia leiṭha kha thlai chi dangte khan an lo ringin leiṭha ei hêk tawhte pawh a lo insiam thar ve leh zel thei ṭhin dawn a ni. Hei mai bakah hian thlai chin thlak kual fo ṭhin hian thlai natna leh eichhetu rannungte inthlah pung chho tur a tikhaihlahk ve thei bawk. Thlai chin kan thlak kual hian an zung pian hrang hrang avangte hian lei nih phung a lo danglamin hma a lo sawn phah ve thei bawk a ni.

Crop rotation hi thlai chin dan phung pangngai leh organic farming-ah pawh an chin fo ṭhin dan a ni. Thlai chin thlak kual hlâwkna tak pakhat chu nitrogen siam thei thlai leh nitrogen mamawh tak tak thlaite kan chin thlak kual ṭhin hi a ni. Legumes thlai ṭhenkhat heng; alfalfa-te leh clover-te hian an zunga bawk (nodules)-te hmangin leia nitrogen awmte chu an seng khawm a, heng thlaite hi seng an nih hnuah an zung bawka nitrogen awmte chu thlai chin leh turte tan leiah an lo hnutchhiah ta ṭhin a ni. Legumes-ho hi green manure pawimawh tak an ni nghal bawk a ni. Hei mai bakah hian, legumes-te hi zung ngah tak an nih ṭhin avangin lei an ti dur ṭhain lei leh a tiawlsam a, tui an fawm ṭhat theih phah bawk ṭhin a ni.

MODULE- 3

THLAI CHAW ṬHA (PLANT NUTRITION)

THLAI CHAW ṬHA (PLANT NUTRITION)

Thlai chaw ṭha (plant nutrition) hi thlai ṭhat nan te, an chaw siamna (metabolism) nante leh pawn lam aṭanga an mamawh khawm nan-tea thil ṭul - damdawi bawlhlo (chemical element) leh chungho inpawlh (compound)-te zirna hi a ni a. Kum 1972 khan Emanuel Epstein-a chuan thlai ṭhan ṭhatna tur chu kawng hnihin a hrilhfiāh a:-

1. A tel loa a pangngaia thlai nih phung a ṭhat pumhlum theih lohna thil.
2. Kha thil (element), thlai taksa tan emaw, thlai chaw siam nan emawa ṭul ve kha.

Thlai chaw ṭha atana thil ṭulah chuan carbon-te, oxygen-te leh hydrogen-te hi boruak aṭanga thlaiin a lâk/hîp a ni a; a mamawh dang, nitrogen-te pawh hi lei lam aṭanga a châwk luh a ni thung.

Thlai chaw ṭha atana thil ṭul zual chu 17 lai a awm. An ṭhan ṭhat nan thlai chuan a hnuaia thil (mineral) hi a neih a ngai a ni.

1. **Macronutrients:** Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Sulphur (S), Magnesium (Mg), Carbon (C), Oxygen (O), Hydrogen (H).
2. **Micronutrients (or trace minerals):** Iron (Fe), Boron (B), Chlorine (Cl), Manganese (Mn), Zinc (Zn), Copper (Cu), Molybdenum (Mo), Nickel (Ni).

Khawvel hmun hrang hrang boruak dinhmun (environment) leh leilung (soil) hi, thlai/thil ṭo chi hrang hrangten an nun phung pangngai (life cycle) ṭheuh zawh thei tura kha boruak leh sik leh sa mila an insiam rem (adapt) theih nan kha hmunah khan an tana chaw ṭha a awm kim vek thei a; lei tihṭhatna (fertilizer) pêk belh ang chî-a an mamawh puhruksak an ngai chuang lo. Mahse, kha leia thlai chîn a lo nih fo takah khan kha mi hmuna thlai chîn ṭhan duan nan te, a thar a hlawk zawk theih nante leh a hlawk ngai renga a thar hlawk theih nana a lei tihṭhat reng nan, lei tihṭhatna (fertilizer) pek a lo ngai ta ṭhin chauh a ni. Tui leh boruak êng ṭha kha tam reng mah se leia an chaw ṭha (nutrient) tlem ta vang khan an ṭhang duang thei ta loin, a thar pawh a hlawk nep ta ṭhin a ni.

1. Macronutrient chi hrang hrang (boruak leh tui aṭanga thlaiin a hmuhte):

- a. Carbon:** Carbon hi, protein, starch leh cellulose-te nen hian thlai mamawh pui ber a ni. Carbon hi thlaiin ni eng aṭanga ama chaw a siamna (photosynthesis)-ah boruak aṭanga boruak chi khat, carbon dioxide a hîp luh kha carbohydrate-ah a chantir a; a chhek-khawl a, a taksa mamawh atan a hmang ta ṭhin a ni.
- b. Hydrogen:** Hei hi thlaiin thil thlum (sugar) siam nan leh a ṭhan ṭhat nan a mamawh. Hei hi chu tui aṭanga a lak luh deuh vek zuk nia! Hydrogen (fang te reuh te [ion]-te) hi boruak leh tui aṭanga thlaiin a chaw tur a lak luh, ni eng nena ṭang kawpa a ei theih tura chawhpawlh a, chawh kawî a, siam danglam (photosynthesis) a, chhum hmin nan leh a thawk/boruak hîp nan, loh theih loha a mamawh a ni.
- c. Oxygen:** Hei hi thilnung leh thilnung lo taksaah hian a tam hle a, thil chi hrang hrang aṭangin an chaw lut ṭhin. Thlai hi chuan oxygen hi an chaw siam (photosynthesis) hun lai hian, glucose nen an siam chhuak a. Chu chu an thawk (aerobic cellular respiration) nan leh a glucose siam chhuah kha ATP (Adenosine Triphospha te, thlai chaw ber chhek khawmna 'kudam') ni tura siam chhuak leh turin a mamawh ta ṭhin a ni.
- d. Nitrogen:** Hei hi thlai taksa thil pawimawh tak tak zinga pakhat a ni a. Thlai timur (cell)-a thil awm zinga a tuiṛîl ve lo (dry matter of protoplasm), protein awm khawm-a 40 % - 50% hi nitrogen vel telna a ni a; protein siamtu bulpui ber pakhat, amino acid-a thil tel pawimawh tak a ni bawk. Thlai hrinna (chlorophyll) tana thil pawimawh a ni a; thlaiin a tlakchham chuan a ṭhang duang lo a, a ṭhan a ṭhu a, rawng dangin a kap ṭhin.
- e. Phosphorus:** Nitrogen ang bawka thlaiin a chaw a siamna kawnga pawimawh tak a ni. Thlai kung /taksa acid pawimawh tak - Deoxyribonucleic acid (DNA) leh Ribonucleic acid (RNA)-

a ṭul tak a ni a. Tin, thau (fat) lam chi, Phospholipids, thlai ti-mur bang (cell wall) siamtu pawimawh leh, chung ti-murin ṭha taka hna a thawh theihna tura puitu siamna kawnga pawimawh tak a ni.

- f. **Potassium:** A pawimawh zual deuh deuh ang chuan hei hi chu thlai chaw vel siamna kawnga inrawlh ve lo a ni a; mahse, thlai taksa bung khawiah pawh hian a awm thung. Thlai hnah leh thlai ṭhan lai hi a pawimawh zual hun niin a lang. Thlai chhunga thlai tihrawl chet ṭhat theihna tur leh tuiṛil deuha a awm theihna tura pawimawh a ni. Thlaiin carbohydrate leh protein a siamna kawngah leh, thlai chhunga tui leh hnawnna vawn ṭhat kawnga hna thawh chaktirtu leh, tuiṛil lo tura vawn ngai thil vawng ṭha tura puitu a ni bawk. Thlaiin ama chaw a siamna kawnga puitu, protein chikhat kha hnathawk chak turin a tur hmanhmawh bawk. Tin, ni eng nena ṭang kawpin thlaiin ama chaw a siamna kawnga pawimawh tak a ni bawk; a bîkin ni eng duh tawh hmuh lohna hmun leh hunah.

Potassium chuan a fang te reuh te (ion) hmanga nemna (pump) hmangin thlai hnah hnuai lama a thâwkna (hnar) kaw (stomata) inhawng leh inkhar dan leh hun a siamsak (control) a, thlai hnah aṭanga tui put bo tur a veng a, chu chuan thlaiah khan khaw rô leh ṭhal tawrh theihna a siamsak. Potassium tlakchhamna hian thlai hnah hrin ṭhat lohna leh a thisen zama rawng dang rawn pawlhtu a awm thei. Potassium ion/fang te reuh te (K-) hi a phelengin awmhmun nghet nei thei lo zeta che reng mai a ni a. A chet vel reng vang chuan thlaia negative fang te (anion) awm zat tur dik tak ang awm lo kha a sem rual ṭha ṭhin. Thlai rah rawng dik neihna turah te, thlai rah piangsual awm loh nante leh a Brix (thlai kung vela thil thlum [sugar]awm) tipung tur pawhin a ṭangkai bawk. Potassium tamna leia thlai rah chu a ṭha ta bîk a nih chu. Tin, ama chaw a siam ve-na (photosynthesis) leh a thawk lâkna tichaktu protein chikhat (enzyme) kha thawk chak tura turtu atana thil pawimawh tak a ni bawk.

2. Micronutrient pawimawhte:

- a. **Iron:** Iron (thir) hi thlaiin ni eng nena tangkawpa ama chaw a siamna (photosynthesis) atana thil tul a ni a, thlaia a thawk lakna tichaktu protein chikhat (enzyme) nena tang dun an ni. Thlaiin iron a tlakchham chuan a hnaha thisen zam rawng a dik lo a, thlai than a thu thin.
- b. **Molybdenum:** Thlaia a thawk lakna tichaktu protein chikhat (enzyme) nena thawk dun tho a ni, amino acid (protein tlem keng teltu) siam chhuah nana tangkai tak a ni a, nitrogen-in thlai mamawh a siam chhuahna (metabolism) kawnga tul tak a ni.
- c. **Boron:** Kawng hrang hrangin - thlai par leh a rah hrisel tha tur te, thlai para a pa chi (pollen) tinung tha tur te, a timur (cell) tipung turte leh 'chi' kan tih mai chi (salt) hip bo tur hian thlai tan a tangkai em em. Amino acid leh protein-te, carbohydrate-te, calcium-te leh tui te, thlai tana tha tura siam danglamna kawngah a tangkai hle.
- d. **Copper:** Ni eng nena tangkawpa thlai chaw siamna (photosynthesis) atana thil tangkai tak a ni. Copper a tlem chuan thlai a tang tha thei lo. Enzyme hnathawhna tam taka tel leh puitu a ni.
- e. **Zinc:** Enzyme chi hrang hrangah a tel a ngai a, DNA siamna kawnga tel a ni. Hemi tlachham thlai hnah chu, thlai than tirtu thil (hormone auxin)-in a kham khawp oxygen a hmuh loh vangin a tang thei lo a, 'hnah te/sawng/chawrche/little leaf' ti-a vuah a ni.

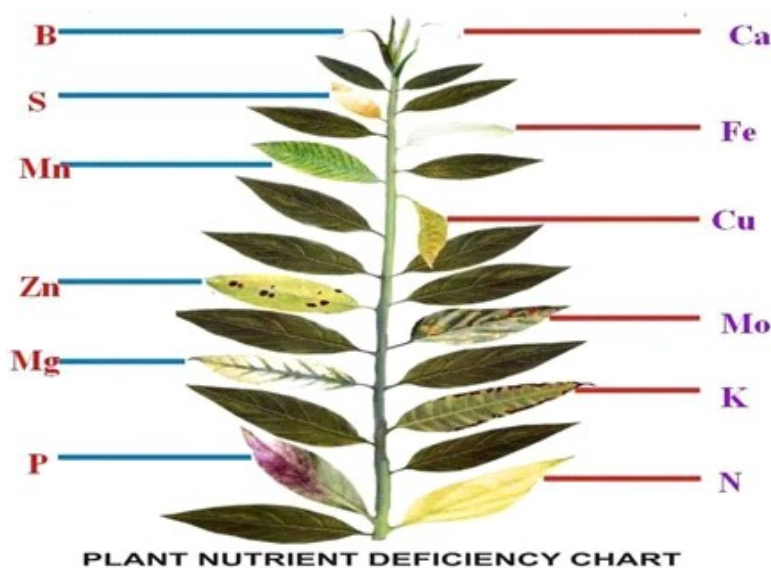
Chaw tha tlachham thlaite:

Nungdama awm tur te, tha taka tang turte leh chi chhuah tur hian thlai hian an mamawh tawka an chaw tur an hmuh a tul a. Chutiang an hmuh zawh loh chuan an hrisel lo tih a lang ta mai thin a ni.

An chaw pui ber (macronutrient) hi an mamawh tam deuh thin. Chungte chu nitrogen, potassium, sulphur, calcium, magnesium leh

phosphorus-te an ni. An mamawh ve tho ho (micronutrient) hi chu an mamawh tam lo. Chungte chu iron, boron, manganese, zinc, copper, chlorine leh molybdenum-te an ni. Macro- leh micronutrient-te hi thlai zungin lei aṭanga a lak a ni:

- (N) **Nitrogen:** Thlai hnah hnuaihnhung, a upa deuh hi a kaurau vat ṭhin. A taksa dang pawh a hring nalh nêp bawh. Thlai tam ber hian nitrogen hi ammonium emaw, nitrate emaw, tuiin a chiah zawp theih vat aṭangin an dawng ber.
- (P) **Phosphorus:** Hnahlâng a ro sen a, a hnah chang deuh phei chu a hring dum emaw, a sen dukin emaw a rawn awm ṭhin. Phosphorus hi phosphate aṭangin an dawng ber. Tuisikah a tui-ral vek thei lo a, mahse lei thur leh thur loh hian thlaiin a hîp luh ṭhat theih danah kawngro a su hle.
- (K) **Potassium:** Thlai hnah chang lam chu a sâwng kir ṭhin. A kau bul lam aṭangin a thisen zâm a hring ṭha lo ṭan a, a hnahlâng aṭangin a hnuai lamah a invial lut ṭhin. Leia potassium fang te te (ion), luang bo sam zet aṭangin thlai hian an dawng ber.



Thlai chaw tha siam/enkawl dan -

- A. Thing hnah tawih vel pek (composting).
- B. Êk atanga boruak kang thei hmanga thingtuah siamna atanga a ek tui chhia lo luang chhuak pek (bio-gas slurry).
- C. Leitha (green manure). Leitha siam nan hrim hrima thlai emaw, hnim emaw chin hmasak a, thlawh vek a, leithaa chang tura leia dah tawih.
- D. Lei tihthatna (bio fertilizer). Thilnung te te (microorganism) hmanga thlai chi emaw, thlai kung emaw sawisak khan thlai bul bal emaw a taksa chung emaw kha a bawm a, thlai chaw pui (primary nutrient)-ho kha a tipung a, thlai a thang duang duh.
- E. Azolla (hnim chikhat) chin.
- F. Khuana kutchhuak leitha, bawng ek atanga siam ang chi (Natural fertiliser).

A. Thing hnah tawih vela leitha siam dan :

Organic farming tura hetiang chi leitha hmang tur chuan a siamna thil tha - hnim hnawksak leh tha lo chi-te, thlai natna hrik awm baw si lo, thlai chaw tha pai hnem si hman a ngai a. Lo leh huan vel atanga hnawmhnaw, leitha siam nana hman dan hi chi hrang hrang a awm a. Khang hmuna hnawmhnaw chi leh a tam dan azir pawh a ni ang chu. A hnuaia chi khat emaw chi dang nena kaihkawp emaw atang hian siam theih a ni.

Lo/huan hnawmhnaw atanga leitha siam dan (method of composting) :

- a. NADEP LEITHA.
- b. NADEP PHOSPHO LEITHA.
- c. VERMI LEITHA.
- d. PITCHER KHAD.

I. NADEP LEITHA :

Hetiang chi-a siam hi Naryan Devrao Pandri Pandey-a tihchhuah a ni. 10'x6'-a lian, 3'-a sanga leirawhchan khur rem tur a ni a; a chhunga hnawmhnaw tawih theihna taw tur boruak

luhna turin a pangah kua siam baw tur a ni. Khur chu lei 16-18 qtl.-te, hnawmhnaw 14-16 qtl.-te, bawng ek 1-1.2 qtl.-te khan hnawh khah tur a ni a; a hnawng taw turin tui leih a, a chung chu lei leh bawng ek chawh pawlha zût phui tur a ni. Ni 75 - 90 vel a in-up hnu-ah rannung te te - azotobacter, rhizobium leh phosphate awmna thil ti-tui a, ei sawm a, chawhpawlh tha tura hrik awmna (microbial culture) telh leh tur a ni. Ni 110 - 120 a ral chuan hman theih a ni a; khur khatah hian lei tha, ram hectare khata hman taw tur, 2.5 - 2.7 qtl. a awm thei.

II. NADEP PHOSPHO LEI THA :

Heng lei tha hi hnawmhnaw te, rock phosphate awmna thil ti-tui a, ei sawm a, chawhpawlh tha tura hrik (bacteria) telh leh tur a ni. Tichuan, tua tui ral ve thei lo rock phosphate chu hrik (bacteria) hnathawh vangin tua tui ral thei a lo ni ta thin.

Hemi tur hian hnawmhnaw te, bawng ek-te leh leite kha, NADEP siamna zat kha hman ve mai tur a ni a, rock phosphate chu @ 12.5% w/w telh leh tur a ni. NADEP khur/BHU-NADEB-ah khan siam ve mai theih a ni. A tawih that nan a chung kha bawng ek leh lei chawhpawlha zut phui tlat tur a ni. Ni 15 hnu-ah chawh leh tur a ni a; chuta tanga ni 30-ah chawh leh leh tur a ni baw. Chawh leh apianga a hnawn that reng theih nan tui leih ziah baw tur. Thla 3 - 4-ah hman theih a ni a, N: 1%, P₂O₅: 2 - 4 % leh K₂O: 1 - 2 % a awm tel tawh ang. Phosphorus (P) telna lei tih thatna chi ang thova thlaia hman theih a ni.

III. VERMI LEI THA :

Changpat hi thil tawih vel ringa leia cheng an ni a. An thil pai tawih theih loh an ek chhuah leh hi hriak tlemin a tuam zel a. An ek-a hriak awm chu thla hnih hnu velah chuan a ral leh mai a. An ek-a thlai chaw tha kha thlaiin an ei nghal thei mai a, chuti chung chuan hriakin a tuam a, amaha thlai chaw tha ral thuai tur a ven vang khan hun rei zawk chung chu thlai tan a tha thei a ni. He lei tha hi thil dang teh vak ni lovin, changpat ek a ni mai a, a ek-ah chuan lei chunglang lei tha dum hum mai (humus) ang chi leh thlai

chaw ṭha a tam hle a ni. Changpat kawchhungah khan thil ṭawih vel kha khuanu kutchhuak leiṭha (natural fertilizer)-ah a rawn insiam chhuak ta ṭhin a ni. Changpat kawchhunga thil ṭawih vel a insiam danglam khan thil ṭawih rimchhia kha a reh vek a, thlai tana thil ṭha lo tur pawh kha a ṭha ta vek mai ṭhin a ni.

Horticulture thlai (thei/thlai rah, an hnah, pangpar leh thil tō mawi chi) kung bulah leirawhchana kuang siamin emaw, plastic bur hmangin emaw changpat hi a khawi theih. Chutianga khawi chuan ngun taka vil reng a, an chaw turin thil ṭawih vel pek reng a ngai a. Tiang chuan kan mamawh ang vermi leiṭha kha a ngah mai theih a ni.

Vermi leiṭha ṭhat dan :

A ṭhat dan hi thil ṭawih tura kan dah chi-ah a innghat a. Kan thil dah kha thil chi hrang hrang a nih chuan thlai mamawh chaw ṭha chi hrang tam tak a awm thei. Mahse, chi khat chauh a nih chuan thlai mamawh chi hrang a tam thei ṭhin lo. A tlangpuiin a hnuaia mi hi chaw ṭha awmte chu an ni ṭhin -

Nunna nei aṭanga carbon insiam (Organic Carbon)	:	9.5 - 17.98%.
Nitrogen	:	0.5 - 1.50%.
Phosphorus	:	0.1 - 0.30%.
Potassium	:	0.15 - 0.56%.
Sodium	:	0.06 - 0.30%.
Calcium and Magnesium	:	22.67 to 47.60 mEq / 100g.
Copper	:	2 - 9.50 mg kg - 1.
Iron	:	2 - 9.30 mg kg - 1.
Zinc	:	5.780 - 548 mg kg - 1.
Sulphur	:	128 - 548 mg kg - 1.
(mEq - 'milliequivalent' tih-na a ni).		

Vermi compost ṭhatnate:

- Thlai chaw ṭha a chi kim.

- Thlai ṭhan duanna turin kawng tinrengin a pui a; a tuai, kak leh hnah thar chhuah awlsam turin a pui a; thlai thar a mawi nah ṭha bik a; a thar a dah ṭhat rei theih bîk bawk.
- A nem a, hman te, khawih velte leh chhek khawlte a sam a; a rim a chhe lo bawk.
- Leilung awmphung te, lei chunglang pianhmang te, leilunga boruak lut leh chhuakte a tiṭha a. Tin, lei kha tui pai rei thei turin a pui a, chung thil chu a vawng him bawk.
- Changpat tui a tam vangin changpat leh lei tiṭha tura changpat khawsakna/hnathawh a pung.
- Leilung a vawng ṭha.
- Leia thlai chaw luang ral tur a veng a, hlawk leh kawngro su tam zawk turin damdawi hlo lei tihṭhatna (chemical fertilizer) hman a pui.
- Thlai natna hrik (pathogen)-te, thlai huat zawng thil te, hnim ṭiak mai thei chîte leh thil dang, thlai tana hnawksak leh chimawm a tlem bawk.
- Thlai eichhetu rannung leh thlai natna a titem.
- Leilunga thil ṭawih a titam.
- Thlai tana thil ṭul tak tak - vitamin-te, protein awmna thil (enzyme) te, thlai ṭhan ṭhatna thil (hormone) chi (auxin angte) leh thil ṭul dang tam tak a pai tel bawk.

Vermi leiṭha siam nana thil ṭulte:

1. Changpat (1 kg).
2. A khur (6'x4'x2').
3. Phelsep kalh leh a khuh hulna tur thil.
4. Ṭawih thei thil eng pawh.
5. Mamawh thil chi hrang hrang, entir nan -
 - a) Thlai peng eng eng emaw, paih mai turte.
 - b) Bawng ek.
 - c) Hnim chi hrang hrang.
 - d) Balhla tukna kung.

e) Ei leh in bâng thil.

f) Hnahthel.

Vermi leiṭha siam dan tur :

1. Thil ṭawih thei lo chi - thil chhe nawi te, khawl lam chi thir them te, darthlalang keh te, ceramic kehte leh ṭawih thei lo thil chi hrang hrangte lak khawm tur.
2. Chung ṭawih thei lo thilte chu bawng ek awm khawm zing emawa ni 20 chhung dah tur. Hetia tih hian khang thil kha a nem deuh thei a, changpat ei theih turin a awm thei. Bawng ek leh Bio-gas siamna aṭanga a ekchhia luang chuak dah ro pawh a hman theih a; bawng ek hring erawh chu vermi leiṭha atan hian hman loh a ṭha.
3. A khur chu concrete emaw, thil chang/sak chi, tui put tlang thei lo tur chhungah khan vermi leiṭha tur thil zawng zawng kha khung tur a ni. Tui han leih khan leivung chhun tel karah changpat kha an lut nghal thei ṭhin a. Tin, thlai chaw tur thil ṭawih theite pawh kha chung leivung karah an lut ve a, tui khan a luanpui ta ṭhin a. Plastic kuang kan hman chuan khang tui lo luang chhuaka thlai chaw ṭha lo tel kha a dawhna eng emawin kan lo dawh khawm mai thei thung.
4. Vermi leiṭha kha a thawh hun/hman theih a nih hunah a changpat vel la tura chhihrî-a hrîk tur a ni a, thil la ṭawih zo ve lo kha a khurah siam leh nan dah luh leh mai tur a ni.
5. Vermi leiṭha chu hnawngin a chiah theihnaah chhek khawm tur a ni a. Tichuan, thilnung/natna hrik te te, thlai tana ṭangkai thei, dam theihna tura chhek khawm a lo ni ang.

Ṭha taka Vermi leiṭha siam nana thil ṭulte:

Hemi atana changpat hi thil ṭul ber a nih vangin ṭha taka an thil mamawh (environment) ang an hmuh a ngai a ni.

Chung thilte chu - A khur kha ro lutuk lo, hnawng lutuk lo a ni tur a ni. 50% tui awm ni se. Changpat thawk ṭhat theih turin tawt leh muk lutuka beng loh tur. Changpat hi an vun hmanga thaw chî an ni

a, boruak thawleng deuhah lo chuan an thi mai thin. A kuang kha a lum/sat lutuk chuan changpat kha an thi mai thei bawk.



1. A chung khuh nan a remchang chang hman.
2. Plastic kuang (6'x4'x2').

Vermi leiṭha siam dan:

Heta tan hian lei pawnlanga khawsa chi changpat chauh hman tur a ni a; lei chhungril deuha khawsa chi chu hman loh tur a ni. A ṭha chi-ho chu - Africa changpat (*Eudrillus engenia*)-te, changpat sen (red worm)-te leh leiṭha hmuna cheng/composting/Asian worm (*Peronyx Excavatus*)-te an ni. A chi thum hian khur khata pawlh theih an ni nghe nghe. A dang pahnih ai khian Africa changpat hi hun rei lo zawka vermi leiṭha a siam chhuah theih vang leh, chumi chhunga no/thlah tam tak a neih hman bîk vangin a thlanawm zawk deuh.

A siamna hmun tur thlan chungchang:

Hmun hlim (shade), hmun/boruak hnawng leh hmun vawtah chuan a siam theih vek. Bawng in leh ar in hlui te, in ram luah tawh lohte pawh a ṭha vek. Hmun ual-au taka siam a ṭul chuan hmun hlim

(shade) ni thei se a tha. Ni sa leh ruah laka a him nan a chung chih a tha. A kuanga dah tur thil tawih thei lak khawm kha sai-ip/buara huha khuh tur.

A siamna tur khur :

Cement kuang emaw, plastic kuang emaw, lei laih khwar mai emaw pawh hman theih a ni. Feet hnih leh a chanve-a thuk, feet thuma zau ni se; a sei lam erawh chu tawih thei thil kan dah tam theih dan azir leh lei tha kan mamawh zat azir a ni mai. A khur/kuang mawng kha tui luan theihin lei/awih sela, chuta tui lo luang chhuak chu lo dawh khawl zel tur a ni.

A tui lo luang chhuak dawh a sam nan hmun kanga a hun kanna dah a tha. Lei lawng nena a indeh loh vangin vermi lei tha siamna kuang kha a dah that rei theih bawh.

Vermi lei tha siam nana thil tulte:

Bawng ek (vawk, ar leh kel ek tel lo), lo leh huan vel hnawmhnawh, thlai kau leh a hnah chhia vel, thlai zawrhna hmuna hnawmhnawh, pangpar zawrhna hmuna hnawmhnawh, agriculture atanga thil thar chhuah lam thil khawihna hmunpui (agro industry) lama hnawmhnawh, thei rah zawrhna hmuna hnawmhnawh leh thil tawih thei tawh phawt chu a hman theih. Bawng ek chu ni saa pho ro phawt tur a ni a; thil dang telh tur pawh kha bawng ekah chiah/phum hmasak phawt tur a ni.

A kuang/khura thil hman tur dah luh dan:

Khang thil a kuanga dah luh hmaa bawng ek-a chiah/phum hmasak kha a buk emaw, a tam dan (volume) emaw atanga teh a, bawng ek 30% leh lei chawhpawlh nena chawhpawlh tur a ni. Chuta chawhpawlh hnu chu a kuang/khura khung theih a ni. A tihhnawna kha 60% chin a ni tur a ni. Chumi chungah chuan changpat kha rual khai takin meter khat bial, feet hniha sang angah khan changpat 1 kg (1000 vela tam) dah tawh tur a ni. Changpat kha kan thil daha zuk phum kher a ngai lova, anmahni thu-in an hreuh lut mai dawn a ni.

Tui leih dan :

Ni tina tui leih a ngai lova, siam hun chhung zawng khan a hnawnna kha 60% a ni ngar ngar tur a ni mai. A tul ta a nih pawhin a leiha leih lovin, tuia theh huh tur a ni. Leiṭha seng/lak a nih hma khan tui leih kha bansan tur a ni.

Leiṭha seng/lak dan :

A kuang siam ang chi-ah chuan a chung a leiṭha lo khal ta kha hunbi fel tak, hapta khata vawi khat emaw-ah lak thin tur a ni. Changpat lan theihna chin aia thuk chu lak loh tur. Chutianga hunbi neia lak chuan leiṭha kha a dip tha a, a thatna (quality) a sang bik baw. Chutianga a chunglang lak zel loh chuan tui han leih khan a chunglang kha a tichar bel ta thin a ni. A kuang te deuh feet hnih vel leka sangah chuan chutianga a tha tawh sa lak then pawh a ngai lova, a that hunah lak vek theih a ni. A khur / kuang 6'x4'x2' ang chi-ah chuan kum khatah vawi 4 - 5 a seng theih a; thil tawih thei (bio waste) leh bawng ek dah tam dan azirin leiṭha kha a tamin a tlem mai. Tawih thei leh bawng ek, 70:30-a dahna angah chuan tum khatah leiṭha 150 - 200 kg a seng khawm theih thin.

IV. PITCHER KHAD :

Hei hi bawng ek 15 kg, bawng zun 15 lt, tui 15 lt leh gud/guduchi (hrui zam chi) 250 gm, hman tlaka tih/thawh dan a ni. Thil chawhpawlh kha kuangah dah a, puan emaw, sai-ip/buara emawa ni 4 - 5 chhung khuh tur a ni. Chumi hnu chuan tui 200 lt nen chawhpawlh leh a, acre khat kah nan hman theih a ni. Thlai thar hma chi-ah chuan vawi hnih emaw vawi thum emaw kah a taw. mai.

B. BIO GAS ÊKCHHIA :

Êk leh thil tawih atanga boruak lo chhuak atanga thingtuah (Bio gas) siamna atanga a ekchhia (slurry) hi leiṭha tha zet mai a ni. Ni zung chakna hmanga tih-ro a ni a, a ro chu thlaiah hman nghal theih mai a ni.

C. LEIṬHA (Green manure):

Leiṭha, green manure siamna chi thlai tam tak hian thilnung aṭanga insiam (organic matter), thlai mamawh tawh leh thlai ṭhan ṭhatna turin nitrogen a pe chhuak thei a. A kawm neia rah chi emaw, chutianga rah ve lo chi emaw pawh boruak aṭanga nitrogen khawh khawm thei chi an nih chuan an ṭha vek. A rah kawm nei chi, leiṭha (green manure) siam nana ṭha leh a hnah leh kung vel ṭawih aṭanga thlai chaw ṭha pe thei lar deuhthe chu cowpea, black gram, green gram, dhaincha leh sunhemp-te an ni. Ni 40 - 60 chhunga nitrogen 60 - 90 kg pe chhuak thei an ni. Dhaincha ro/ruang ton khat (1000 kg) hian acre khata zauvah khan thlaiin a rin phak turin N 26.2 kg, P 7.3 kg, K 17.8 kg, S 1.9 kg, Ca 1.4 kg, Mg 1.6 kg, Zn 25 ppm, Fe 105 ppm, Mn 39 ppm leh Cu 7 ppm a pe thei a ni. {ppm hi 'parts per million, 1/1,000,000' tihna a ni a, tui leh leia thil chi dang tak lam / dal lam sawina a ni. Acre khata Copper (Cu) 7 ppm a awm chuan kha lei hmun 1,000,000-a ṭhena hmun 7 kha copper (Cu)-in a luah tihna ang a ni}.

Heng thlai hi hmun thlawh faiah emaw, lo / huanah emaw, ruahtui tlak tirh velah an theh chiam a; a lo len hnu-ah lo/huanah khan lei ti-ṭha turin an chap ta chiam mai ṭhin a ni. Lo/ huana vawi hnih emaw a lei kha an leh hnu-ah chutiang thlai (green manuring crop) chi hi an theh ta ṭhin a. Feet hnih vela sang an nih hunah lo /huanah chuan an phum ta ṭhin a. Dhaincha thlai hi chu hapta 6 - 8 velah a lo par a, a par hun chu leiṭha atana hman hun ṭha ber a ni.

D. BIO FERTILIZER (Thilnung te te hmanga thlai enkawl) :

Thil nung te reuh te te (bio microorganism) - azotobacter-te, azospirillum-te, rhizobium-te, blue algae-te leh phosphate tuiṛîl thei bacteria-te hi thlai chi hrang hranga hman an ni. Heng thil nungte hian thil chi hrang hrang - nitrogen siam chhuah te, phosphate tuiṛîla siam (solubilize)-te leh thlai ṭhan duantir thei thil siam chhuahte hmangin thlai an ṭhan duantir a. Buh tana leiṭha (bio fertilizer) siamtu atan hian blue green algae leh azolla hi an hmang nasa.

E. AZOLLA CHÎN:

Azolla hi tuia ò chi hnim te deuh, kak-a zar ve chi leh hnah hniha kak chi a ni a. A zung khan tuiah a tilang mai a, tui tling rengah a awm deuh ber. A hnah chung bera kaw te reuh te-ah chuan blue green algae (thil ò te reuh te) 80,000-te a awm thei a, chung thil ò chuan boruaka nitrogen kha an khawl khawm thei a, chu chu azolla hnim chuan a hmang ve mai ò thin. Blue green algae chuan azolla chu him nan leh ei hmuh nan a hmang thung ve bawk. Tichuan, thilnung chu an thih chuan thlai tana nitrogen ei theih sa chu leiah an hnutchhiah ta ò thin a ni.

Azolla thar-chhuah:

Loneitu pawhin mahni puala Azolla hi chîn pun theih mai a ni. Kawng hnihin a chîn theih.

- (i) Tui tling renga chîn - Dîl emaw, lo khawi lai emawa tui tling, inches 2 - 4 vela thuk hi a hman theih mai. Chutah chuan azolla chu chîn mai tur a ni a; hapta hnihah chuan azolla chu a rawn inthlah pung ang a, tui chung chu a rawn khuh zui mai dawn a ni. Chung chu lak khawma hman nghal theih a ni a; tih-rova dah ò that pawh a theih bawk. Hapta thum dana lak ziah tur a ni.
- (ii) Azolla kui ò ahna (nursery) - Lei laih khuar a, inches 2 - 4 vela thuka tui tlintir tur. Tui a luan ral loh nan khur mawnga polythene phah pawh a ò a. Hapta thum-ah a seng theih a, lo/huanah lei tihthat nan hman theih nghal a ni.

F. KHUANU KUTCHHUAK (Bawng ek aṭanga siam ang chi):

- a. **Jeevamrutha:** Bawng ek 3kg, bawng zun 3lt, kurtai 600gm, beson 600gm, tui 70lt. leh leiṭha 1kg (buh chinna leilet tlānga mi hi duhthusam a ni). Tui tel loin khang thil kha ngun taka chawhpawlh tur. Ni 4 chhung, a theih chuan boruak luh theih loha chhin a, dah tur. Chumi chhung chuan ni tin vawi hnih, minute 10 chhung chawhpawlh ò thin tur. Ni 4 hnu chuan tui 70lt. kha telh a, chawhpawlha, hman theih a ni. Thlai bula leih kual mai tur a ni.

- b. **Sanjiwak Khad:** Thlaia natna do chakna leh ṭhan duanna pe thei a ni. Sanjiwak khad 100lt. siam chhuak tur chuan tui 66lt. bawang ek tharlam 30kg, bawang zun 3lt. leh kurtai 500gm. a ngai a.

Khing khi chawhpawlh a, kuang emaw, bur emawa ni 10-12 dah tur. I dahna chu sai-ip/buaraa khuh a, nitin zing leh tlaia chawh ṭhin tur. Chumi hnu chuan thlai bulah acre khatah 200lt-a tam hman mai tur.

- c. **A tui chi leiṭha (Liquid compost):** Vermi leiṭha 1kg. leh tui 10lt. chawhpawlh a, darkar 48 dah tur. Darkar 6 danah chawh ziah tur. Chumi hnu chuan a let lî-a tam tui pawlh a, thlai par laia kah nana hman tur. Thlai kha a par ṭhattir a ni.

MODULE- 4

NURSERY LEH A ENKAWL DAN

NURSERY LEH A ENKAWL DAN

- Thlai chin hlawhtlinna chu kan thlai chi tuh azirin kawng tam takin a inngnat kan ti thei awm e. Thlai òiakah pawh chutiang bawkin. Kan thlai thar leh hlâwkna chu kan thlai òiak hrisel dan leh a chinna hmun kan enkawl felfai leh felfai loah kawng tam takah a ingnat bawk a ni.
- Thlai nursery kan tih chu kan thlai chin tur an chinna/phunna hmun tura phun an nih hmaa an òhan lenna tura kui òiahna hmun hi a ni.

Thlai òhenkhat chuan an òiah tirh lamah uluk bik taka enkawl an mamawh òhin. Thlai òhenkhat chuan chi te reuh te te an nei a, heng thlaite hi nursery-a enkawl hmasak niin tuh aṭanga thla khat hnu velah a phunna tur hmun takah sawn an ni òhin.

Chung thlaite chu: tomato, bawkbawn, hmarcha, capsicum, parbawr, zikhlum, knolkhol leh a dangte an ni.

Nursery enkawl òhatnate:

- An òiah leh òhan thatna turin an mamawh hrang hrangte pek a awl bik.
- Hmun zim teah uluk taka enkawl theih an ni a; hri, rannung leh hnim lakah an him bik.
- Nursery-a thlai chinte chu an thar hmain hralh hunah a hlawk bik em em a ni.
- Kui hun chhung thla khat (1) kha chu rama hahchawlin tha sen pawh a hniam phah thei bawk a ni. Thlai dang chin thlak zung zung pawh a tiawlsam hle bawk.
- Nursery-a enkawl hmasak a nih avangin a phunna tur buatsaih hun chhung a tam bik. Nursery enkawl turin a hmun thlan fimkhur a pawimawh hmasa.
- Nursery hmun chu tui tling loa luang chhuak zung zung thei a ni tur a ni.
- Ni êng a hmu òha tur a ni.
- Tui pek awlsam zawk nan tui lakna hmun a hnaih tur a ni.
- Ran leh ramsa lakah a him tur a ni.

Leilung buatsaih dan:

- Lei zia/nihna/that dan (Soil quality):
- Thlai chi tuh turin leiṭha leh hrisel a pawimawh.
- Nursery lei (soil) turah chuan lei dur ṭha leh thil ṭawih tamna lei, sawntlung/hlum lei (loam) - sandy loam lei ni thei se.
- Lei chu a thur emaw al lutuk tur a ni lo.

Nursery atana lei buatsaih dan:

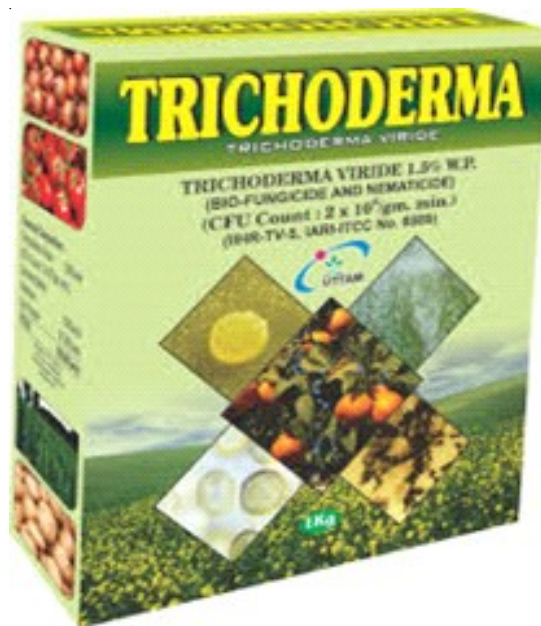
- Tuthlawh emaw suahdur emaw, lei lehna emawa thuk deuh taka ṭum hnih ṭhum lei leh phut a pawimawh.
- Chumi hnuah chuan lei tlang te, lungte leh hnim zawng zawng paih faia hrut rual leh tur a ni.
- Bawng ek leiṭha (FYM, compost/leaf compost) kg 2 vel emaw changpat leiṭha 500g vel square meter khat (1) zela pawlh leh tur a ni. Lei a heavy a nih chuan square meter khat (1) zelah balu lei 2-3kg telh a ṭha, chu chuan thlai lo ṭiak tur chu leiin a lo dang/tihbuai loh phah thei dawn a ni.

Lei sawngbawl (Soil treatment):

Thlai ṭiak hrisel tak neih theihna turin lei chu uluk takin kan sawngbawl hmasa tur a ni. Chu chuan rannung leh natna thlen thei hri lakah a veng dawn a ni.

Natna laka fihlim theihna tura lei sawngbawl dan:

- a). Lei ni saa hem (Soil solarization):** May-June thla chhung hian boruak sat zawng hi 40°C thleng a ni thei a. Chutih hunah chuan lei chu tuiin tihnawng la, polythene var 200 gauge-a chhahin nursery pum chu kar 5-6 chhung khuh tur a ni. A khuhna hmawrte chu boruak a luh lohna turin chirha zut phui tlat tur a ni. Kar 5-6 hnuah chuan a khuhna chu hawna thlai chinna tura buatsaih tawh mai tur a ni.
- b). Fungicide hman dan (Application of fungicides):** Huan zawl (Bed) khatah *Trichoderma viridae* 100gm zel pawlh ang che, *T. viridae* chu bawng ek leiṭha (FYM) ṭawih ṭha tak 10kg nen uluk deuhin chawhpawlh la, nursery-ah chuan theh darh ang che.



Nursery bed buatsaih dan:

Nursery hmun chu kan thlai chin leh a hun azir zelin buatsaih tur a ni. Fur-ah chuan a kanga siam tur a ni, nipui leh thlasikah erawh chuan lei zawl zulzuia siam tur a ni thung. Thlai chi tiak tha tur chuan lei chu a dip thain a hnawng tha tur a ni.

Sik leh sa duhawm tak awm lohna hnuaia thlai kan ching dawn a nih chuan bawmah a hranpaa thlaite chu kui tiah mai tur a ni, pangpar pot emaw, polythene ip emaw, potting plugs emaw, thingthleng emaw, lei pot emaw hman theih a ni. Hengah hian lei, balu leh bawng ek leitha (FYM)-te chu a inzat chiaah (1:1:1)-a chawhpawlh a, pot-ah chuan dah tur a ni. Tui tling tur venna atan pot mawngte chu verh pawp tur a ni.

A pawnga thlai chin (Raised nursery beds):

Huan zawl (Bed) pakhat sei zawng hi feet sawm (10) atanga sawmpanga (15)-a seia siam theih a ni a, hlo thlawh leh thlai enkawl awlsam zawkna atan a hlai zawng erawh chu 1 meter (feet thum leh a

chanve) aia hlai tur a ni lo. Chhuat zawl aṭanga centimeter 15 aṭanga 20-a sang a nitur a ni. Huan zawl (Bed)-te hi centimeter 30 aṭanga 40 tal a inkar hlat tur a ni bawk. Hei hi a chhan chu thlai ṭiak te, rannung leh hri laka an him nan te, hnim thlawh fai awlsamna atan leh ruahsur laia tui tam lutuk tur paih ral nan a ṭangkai. A huan zawl (bed) tam lam erawh chu kan thlai chin tur te, a hun azir leh kan thlai chinten ṭhanna atana hmun an duh zauh dan azirtein a danglam zel a ni. A dung hi chhak leh thlang (chhuah lam leh tlāk lam) zulzuia siam tur a ni, chhim leh hmar zulzuia tlar tur a ni thung.

Nursery-a thlai chin :

Kan thlai tuh/chin azir leh a hun azir zelin thlaite chu kan theh emaw a tlarin emaw kan tuh/chin tur a ni.

i). Thlai chi theh (Broadcasting method):

Broadcasting method-ah chuan thlai chite chu a chinna hmun buatsaihah chuan theh darh an ni a, chumi zawhah leiṭha dip (hrik hnu)-a khuh leh ṭhin a ni.

Hetianga tuh erawh hi chuan a insem rual loin phul hmun ang maiin thlai ṭiakte chu an ṭo bit thei ṭhin a, damping off natna awm a awlsam phah ṭhin a ni.

ii) A tlara tuh (Line Sowing):

Line sowing hi nursery-a thlai tuh dan ṭha ber a tih theih awm e. Centimeter chanve aṭanga cm khat (0.5-1cm)-a thuk, 5.0 cm-a line inkar hlata laih khuar tur a ni. Hemi laih khuarah hian thlai chi chu pakhat te tein 1cm. zela inhlatin an tuh ta ṭhin a ni. Thlai chi tuh chu lei, balu leh leiṭha inzat (1:1:1) a pawlh hmanga khuh leh vek tur a ni. Chumi zawhah thlai chi chu tui tlem te pek chhunzawm nghal tur a ni.

Thlai chi khuh (Seed cover):

Thlai chi chu kan theh emaw, line-ah kan tuh emaw pawh ni se an ṭiah ṭhat theihna turin uluk taka khuh a ngai a. Lei, balu leh leiṭhate chu a inzatin (1:1:1) uluk taka chawhpawhlin, chumi hmang chuan thlai chi chu kim takin khuh leh diam tur a ni.

Chhawlchhin (Use of mulch) :

Thlai tiah theihna tura lei hnawng vawn thatna turin huan zawl (bed)-te chu buhpawl te, fu fe te, organic chhawlchhinna eng pawh hmangin khaw lum lai chuan kan khuh tur a ni a, khaw vawh hunah erawh chuan polythene hmanga chhawlchhin hi a tha hle.

A thatnate chu:

- Thlai chi a tiah theihna turin lei hnawnna leh lum lam a vawng tha.
- Hnim to tur a veng.
- Niin a hlanga a chhun tur leh ruahin a nan na lutuk lakah a veng.
- Sava lakah a veng bawk.

Chhawlchhinna lak sawn (Removal of mulch) :

Thlai chinna atanga chhawlchhinna lak sawn hun ngaihchan reng hi a pawimawh em em a. Thlai phun atanga ni thum (3) hnuah chuan uluk taka vil zui reng tur a ni. Lazai var ang maia thlai tuhte an rawn chawr chhuah veleh thlai tiakte tichhe miah loin chhawlchhinnate chu kan la kiang tur a ni. Ni zungin thlai tiak tirta a tihchhiat lohna turin tiai lamah chhawlchhinnate hi lak sawn chauh tur a ni.

Shed net hman (Use of shedding net) :

Thlai chi chu a lo tiah a, a tiak an than chhoh laia boruak a sat lutuk (30°C aia a lum chuan) bed-te chu 50% or 60% shedding net, a hring emaw/a hring leh dum emaw hmanga khuh tur a ni. Lei atanga cm 60-90-a sangah khuh tur a ni.

Watering :

Thlai a chawr chhuah hma chuan pangpar tui pekna hmanga tlem te chauha tui pek tur a ni. Tui a tam lutuk emaw ruah tla tam lutuk a awm chuan a tul ang zelin luan chhuahtir zung zung tur a ni. Tui tam lutuk hi thlaiin a thih phah thei.

Tui pek zat tur hi sik leh sa azir a ni thei. Khua a lum viau chuan open irrigation tih tur a ni a, fur ruah tam lai erawh chuan tui pek reng a ngai lo ve thung.

Suat (Thinning):

Thlai tiak hrisel lo, chak lo, natna hrik kai, rannung eichhiat leh a bit lutukte chu kan suat zung zung tur a ni. Thlai tiakte hi 0.5 cm - 1.0 cm tala inhlat tur an ni.

Thlai tiak kan suat then hian thlai mal tinten boruak leh eng rualkhai takin an dawn theih phah a, nursery-a tei vel pahin natna leh rannungin a tihchhiat thlai tiakte kan hmuh zung zung theih phah bawk a ni.

A hnim tur ven (Weed control):

Thlai tiak hriselna turin hnim thlawh fai hi a pawimawh em em a ni. Hnim a awm a nih chuan kutin emaw tuthlawh (thin forked Khurpi) hmangin thlawh fai tur a ni.

Phun sawn tur thlai tiak thlan (Selection of seedlings for transplanting):

Thlai tiakte chu phun sawn rual an lo nih chuan loah phun sawn tur an ni. Sawn chhuah an nih hma hian thlai tiakte chu a hnuaia tar lan ang hi an ni tur a ni :

- An san a thain an nghet tur a ni.
- Zung an kaih tha tur a ni.
- Rannung leh natna lakah an fihlim tur a ni.

Hardening of the plants in the nursery:

Hardening kan tih chuan - "Sik leh sa leh harsatna hrang hrang do zoa pal tlang thei tura thlai buatsaih." Hardening-ah chuan thlaite chu a zung nena lak chhuaha huana sawn an nih hmain ni sarih (7) atanga ni sawm (10) chhung a hnuaia mite hi pal tlangtir an ni.

- Ni sa hnuaia dah.
- Shedding net leh polythene khuhnate lak sawn.
- Tui pekna zawi zawia tihtawp.

Hardening tih dan:

Hardening chu a hnuaia tar lan ang hian tih thin a ni.

- Phun sawn an nih hma ni li (4) emaw ni nga (5) chhung tui pek tlem.
- Boruak tihvawh hian thlai than a tithuin hardening tih dan tha tak a ni.

Hardening tih rei zawng leh a nasat lam:

Thlai tiakte chu a thlai azirin hardened tur a ni a, a tam thei ang ber an dam chhuah theihna atan leh phun sawn dawn huna an than a thut deuh theihna turin a pawimawh hle a ni. Thlai tiakte an thang zel tur venna atan hardening hi zawi zawiin tih thin tur a ni. Khaw lum thlai chi heng tomato te, bawkbawnte leh hmarchaahte chuan hardening hi tih nasat an ngai lo. India ram angah chuan lei hi ni 5-6 chhung dah ro hi hardening tih dan awlsam tak a ni.

Hardening-in a nghawng chhuahte:

- Hardening chuan thlai nih phung tidanglamin tui harsat avanga thlaiin harsatna a tawh theihnte lak atangin thlai chu a tichang tha thin.
- Hardening chuan thlai atanga tuihu chhuak hnem lutuk tur a titem.
- Thlai thang zel tur a tikhawtlai.
- Thlai hardening tih hnu chuan boruak lum leh vawtte an tuar thei bik thin.
- Hardening chuan zikhlum hnah khuhtu hriak a titam lehzual thin.

MODULE- 5

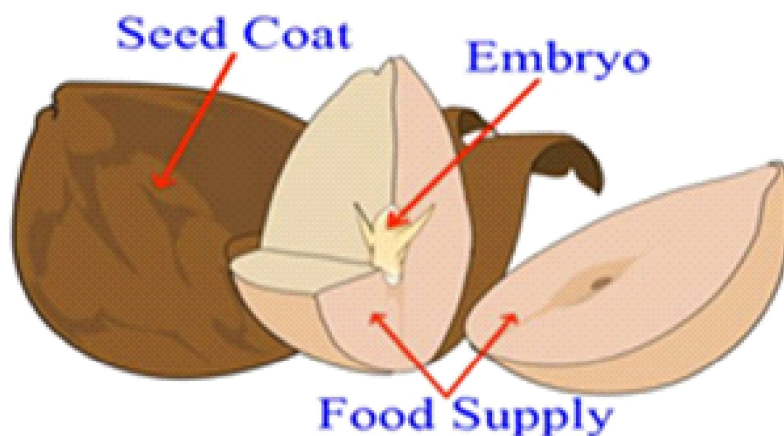
**THLAI CHI (SEEDS)
RANNUNG LEH NATNA
LAKA ENKAWL DAN**

THLAI CHI (SEEDS), RANNUNG LEH NATNA LAKA ENKAWL DAN

Thlai la keu tur chi nungin (embryo) a tuam hi a chi a ni a. Thlai chi chu ovule-in a raitir (fertilize) tawh thlai embryo paitu a ni.

Thlai chi hi hmun thuma then a ni a. Chung a bung hrang pathumte leh an hnathawhte chu hengte hi an ni :

1. **Seed Coat** : Thlai chi tuam himtu a ni. Thuah khat emaw a aia tam emaw thlai chi khuhtu a ni a. Coconut kawm anga chhah a ni thei a, nem tak, bean angtea kan hmuh ang hi a ni thei bawk.
2. **Embryo** : Thlai rawn tiak tur, thlai thara rawn chawr chhuak tura kha a ni.
3. **Food Supply** : La keu tur chi nung (Embryo) a lo than theih nana chakna leh chaw tha, a bikin starch petu a ni. Hemi avang hian thlai chi hian a tiak lai (germination) leh nursery-a a to hun lai hian pawn lam atanga chakna petu a mamawh lo a ni.



Thlai chi chi hrang hrangte :

Thlai chi hi a tlangpuiin chi hrang pangaah then a ni a. Chungte chu :

a) Nucleus Seed : A chi emaw, a thlahtu emaw tha zawk hybrid (thlah pawlh), a siam chhuaktu (breeder)-in uluk taka a enkawlina hnuaia siam chhuah thlai chi fir a ni a. Nucleus seed hi a inthlah chhawnaah 100% in a fir vek a nih vangin pawlh daltu eng mah a awm lo. A inthlah chhawna leh a nih phungah tikhawloh a nih loh nan nucleus seed hi thil dang chim buai theih lohna hmunah siam a ni a. Nucleus seed hi a chi (variety) emaw thlahtu (parental line) angin a chak tha leh tur a ni.

b) Breeder Seed : Agricultural University-a research institute-ah thlai breeder rin tlak enkawlina hnuaiah breeder seed hi nucleus seed atanga siam chhuah thin a ni. Breeder seed hi a inthlah chhawnaah 100% a fir a ni tur a ni.

Hriat theih dan tur : Packet-ah chhinchhiahna eng a awm ang.

c) Foundation Seed : Foundation seed hi breeder seed thlah a ni a, State Farm Corporation of India, National Seed Corporation leh State Seed Corporation ten thlai breeder rin-tlak emaw technical officer-te thuneihna hnuaia an siam chhuah a ni. Foundation seed hi a inthlah chhawnaah 99.5% a fir a ni tur a ni.

Hriat theih dan tur : Packet-ah chhinchhiahna var a awm ang.

d) Certified Seed : Certified seed hi foundation seed thlah a ni a, certification agency enkawlina leh phalna hnuaia siam a ni. Hei hi commercial seed, loneitute lei theih tura siam a ni a, a inthlah chhawnaah 99% a fir a ni tur a ni. Kum thum chhung chiah a hman theih a ni.

Hriat theih dan tur : Packet-ah chhinchhiahna var a awm ang.

Thlai chi zia/nihna/that dan (quality) :

Thlai chi quality hi tehna hrang hrang atanga tehna khai khawma chi tha a nih leh nih loh hriatna a ni a. Thlai chi quality hian loneitu

thlai thar that leh that loh a hril a ni. Heng a hnuaia tar-lante hian thlai chi quality a hril a ni:

1. Physical Attributes. (A pian phung)
2. Physiological Attributes. (A chhungril hnathawh dan)
3. Genetic Attributes. (A inthlah chhawn dan)
4. Storability. (A dah that rei theih dan)

Thlai chi quality tha tangkainate :

- Thlai thar inthlah chhawnna leh pian phung fir zia a tichiang.
- Thlai duh zat ang tak a thar theih.
- Harsatna hrang hrang hnuaiah pawh a tlo.
- A chi siam chhuahte a chak thatin a to chak bik a, kawng tam taka a tichhe thei rannung (pest) leh natna a do zo bik.
- Thlai thar that dan a inrualkhai.
- A zung a to chak that avangin chaw tha a hip lut awlsam a, chu chuan thlai thar a tipung thei a ni.
- Thlai chi quality tha, variety tha chuan a lo berah 10-12% in thlai thar a tipung.

Thlai chi quality endik dan :

- Inthlah chhawnna fir chiang. (95-99%)
- A pian phunga fir chiang. (95-98%)
- A chawr chhuah dan (germination) sang. (35-90% a thlai azirin)
- A chak that dan azirin.
- Rannung leh natna laka fihlim.
- A chi hrang hrang nihna (variety) tehna azira a pianzia, len zawng, rawng etc. tha.
- A hralh theihna man sang.
- Boruak hnawng (moisture) pai zat hniam.
- A thih/tawp (expire) hun azirin.

Thlai chi siamna technology :

Thlai chi hralh chhuah tura siam dan hi chi hnih a awm a, chungte chu :

- a) Hybridization:** Variety chi hnih thlahpawlha duh ang taka chhuak tur chi siam chhuah hi a ni. Hemi hmanga thlai chi siam hian a

siam nana hman variety dang ai hian thlai a thar hnem theih zawk a, amaherawhchu, a inthlah chhawanna a nghet lo a ni.

- b) **Open pollinated seed:** Pollination hi thil thleng ve reng a ni a, hmun khata thlai chi thlahtu chi hrang tam tak a awm thei. A awmna hmun azirin a insiam rem thei a. Kum tin a chi ngai angin a awm thin.

Thlai chi enkawl dan leh enkawl tangkainate :

Thlaia hmuar (fungal) natna tam zawk hi thlai chi sawngbawl that loh vanga awm a ni a. A nihna ang tura sawngbawl loh thlai chi hian thlai tiak emaw a thlaia emaw a tichak lo thei a. Seed treatment tih awmzia chu fungicide emaw, insecticide emaw, a pahnih inkawp emaw pawh thlai chi a hnawih hi a ni, hei hian thlai chi atanga natna kai theih (seed-borne) emaw lei atanga natna kai theih (soil-borne) natna awmtir thei (pathogenic) organisms leh rannung a tifaiin a tikiam a ni.

Agro-ecological practices for seed treatment :

Agro-ecological practice hmanga thlai chi sawngbawl dan thenkhatte chu :

a) **Bawng zun hmanga sawngbawl dan :**

- Kan thlai chi tuh hma minute sawmthumah bawng zun 100ml leh tui 2 litre pawlh-ah thlai chi chu chiah tur, hei hian a chi atanga natna awm thei (seed-borne disease) a veng a ni.
- Thlai chi kg khat zelah *Trichodema viridae* 5grams emaw, thlai chi kg khat zelah *Pseudomonas* 10grams-in sawngbawl la, darkar 24 hnuah i tuh dawn a nia.

b) **Beejamrutha hmanga thlai chi sawngbawl dan :**

- Tui 4 litre, bawng ek 1kg, bawng zun 1litre, chinai (lime) 10grams, aieng 5gram, kurtai (jaggery) 100gram leh leiṭha tlem la khawm rawh.
- Puanah bawng ek 1 kg dah la, ṭawn la, tui litre 4-ah darkar 24 chhung chiah rawh.
- Chinai (lime) gram 10 tui 50ml-ah zankhuain chiah rawh.

- Puan tua i chiah kha sawr la, a tui chu leiṭha nen pawlh rawh.
- Bawng zun 1 litre, chinai (lime) 10 gm, aieng 5 gm, kurtai (jaggery) 100 gm leh chinai (lime) tui uluk takin chawhpawlh rawh. Chumi chawhpawlh hnu chuan thlai chi sawngbawl nan a hman theih tawh a ni.

Beejamrutha hi thlai chi chi hrang hrangah a hman theih a. Saiip puanah thlai chi chu dah la, beejamrutha siam nen chuan uluk taka chawlh pawlh ni hlimah pho ro tur. A ro hnuah chuan a tuh theih tawh a ni.

Thlai ṭiak zung sawngbawl nan pawh a ṭha a ni. Thlai ṭiak zung chu minute 10 aṭanga 15 chhung chiah hnuah a phun sawn theih a ni.

c) Bawng ek leh bawng zun chawhpawlh a thlai chi sawngbawl dan :

Bawng zun litre 1 leh bawng ek 500 gm leh leiṭha tlem chawhpawlh a, thlai chi minute 15 chhung chiah hnuah kan duhna hmunah tuh tur.

d) Sawhthing hmanga thlai chi sawngbawl dan :

Sawhthing 10 gm leh tui 100 ml chawhpawlh a, minute 15 chhung thlai chi chiah hnuah kan duhna hmuna tuh tur.

MODULE- 6

**RANNUNG THAHNA HLO
(PESTICIDE)-IN MIHRING
HRISELNAA NGHAWNG A NEIH DAN**

RANNUNG THAHNA HLO (PESTICIDE)-IN MIHRING HRISELNAA NGHAWNG A NEIH DAN

Rannung thahna hlo (Pesticides) hi tur niin, vanduaithlak takin rannung thah tur a bituk bak pawh a that thei a ni. Heng pesticides-te hi an hlauhawm em em a, kan hman hian kawng emaw zawng tak chuan harsatna mihringah a thlen thei a, chu mai piah lamah chuan natna chi hrang hrangte thlenin heng chuap/thawkna lama harsatna, cancer chenin a thlen thei a ni.

Rannung thahna hlo (Pesticides) hman chungchang :

Pesticides hmanna hi chi hrang hrang a awm thei awm e. Agriculture lamah, heng thlai enkawlina atante leh thlai chi dah thatna atan te, ngaw/ramhnuai (forest) enkawlina atan te, chuktuah huan siamna atan te, ran enkawlina atante leh kan thil neih hlu enkawlina atan te, heng lenkhawthawwna hmun (Park), kalkawng sir (Pavement) leh khelmual te. Heng bakah hian pesticides kan ei leh in tura tel hian dinhmun hlauhawmah min dintir thei a ni. Pesticide-te hi an hlauhawm em em thei a ni. Chumi awmzia chu, tlem te kan thawk luh emaw, kan ei emaw, kan taksaah a kai emaw chuan kan taksate tichhiain thihna hial pawh a thlen thei a ni. Heng harsatnate hi pesticides kan hman atanga rei lo te hnuah emaw darkar 48 chhungin a rawn lang chhuak thei a ni.

Pesticides hman uar avanga harsatna lo awm theite :

Pesticides hi kan hman reng chuan harsatna tam tak a awm thei a. A tira tlem tea kan hman hian harsatna a awm nghal mai lo pawh a ni thei. Amaherawhchu, hman reng a nih si chuan harsatna lian tham tak a thleng thei a ni. Pesticides hi hman nasat emaw hman rei lutuk chuan heng harsatna hrang hrangte hi a awm thei a ni. Parkinson disease, thawhah (asthma), nguina (depression), hlauhthawwna (depression), cancer (leukemia chenin), Non-Hodgkin lymphoma leh Attention Deficit and Hyperactivity Disorder (ADHD). Endocrine disruptor kan tih chu kan hormone leh kan taksa hormone balance siam tur lo tibuitu hi a ni. Hormones kan tih chu kan taksa chemical thawh chhuaktu a ni a, mihring thanna atan leh chi inthlahna kawngah nasa takin hna a thawk a ni. Kan taksa thil tuihnang insiam thawh kual/tinung (activated) tur hian chemical tlem te bak a ngai lo a ni.

Hetiang hian harsatna an thlen thei a ni :

- Mipa chi-te tichak lovin, inthlah chhawn theihna a tihniam a, chi inthlah chhawnna (genital) a tidanglam a, tilmu leh prostrate cancer-te a thlen thei a ni.
- Naupang (heng inthlah chhawn theihna) lo puitling hma te (early puberty), chhula baw awm, chhul tha lo, hnute cancer, nau chhiatte (abortion), chi nung lote.
- Zunthlum leh thau lutuk (Obesity).
- Thluak, hnungzang (spine) leh tha (nerve) lama harsatna.
- Hyper leh Hypo thyroid (Thyroid sang lehniam).

Hmeichhia leh naupangte pesticides-in nghawng a neih te :

Hmeichhia leh naupangte hi pesticides hman avang hian harsatna an taw awsam bik a. Nu nau hnute pelai leh nunau nei mai turteah nghawng a nei nasa lehzuai bik a ni.

Developmental toxin :

Developmental toxin kan tih chu nau la piang loa harsatna thlen thei thil hi a ni. Nu naupai laiin heng chemical-te hi a khawih reng emaw a bul vela a awm reng chuan a nau paiah harsatna a awm thei a, chu mai bakah a naute hrin tur chuan a dam chhungin harsatna engtik hunah pawh a nei thei a ni. Heng harsatna hrang hrang awm thei te chu: nu pum chhunga naute thi/nau thi saa piang, pian phunga rualbanlo, thang thei lo, taksa bung hrang hrang (organ) hnathawk tha thei lo.

Pesticides leh naupangte :

Naupangte hi puitlingte aiin heng pesticides lakah hian an him loin, an taksa hriselna kawngah harsatna a thlen hma bik a ni.

a) Nungchang (Behaviour) :

Pesticides hmanna hmuna naupangte an kal emaw an infiam hian emaw an thil khalh lai bal takte an kaa an dah hian harsatna thlen theihna a nei sang bik a ni. Pesticides hi heng park leh khelmual enkawlina atana kan hman hian naupangte infiamna leh len khawthawnna hmun ber a ni baw si a, chu vang chuan naupangte chuan heng pesticides kah thar hlimte hi awsam takin an kai thei a ni.

Naupangte hian rannung tûr hnathawh an do theih dan hi puitlingte nen a inang lova, an taksaa heng tûr lo dawngsawng theitute a la insiam that tawh loh avangin heng chemical hlauhawm te an do theihna a tlem hle a ni. Heng tur kan hman avangte hian naupangte an taksa thanna kawngah leh an thluak insiam tur te, naute nu pum chhunga mi, puitling chenin harsatna a thlen thei a ni.

Thil-dang nena chawhpawlh a nghawng dan :

Harsatna awm thei chu chemical pakhat hnathawhin a nghawng hi thil dang nena chawhpawlh hian a thlak danglam theih a ni. Ni tina heng chemical chawhpawlh kan hman hian engtiang takin nge kan chungah hna an thawh let hi kan hre si lo.

Leilung hausaknaa pesticides-in nghawng a neih theih dan:

Pesticides kan hman hian kan lei, tui, tualzawl leh thlai chinna hmun thenkhatte a tichhia a, hemi bakah hian tûr kan hman avang hian a bitum loh zawk heng sava, sangha, rannung tangkai chi leh thlai thenkhatte tan hlauhawm a ni thei a ni. Rannung thahna hlo hi a tlangpuiin rannung thah nan a ni a. Mahse, hlo tûr (herbicides)-te hi hnim mai bakah thlai leh rannung thenkhat tan a hlauhawm thei a ni.

a) Tui a tibawlhhlawh : Thlai leh leite damdawi hmanga kan enkawl avang hian ruah lo surin hengte hi len faiin kan lui tui/tui tlingte hi a tibawlhhlawh thei a ni. Pesticides kan hman avang hian kan tuite hi a bawlhhlawh nasa hle a ni. Zir mitena an zir chiannaah chuan kan lui tuite hi heng pesticides leh agriculture kaihhnawih leh khawpui thli hian a chiah nasa hle an ti a ni.

b) Lei chhung tui a tibawlhhlawh: Khawvela harsatna lian tham tling pakhat chu kan lei-hnuai tui tihbawlhhlawha a awm hi a ni. India ram hmun pakhat Bhopal-a zir chianna (survey) an neihah chuan hand pump leh tuichhunchhuah atanga tuiin tur an lak chhuah atanga 58% (za zela sawmnga pariat) chu Organo Chlorine Pesticides (rannung thahna hlo)-in a tihbawlhhlawh a ni (Kole leh Bagchi, 1995). Kan lei hnuai tuite hi vawi khat a bawlhhlawh tawh chuan kum tam tak a inthlitfim/ tihthianglim leh nan hun a mamawh a ni.

c) Lei tihthatna kawnga nghawng a neih dan: Lei hi pesticides hmanga nasa taka kan sawngbawl a nih chuan lei timur siam thatu rannung te reuh te te a tikiam thei a ni. Soil Scientist Dr. Elaine Ingham sawi danin, "Bacteria leh fungi-te kan hlauh chuan lei hi a chhe thin a ni. Mihringten Antibiotic hi damlo enkawlina atan kan hman vak a, nghawng a neih ang hian fertilizers leh pesticides kan hman nasat lutuk hian rannung tha chi-ah nghawng nasa tak a nei thei a ni. Chin tawk nei lova chemical kan hman hian kum eng emaw ti chung chu a daih mai thei. Amaherawhchu, nakinah chuan lei timur siamtu rannungte an boin, lei thatna a lo da thei a ni". (Savonen, 1997). Entirnan: thlaite hi leitha siamtu mita hmuh tham loh rannung chi hrang hrangahte an inngat a, hengte hian atmospheric nitrogen chu nitrates-ah thlaite hip theihin an siam a ni. Hmun zau tak enkawlina atana hlo tûr (Herbicides) zing taka kan hman hian heng rannungte hnathawh hi a tibuai thei a ni. Triclorpyr hian bacteria te dipdal in ammonia chu nitrate-ah an siam a ni (*Pell et al., 1998*): Glyphosate hian bacteria thate an than a tithuin an hnathawh a tithuanawp thei a ni (*Santos and Flores, 1995*). Tin, 2, 4-D hian nitrogen siamtu bacteria bean thlai zunga awm te chu a suat bawk a ni (*Arias and Fabra, 1993; Fabra et al., 1997*). Chu mai bakah nitrogen siamtu blue green algae te than a tithuin an hnathawh a tibuai bawk a ni (*Singh and Singh, 1989; Tözüm-Çalgan and Sivaci-Güner, 1993*), chuan leia bacteria-in ammonia hi nitrates a thlak tur a dipdal a (*Frankenberger et al., 1991, Martens and Bremner, 1993*). Mycorrhizal fungi kan tihte hian thlai chaw lakna kawngah nasa takin an pui a, heng fungi-te hi hlo tûr leia awm te hian an tichhe thei a ni.

MODULE- 7

SAWHTHING SAWNGBAWL DAN (GINGER PROCESSING)

SAWHTHING SAWNGBAWL DAN (Ginger Processing)

Chaw ṭha paite (Nutrient composition) :

Protein (2.3%), Fat (0.9%), Carbohydrates (12.3%), Mineral (1.2%), Fiber (2.4%) leh Moisture (80.9%) te hi sawhthingin a ken telte an ni. Minerals a ken tel chu Phosphorous, Calcium leh Iron-te an ni a, Vitamin lamah chuan Thiamine, Riboflavin, Niacin leh Vitamin C-te a keng tel baw. Heng a ken tel dan hi a sawhthing chi, a chinna hmun sik leh sa, sawngbawl dan leh dah ṭhatna azir tein a danglam thei a ni.

Sawhthing ṭangkainate (Beneficial quality of ginger) :

Sawhthing hian chaw pai ṭawih a tiawlsamin damdawi atana hman lar tak a ni. Ek khal leh ek chhuak mai thei lo tan a ṭha hle baw. Ṭangkaina a ngah em avangin hmasang aṭang tawhin India leh China ramah damdawi atan an lo hmang fo tawh ṭhin a ni. Lung, tihrawlte a tichakin, thisen a pawlh dal/thianghlim theih avang hian taksa chhunga tuiril chi hrang hrang a kal kual zung zung theih nana puitu pawimawh tak pakhat atan China ramah chuan an hmang uar hle.

Sawhthing ei tam luat vangin harsatna ṭhenkhat thleng thei a nih rualin zir chiannaah erawh chuan lungphu leh blood pressure a khawih buai lo tih hmuh chhuah a ni thung. Tin, thisen khal tur venna damdawi (anticoagulant drugs) warfarin-te hnathawh a khawih buai lo tih hmuh chhuah thar a ni baw.

Sawhthing hi khawvel pumah ei leh in leh damdawi chi hrang hrangah telh ṭhin a ni. Hun rei tak aṭang khan thil ei fuh loh vanga pum nuam lo leh luhai luakchhuak tihreh nan hman a lo ni tawh ṭhin baw a ni. Gingerols an tih mai, sawhthing rim siam ṭhintu ber hi heng atan hian a ṭha hle. Na chhawkna, khawsik damdawi, anti-inflammatory, chemopreventive leh antioxidant ṭha takahte hian.

Processing of ginger :

Sawhthing hi thil hrang hrang atana sawngbawl a nih hmain thil pawimawh tak pahnih kan ngaihtuah ngei ngei ngai a awm a, chungte chu :

- Seng/chawh a nih laia a bul bawk puitlin dan (maturity stage at the time of harvest)
- A sawhthing lin nih phung dik tak hriat chian (Native properties of the type grown)

A hnah upat lam leh thlar len zawng hian a chawh hun a hril ber a. A hnah a lo en (yellow) òan a, a lo ro chho òan tihah hian chawh a hun tawh tih a hriat theih. Hei hi lin a nih aṭanga thla sarih (7) aṭanga thla kua (9) naah a ni tlangpui. A puitlin hmaa chawh tur a nih chuan lin aṭanga thla nga (5)-naah chawh tur a ni thung. Hetih hunah hian hrui an nei tlemin an rim a tak nep deuh a, a hela ei atan pawh a tui bik a, thil danga sawngbawl leh dawn pawhin a hun lai tak a ni bawk a ni. Thla 7 a lo tlin hnu chuan a tui pai a lo tlemin a zung pawh a lo pung chho a, a rim pawh a lo tak sawt tawh ṭhin a, hetiang hunah hi chuan sawhthing ro atan a ṭha zawk ve leh thung, hriak a pai leh oleoresin pai pawh a tam lai tak a ni bawk. A hnah en chhuah vek tawh (chawh tlai lutuk) hnua chawh pawh hi a ṭha chiah lo a, a chhan chu a bulbawkah hrui/zung a lo tam lutuk tawh ṭhin a ni. Tin, a lo puitlin hnua chawh chuan a chawr awlsamin rei tak dahṭhat atan a tlak loh bik ṭhin. Kan han tar lan tak ang hian sawhthing kan sawngbawl duh dan hi a chawh hunin nasa takin a hril tih kan hmu thei awm e. A sawngbawl dan tur azira sawhthing chawh hun tur tlangpui chu a hnuaiah hian tar lan a ni (Source : FAO) :

A hel/tharlama ei atan	:	Phun a nih aṭanga thla 5 hnua
Dah ṭhat atan	:	Thla 5 - 7 hnua
Dah ro atan	:	Thla 8-9 hnu, a hnah en hunah
A hriak lak tur atan	:	Thla 8 - 9-ah

Sawhthing lin nih phung dik tak hriat chian (Native properties of the type grown) :

Sawhthing tui dan, rim leh rawng hi khawvel hmun hrang hrangah a ṭona hmun azirin a danglam thei. Hei hian sawngbawl zui zel dan turah nghawng thui tak a nei thei. Sawhthing ro atan chuan a rim

na tak chi thlan a pawimawh. A thlar len zawng pawh hi sawhthing ro siam dawn chuan a pawimawh hle bawk. A thlar lian tak chuan tui a pai hnem avangin tihro a tihautak deuh a, chuvangin, tihro atan chuan a thlar laihawl thlan a pawimawh hle.

Kan sawhthing sawngbawl zui zel dan tur kan thlan fel tawh chuan sawngbawl zui zel tur chuan a hnuaia mi ang hian chhonzawm tur a ni:

1) Sil-fai (Cleaning) :

Bawlhhlawh hrang hrang awm te, a kung nawite leh a zung nawihote tihfai te hi a pawimawh em em a. Sawhthingte chu thawh chhuah emaw rei tak dah that tur emaw a nih chuan chawh zawh veleh uluk taka then fai nghal vek tur a ni. Sawhthing thlar chu kutin emaw brush-in emaw tui leh Hypochlorous Acid (HClO, 150 ppm) tlem chawhpawlha sil tur a ni. Tih dan phung pangngaiin sawhthing chu sil zawhah a tiak tur tihthihna turin a thlar chu tui so-ah minute sawm (10) chhung chiah leh tur a ni. Tui thur lam (pH) 6.5-ah hian Hypochlorous Acid hman hi a tha tawka ngaih a ni. Sil anihlai hian a silna tuiah fungicide tlem telh emaw, a hranga kah emaw a tha hle. Hetiang atan hian Benomyl (500 ppm active ingredient) emaw Thiabendazole (1000 ppm) hman duhthusam a ni

A sil dan chi dang leh chu pressure washing tih a ni a. A awm remchang a nih phawt chuan hetiang a sil hian natna hrik tam tak a tihlum avangin a tha hle a ni.

2) Thliar hran (Sorting) :

A len zawng emaw, pianphung emaw, rawng emaw, landan azira thliar hran hi Sorting an ti thin a ni. A thlar tha lo leh pemte chu la hrangin, a bak chu an len zawng leh pian phung milin dah hran leh thliah thliah tur a ni. A fai tha leh rawng uk-eng (brown-yellow) deuh khak emaw a rawng eng (light colour)-te chu thlan thin tur a ni. A khi leh pem sa te, natna kai ni awma rawng dum kaite chu telh miah loh tur a ni.

3) Vel (Peeling) :

Peeling kan tih chuan a kawr vel leh chan sawm a huam awm e. A tlangpuiin peeling hi hun rei lo te chhunga sawhthingte an ro theihna atana tih thin a ni. A lo hmuar mai loh nan leh a inum

(ferment) mai lohna turin a pho ro chhung rei lo hi a pawimawh hle. Amaherawhchu, sawhthing vel (peeling) hian a kawra vela sawhthing hriak (Oleoresin) tha tak awmte a bo then loh nan fimkhur taka tih a tha. Mau phel hmawr zum hmante pawh a tha awm e. Sawhthing pho ro hma hian peeling hi tiha tih loh theih bawk a ni a, a sawhthing chi azir leh a linna hmun azirte pawh a ni thei awm e. Peeling hi ti loa sawhthing chu sil fai leh tihro a nih ringawt chuan "black ginger" emaw "green ginger" emaw tih a ni, peeling tih erawh chuan "white ginger" tih a ni ve thung.

4) Chan sawm (Slicing) :

Sawhthing chu pho ro hmaa chan sawm hi a pawimawh em em a, a chhan chu tui tam tak a pai thin vang a ni. Amaherawhchu, zai lep a nih hian a hriak paite a hloh then ve thei thung. A lep a len zawh poh leh a hriak pai a tam ve zel a, a puma tih ro a nih hian a hriak pai a hloh tlem ber a ni.

5) Pho ro (Drying) :

Sawhthing sawngbawl naah chuan pho ro hi a pawimawh hle a. Hei hian phurh sawn a tihawlsam rual rualin hman tlak loh a chuangbang a titem bawk a ni. Pho ro kan tih hian thil sa emaw lum emaw hmanga a tui paite tih ro a ni.

A lo hlawk zawk theihna turin tualchhunga sawhthing sawngbawl dawn hian remhre taka tih a ngai a. A senso tlem zawk nan leh hlawk zawk nan India ramah chuan sawhthing chu ni saah pho ro mai a ni thin. Hmun hrang hrangah sawhthing tih ro dan chi hrang hrang hman a ni bawk. Indian Spice Board-in hmuimer tih ro dan tlangpui a duante chu :

- A thlar chu zankhu aa tuia chiah.
- Mau/thingthera a kawr ziah fai.
- Kar khat chhung ni saa pho a, darkar ruk (6) chhung chinai (lime 2%) leh tui tlem pawlha chiah leh tur.
- A tui pai chu 8-10% tala pho ro tur a ni (12% aiin a pai tam tur a ni lo).

Kan han pho ro hian a rih zawng hi 60 - 70%-in a tlahniam thei a, hei vang hian sawhthing tam tham phurh kual a tihawlsam phah thei hle a ni. Peeling tih hnua ni saa phoin 7.8% to 8.8%-a hniam a tui pai tihnam tur chuan ni sarih (7) atanga ni kua (9) thlenga pho a ngai a. Chutih lai chuan cross-flow drier hmang chuan darkar nga (5) atanga darkar ruk (6) chiah a ngai thung. Amaherawhchu, a puma tihro dawn chuan kheh ni tho mah se a lo berah darkar sawmparuk (16) atanga darkar sawmpariat (18) tal a mamawh. Chutichuan, a tih ro dan azirin a tih ro hun chhung kai tawi turin peeling leh a chan len lamin a hril thui hle a ni.

Mechanical drying hmanga tihro a nih hian a sawhthing chu a fai tha zawkin a rualkhai zawk a, chutih rualin ni saa pho ro leh solar tunnel drying hmanga tihro a nih hian a oil pawimawh leh oleoresin a pai hnem zawk thung. Hot air drying-ah chuan boruak che vel leh boruak sat zawng uluk hi a pawimawh hle. Mechanical drying-ah hian 60 °C-a saa boruak lum lam vawn hi a tha. Hei aia saah chuan sawhthing chuan a oil leh Oleoresin chu 12.2% and 5.3% chung lam a hloh thei.

6) Thliar hnan leh fun/tuam (Grading and packaging) :

Sawhthing sawngbawl tawhte chu an len zawng leh nih phung that dan (quality) angkhat zela thliar hnan tur a ni. Sawhthing rote chu; kheh, kheh loh, vel, vel loh, chiah, phel, chan sawm titein tihro an nih dan mil zelin thliar hnan thin a ni. Sawhthingte an chhiat lohna turin bawm chher chhuan mai theih leh thaw tha leh boruak che vel thei tur bawmah khung khawm tur a ni. Zawrh chhuah dawn chuan lehkhakhawng leh sarang vel mai maia khung ai chuan thing bawm ngei hman a tha. Ram pawn lama thaw chhuah atan chuan fiberboard carton ngei hman tur. Fiberboard bursting strength chu inches khat bialah 275 lb aiin a tlem tur a ni lo. Bawm bang thuah leh inkah tawn thei emaw bawm khawng tha chi emaw hi duhthusam a ni. Tin, sawhthing chu bawm pakhtah khat leh tawt lutuka hnawh loh tur.

MODULE- 8

INTEGRATED PEST MANAGEMENT

INTEGRATED PEST MANAGEMENT

Pest awmzia :

Pest chu thil eng pawh nunna nei, thil ʔo emaw, nungcha lam emaw zawng zawng - pangngai taka kan thlai ch̄n ʔan ʔatna leh a lo punna (inthlah punna) tur khawih chhe ʔhin hi a ni. Rannung (insect) te, hrik (mite) te, mita hmuh tham meuh loh thil ʔo (fungi), hmuar ang maia lang chi-te, 'natna hrik' kan tih mai chi hrang hrang - bacteria leh virus te, 'hnim' kan tih mai (weed) te; a lung leh changpat lam chi (nematode), leilung leh thlai kunga khawsa ʔhin te; sazu lam chi te; savate leh ramsate hi a huam vek a. Thlai a hrisel loha a chhiatna chhan chu nunna nei chi hrang hrang (biotic agent)-rannung te (insect) te, thil ʔo-te, hmuar ang lang (fungi)-te; 'natna hrik' kan tih mai (bacteria)-te, hnim chi hrang hrang (weed)-te leh an chaw ve thil chi hrang hrangte leh nunna nei lo (a-biotic agent) - khaw awm dan (sik leh sa)-te, ruahtui leh khaw lum leh vawt (temperature)-te an ni.

Thlai eichhetuin thlai a beih avanga nghawng awm theite :

1. Thlai kha a pawp emaw, a kua emaw a lo ni a, a ʔawih thei baw a, thlai pangngai rawng ang loin rawng chi dangin a rawn k̄pin a rawn ʔial thei baw.
2. A eichhetu vanga thlai enkawl a ngaih vangin thlai thar tura senso a tam phah.
3. Thlai thar a tlahniam.
4. Thlai thar hmel mawina leh a ʔatna (quality) a tlahniam.

Rannung (insect) chanchin leh thlai an tihchhiat dan :

Rannung (insect) chu pian hmang leh nih dan phung (characteristic) b̄k riau nei an ni. Z̄ng ruh nei ve lo chi, 'invertebrate' an tih chi an ni. A tam zawk chu a vahin an vak ber a, mahse ʔhenkhat chu an thlawk thei a, ʔhenkhat chu an zuang/kat thei baw. Tui te, boruak te, chaw-te an mamawh ve baw.

Awlsam taka rannung (insect) hriat mai theihna kawng panga:

1. K̄wr khawng sak deuh hlekin an taksa a khuh ʔhin.
2. An taksa hi bung thum - lu, âwm leh dulah a inʔhen.

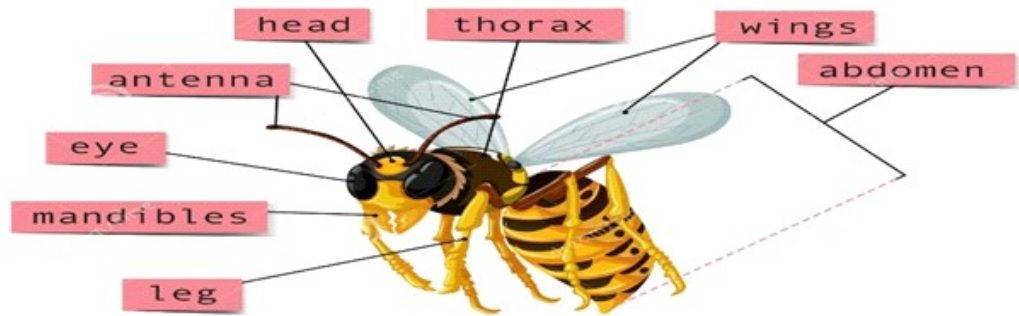


Fig: Rannung bung hrang hrang

3. An lu-ah kê (antenna) pahnih an nei vek.
4. Ke tuak thum (paruk) kal nan an nei a, ðenkhat thung chuan chung an ke tuak khat (pahnih), an bawppui chu zuan nan, inperh sawn daih nan an hmang bawk.
5. A chi ðenkhat chuan thla kawp hnih (pali) an nei.

Rannung ðenkhat chu mihring tana ðangkai tak an ni a, ðenkhat erawh chu hnawksak tak an ni.

1. Thlai tana hnawksak rannung (insect) thliar hran dan :

A. Thlai dâwt leh zûk chi : Hetiang rannung hi chuan thlai tuihnang kha an fawp ngar ngar ðhin. Chung zinga a langsar zual chu - rannung (insect) dum chi chi hrang hrang (thrip) te, rannung phek bial chi, thil fawh leh hîp nana nawn nei chi (bug)-ah pawh a hnah leh a kung bei chi (plant/leaf bug) te, lace bug-te, chutiang chi (bug) insect chi hrang hrang te, thlai kung vela kat nelh nelh chi - psyllid te, fanghmir bawng (aphids) te, whitefly-te, mealybug te, 'scale' an tih mai chi-te, hrik (mite) chi te, maimawm hrik (spider mite)-te, eriophyid hrik (mite)-te an ni.

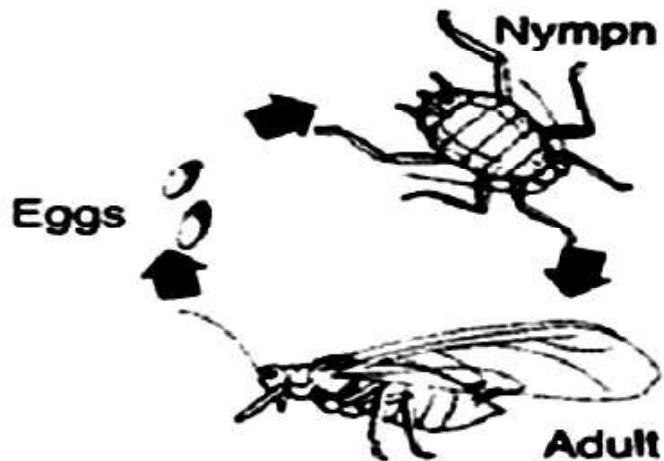
A.A dâwt/hîp/fâwp chiin thlai a beih nghawng awm theite :

1. Thlai ðiak hlim lam leh a zîk lam a sawng kir/khawr ðhin. A timur (cell) a tichhia a, mahse a kung emaw, a hnah emaw kha a ðhan ngaia a ðhan reng si vangin an zukna/fawhna/hîpna lai kha a sâwngin a khâwr a, a kir ta ðhin a ni.

2. Honeydew hi thil tuihnang fîm thlum deuh, thlai chaw kawngpui-a hnahin a chaw siam, thlai taksa hmun hrang hranga a sem darhna thisen zam dawta bei thin insect-in, thlai pang vela an ekchhe chhek a ni. Chung ekchhia (honeydew) aţang chuan hmuar dum hmul ther thur a rawn   a, thlai ti-mur (cell) a ei chhiat tak hnu chuan thil rawng eng bial hi a lo awm ta  uk mai thin a ni. Heng rannung ekchhia hian thlaiin ni zung aţanga an chaw siamna a tibuai thin a ni.
3. Heng rannung thenkhat hian thlai kung pang thenkhat emaw, a hnah bial khawi lai emaw kha a f wp/zuk/h p hlum (dissolve) a, chu lai bial chu a thi ta thin a. Tichuan, thlai pangah emaw, a hnahah emaw chuan a thi ro lai a lo-awm ta thin a, chumi bul velah pawh a darh thei thin.
4. Thlai pang an zuk laia an chil chhuak hian thlai thisen zam kal vel kha a tiping thei a; chu vang chuan kha lai bialah khan thlai kha a chawrche ta emaw, hrisel lo rawng a rawn lang ta emaw, a thi ta mai emaw a ni thin.
5. Heng rannung hian thlai tui pai tam tak leh thlai taksaa thlai chaw kha eng emaw zat an h p tak vang khan khang lai bial velah khan rannung ekchhia - rawng dum lam emaw, thing hnai tle deuh ang tak emaw a rawn lang baw  thin.

Thlai z k chi rannung dam chhung nun: An dam chhung hun hi hun thum-a then a ni.

- a) **A puitling (Adult)** : Ni nga vel emaw an dam a; an harhin an awm hle hle thei lo. Thlai an tichhe lo.
- b) **A tui (Egg)** : Te reuh te te-in an tui a,  um thum aţanga  um nga vel an intidanglam thin. An che sawm thei lo a, thlai an tichhe lo.
- c) **A keu hlim (Nymph)** : Ni 7-10 chhung a awh. Thlai tichhetu ber an ni.



Aphid Lifecycle

B. Thlai rah leh a zîk no hreuhtu: Heng rannungte hian thlai rah leh a zîk an kher/hreuh thin. A hnuaia mite hi a langsar zual an ni :

- a) Bawkbawn rah leh zîk hreuhtu.
- b) Bhendi rah leh zîk hreuhtu.
- c) La kuh-mum hreuhtu.

A rah leh zîk no hreuhtuin thlai a tihchhiat dan :

- a) Thlai zîk no a vuai.
- b) A zîk vuai chu a thi a, a tliak/thlawn thin.
- c) A rah a tlem a, a te.
- d) A rah a hreuh chhiat vangan hralh tlak a ni lo.

An dam-chhung hun inbanlet dan :

- i) **A tui:** A mum var uk deuh, a hlawma awm lo a, a mala awm. Ni hnih ni thum hnu velah a keu.
- ii) **A no/pangang/lung:** A uk deuh te, a eng hring deuh te an ni. Ni 40-50-te a awm a; an mawng a zangan thlai an tihchhiat hun lai ber a ni.

iii) **A buh-chi-um:** Leiah te, hnahah te, a rah kâwr khawroahte an awm a; a buang uk lam an ni. Hemi hun hian thla 10-12-te a awh thei.

iv) **A puitling:** 'Zan phengphehle (moth)' kan tih ang chi, a uk var leh eng lek lek, sa tha leh chum turh mai an ni tlangpui. An thla hma lam tuak khat (pahnih) chu a hring emaw, a uk da deuh emaw a ni a, a laiah a dumin a val kalh bawk. A thla hnung tuak khat (pahnih) chu a var paw lam deuh, a tlanga lian deuha a duma râng kual a ni thung. He hun hian ni 5-10 a awh a, an pheleng hle a, thlai erawh an tichhe lo.

Rannung hnawksak thunun/hnawh bo/thah nana Agro-Ecological lam thil hmante:

- Nunna nei thil aṭanga siam hman.
- Trap crop leh border crop, sticky, light trap hman.
- Thlai awm sa remchang apiang hman.
- Thilnung chi dang hman.

A. Nunna nei thil aṭanga siam hman dan :

Nemmastra				
Hmanna turte	Hmanrua	Hman tam dan tur	Siam/Buataih dan	Thil dang tulte
Thlai kung vela a tui hîp/ dawt/ fawptute awmnaah	Bawng zun	5ltr.	Neem hnah den sawm leh bawng zun leh ek chawhpawlh a, tuia telh hnua inpawlh tha tura darkar 24 dah. Chumi hnua puan them emawa thlitfim a, thlai kah nana hman.	Siam hnu hian thla thum chung a dah theih.
	Bawng ek	1 kg.		
	Neem hnah	5 kg.		
	Tui	100ltr.		

Brahmastra				
Hmanna turte	Hmanrua	Hman tam dan tur	Siam/Buatsaih dan	Thil dang tulte
Thlai kung vela a tui hîp/ dawl/ fawptute awmnaah	Bawng zun	10ltr	A tlem berah hnah hman tur kan sawi chi chi ruk, a hrang theuha chip deuha den sawm hi bawng zun 10 ltr nena chawhpawlh tur. Chu chu hmun ngaa thena hmun khat chauh a nih thlenga chhum tur.	Siam hnu hian thla thum chung a dah theih.
	Bawng ek	1 kg.		
	Neem hnah	3 kg.		
	Custurd apple hnah	2 kg.		
	Castor hnah	2 kg.		
	Pomgamia hnah	2 kg.		
	Lantena hnah	2 kg.		
	Thingfanghma hnah	2 kg.		
	Dhatura hnah	2 kg.		
	Kawithei hnah	2 kg.		
	Changkha hnah	2 kg.		

Agnistra				
Hmanna turte	Hmanrua	Hman tam dan tur	Siam/Buataih dan	Thil dang tulte
Thlai kung leh a rah hreuhtu, khertu leh a nget awmnaah	Bawng zun	10ltr.	Vaihlo, purun var leh hmarcha hring/hel hi chip taka den sawm tur. Bawng zun 10ltr nen pawlh a, minute 30 chhum tur. Darkar 48 dah a, thlitfîm tur. Tui 50 ltr.-a damdawi hi 2 ltr pawlha kah tur.	Siam hnu hian thla thum chung a dah theih.
	Vaihlo hnah	1 kg.		
	Hmarcha hring/hel	5 kg.		
	Purun Var	0.5kg		

Vitex Extract				
Hmanna turte	Hmanrua	Hman tam dan tur	Siam/Buatsaih dan	Thil dang tulte
Buh hmunah	Vitex hnah	10Kg.	Vitex hnah den sawma chhum tur. Tui ltr 100 nen pawlh a, a daih hnu-a kah nana hman tur.	

Hmarcha leh purun var atangin (Chilli garlic extract).				
Hmanna turte	Hmanrua	Hman tam dan tur	Siam/Buatsaih dan	Thil dang tulte
Thlai kung leh a rah hreuhtu, khertu leh a nget awmnaah	Khawnvartui	10lts.	A kuang paih hnu-ah hmarcha hel/hring kha den sawm a, tui 3 ltr leiṭha, hapta hnih dah tur. Tin, purun var den sawm a, khawnvartui 250 ml leiṭha, hapta hnih dah tur. Chutah a pahnih chuan thlitfīm hnu-a ngun taka chawhpawlh tur. Surf 100 gm kha telh a, tui 100 ltr pawlha kah nana hman tur.	Siam sa a dah that theih loh. Hman zawh tur.
	Purun Var	0.5kg.		
	Hmarcha hring/hel	3 kg.		
	Tui	100lts.		

5% Neem rah mu aṭangin (5% Neem Seed Kernel Extract).				
Hmanna turte	Hmanrua	Hman tam dan tur	Siam/Buatsaih dan	Thil dang ṭulte
Thlai kung leh rah zuk/ fawp/ hīptu awmnaah.	Surf Neem rah	100gm. 5 kg.	Neem rah 5 kg den sawma tui 10 ltr telh a, darkar 12 dah tur. Chutah thlit fīma surf 100 gm leh tui 100 ltr telh a, a kah nan hman tur.	

B. Trap crop, sticky trap and light trap:

Trap crop chu thlai emaw hnim emaw, rannungin an ei duh chi thlai pangngai aia an bawh duh zawk hi an ni. Chutiang thlai chu rannung khan ei atan emaw, tui nan emaw, thlai chīn pangngai ai khan an thlang zawk thei ṭhin. Chutiang chuan rannung chu thlai hmun ven kan tum ber thleng lo khan emaw an tawp a. A nih loh pawhin eng thlai emaw kha an ei duh leh an khawih duh hunlai milin, thlai ven kan duh awmna aṭanga hla deuhah chīn a ni ṭhin. Chutianga trap crop hman dawna hriat hmasak tur thil pahnihte chu - rannung ei duh zawng chin tur thlan hmasak phawt a ni a; chumi hnu chuan kan thlai ven duh chīn hma-a chin tur a ni a; rannungin kan thlai ven duh an ei duh hun a nih hma-in chu thlai, trap crop chu rannungin an ei duh hun a ni ang a, kan thlai chīn chu a him dawn a ni. Kan thlai ven duh ei lo tura tawktarhah kan hmang dawn a nih chu.

Trap crop chungchanga hriat tur pawimawhte :

1. Kan thlai chīn aia rannungin an duh zawk tur thlan tur.
2. Kan trap crop chin chu ngun tak leh hunbi fel tak neia enkawl leh vil tur.
3. Kan trap crop china rannung tui kha hmuh a nih veleth tihchhiat nghal vat tur.

Trap crop ṭhatnate :

1. Rannung thahna hlo hman tlem phah a ni chawk.
2. Khuana kutchhuak, thlai beitu hmelma (natural enemy)-te kha a hum.

3. Nunna nei thil a tipung.
4. Thlai thar chhuah a tipung.

Conventional trap crop :

Hei hi kan thlai-chîn duh bul leh sîr kual vela rannungin kan thlai chin a beih loh nana a beih duh zawk leh a beih hmasak tur trap crop chin a ni. Entir nan - Badam (ground nut) leh tomato hmun hual vela Castor (trap crop) leh derhken (marigold), trap crop chin angte hi.

Dead end trap cropping :

Rannungin an duh em em trap crop, mahse kha trap crop-a an tui leh an note-te dam thei hauh lo leh anmahni pawhin an thih phah theih ang chîn hi. Entir nan -Cabbage diamond back moth (rannung)-in a beih tura Indian mustard (trap crop) chin te : beanpod borer rannungin a beih tura sunhemp (crap crop) chîn angte hi a ni.

Sl. No.	Thil pui ber	Trap crop	Ei chhetu
1.	La	Derhken Bhendi	Heliothis Kuhmum khertu(pod borer)
2.	Ground nut	Cow pea badam Castor	Leaf folder (hnah tikhâwrtu) Tobacco caterpillar
3.	Red gram	Soyabean/ Green gram	Thrips
4.	Sunflower/ ni-hawi	Derhken Castor	Heliothis Tobacco caterpillar
5.	Bengal gram	Derhken	Heliothis
6.	Zikhlum	Indian mustard	Diamond back moth (zan phengphehlep)
7.	La	Alfa alfa	Laygus bug
8.	Purun var	Derhken	Thrips
9.	Carrot	Purun sen leh purun var	Carrot root tho (fly)
10.	Zikhlum	Radish / bul-uih	Flee beetle

Sticky trap :

Rannung-ho hi rawng eng hian a hîp bîk riau a, chuvangin, lehkha khawng eng te, thingphek te, rangva phekte kha rannung hîp nan hman a, tah chuan thil ban kawi te, puan bante kha tah emaw, bel mai tur a ni. An rawn bawma an han fuk khan an tang a, an thi mai thin.

Light trap :

Army worm te, rannung te, bial phek (bug) te, cut worm te, tho te, thosi te, bollworm te, a perha kat chi (leaf hopper) te, thlai kung kher/verh/nget chi-te hi eng (light trap) hmanga tihziaawm theih an ni.

Êng hmanga thang kam (light trap) atana thil tulte :

- Plastic baltîn (bucket) 5–10 ltr.
- Êng hliahtu / khuhna tur thir phek (metal light shade), pahnih (2).
- Êng (Flourescent light) leh a vuahna (holder).
- Electric hrui.
- Thir tlawn rawng hnawih – pali (4).
- Rangva phek.
- Hrui emaw flexible wire emaw.
- Nut bolt (bolt leh a herh nghehna nut) leh screw driver.
- Tui paihna kaw hnawhna thelret.
- Sahbawn tui emaw, khawnvartui telh tui emaw.



Fig: Light trap

Baltîn (bucket) tlangah i thir tlawn rawng hnawih pali thun thlakna tur khan verh kua la, a mawng lamah khan tui, bawlhhlawh paihna turin verh kaw bawk la. Êng hliahtu tur thir phekah khan light bulb chu a letling zawngin, hnuai lam hawi tur zawngin vuah la. I thir tlawn rawng hnawihah khan eng khuhna tur thir pheka light bulb i vuah chu a kilhna leh a herh nghehna khan vuah nghet la, baltîn (bucket)-a i verh kuak pali-ah i tung nghet tlat dawn nia. Bucket mawnga tui chhuahna tur kua kha thelret khan hnawh tlat hrih la, bucket-ah sahbawn tui emaw, khawnvartui telh tui emaw kha i dah dawn nia. A pum chuan êng khuhna thir pheh hlai deuh zawk khan i khuh leh ang. Tichuan, rannung (insect) tla khawm vel chu a mawnga tui paihna tur kua aţanga paih fai tur a ni.

A hmun tura dah dan:

- i) Lo/huanah rannung thlawk chi manna hmun tura i duhah dah tur.
- ii) I phuar behna fung kha nghet taka leia phun tur.
- iii) Lei aţanga meter nga vela sanga hun tur.
- iv) I electric hman hrui kha a kan chhiat a, a kan buai loh nan huh thei tura dah loh tur.
- v) A chi dang, khawnvartui thunna (kak) hmanga mawl deuh zawka siam kha chu thlêng dar deuha sahbawn tui dah chungah emaw, sai-ip (buara) chungah emaw khai mai tur a ni.
- vi) I thang chu tlai lam dar ruk vel aţanga zan dar sawm vel thleng kam thin tur a ni.
- vii) Rannung man khawm chu ni tin fel leh tha taka paih fai thin tur a ni.
- viii) Acre khata lo/huan zauah hetiang thang hi pahnih a tawk viau.

C. Thlai awm sa remchang apiang hman :

I huan/lo vela chîn thin thlai, khang lai bial vela hri awm thin emaw, rannung hnawksak ngai pawimawh lo chi emaw chîn khan rannung beihna lakah a fihlim deuh theih bawk.

D. Thilnung hman :

Hei hi thlai beitu rannungte taksa eichhe ve leh chhawngtu thilnung emaw, an tana natna hrik ni ve chi (pathogen/bacteria & virus) leh rannung hnawksak chaw-a hmanga ei thintu rannung dang hmante a ni. Rannung hnawksak beih let nana thilnung chi hrang hrang hmanho kha a hlawma koh nan 'an tana khuanu ruat hmelma hlun (natural enemy)' tihte hi rannung (insect) hnawksak leh thlai hrik (mite) beih nan a pawimawh khawp mai. Ramhnuai hnim pangngai chi hrang hrang (Rangeland and wildland weed, e.g. - Klamath weed, St. Johnswort hnim ang chi) hman/chîn pawh a tih chî khawp baw. Rannung hnawksakte tana natna hrik hman te, an rulhut ve (nematode) hmante leh rannung lian chi deuh (vertebrate) hmante hian ral an nei leh chhawng thin a, chung an hmelma leh chhawngte chu hriatpui mai leh han tihremsak maite kha a harsa ta zawk daih mai thei thung baw. Rannung hnawksak bei tura kan thilnung hmante humhalh leh ven him te, anmahni eichhe chhawng ve leh chhawngtu thilnung dang aia tam zawk, chak zawk leh lian zawka siam chhuahte leh an râlthe hneh theih loh tura duan chhohte kha a ngaiin a tul ta thin a ni.

Thilnung hnawksak hmelma hlunte :

Mi dang ringa ei hmu (parasite) te : Natna hrik - bacteria, virus ang chi (pathogen) te: rannung hnawksak ei chi hrim hrim (predator)-te hi rannung hnawksak – insect leh thlai hrik (mite) suat nana hman thin, an hmelma hlunte chu an ni. Heng mi dang ringa ei hmu (parasite) te, natna hrik (pathogen)-te leh rannung te te ei chi te hian rannung beih bîk an nei fur a, rannung hnawksak chi inang deuh leh inhnaih deuhthe chauh an bei ber thin.

Mi dang ringa ei hmu (parasite) :

Hengho hi thilnung, mi dang taksa chung emaw, pawn emawa ei zawng an ni. Insect parasite-te hi an awmna thilnung kaw chungah emaw, taksa pawn emaw-ah an thang lian thei thin. A tlangpuiin an la puitlin hma hian an awmnate taksa an ring ber. Mahse, a nu leh a chi dang thenkhat – khuai lam chi, scale leh whitefly-te beitu erawh hi chuan an lo puitlin pawhin an ei hmuh nana an belh ber (host)-te pawh

an bei zui a, an tihlum mai thin. Chutianga an tih chuan an ei bêl ber rannung thih kha an pawisa der lo a: thil nung hmanga thlai ven (biological control) kha a tluang tihna a ni. Parasite insect tam ber chu tho leh khuai zu nei lo chi an ni ber. Khuai, zu nei lo chi chuan fanghmir bawng (aphid) te, parasite chi ve tho, Trichogrammatidae tui (egg) te, aphelinidae te, encyrtidae-te an bei ber thin. Ichneumonidae-te hi parasite ve tho, rannung hnawksak chi an ni. Hriat reng tur chu heng khawizu nei lo chi (wasp)-ho, a te leh lian deuh chi-te hian mihring an sehin an zûk ngai lo.

Pathogen (natna hrik – bacteria emaw, virus emaw) :

Heng natna hrik, rannung hnawksak hmelma hlunte hi bacteria te, hmuar siamtu hrik (fungus) lam chi te, nematode te, protozoa-te leh natna hrik chi hrang hrang an chaw hmuhna rannung hnawksak taksa tichhe thei leh tihlum thei chi an ni. Fanghmir bawng (aphid) te, thil lung (caterpillar) te, hrik (mite)-te leh zâng ruh nei ve lo chi tam tak chu heng natna hrik (pathogen)-in an beih vang hian an rem ve duak thei. Chung pathogen tangkai chi-te chu *Bacillus thuringiensis* (BT) te, entomopathogenic nematodes-te leh granulosis natna hrik (virus)-te an ni. Tin, chung natna hrik te reuhte te – evermectin leh spinosyneke chhia hi rannung hnawksak thah nan hman a ni ve thin a; mahse chung thil chu thilnung hmanga rannung hnawksak thahna chi-a sawi a ni ngai lo thung.

A seh chi (predator) :

Sephung lam chi te, tho te, lacewing te, true bug (hemiptera chi)-te leh khuaite hi thlai khawih chhetu rannung te (insect) leh a hrik (mite) eitu an ni. Heng hrik (mite), thlai hrik (mite) eitute hian maimawm hrik (spider mite) te, Amblyseius chi-te leh Neoseiulus chi-te an bei ber.

3. Thlai natna :

Heng thlai natna hi natna hrik te reuh te te, mita hmuh tham loh – hmuar siamtu hrik (fungus) te, bacteria-te leh virus-te thlen a ni.

Thlai natna thlen theihna thil pathumte (disease triangle) :

Thlai natna awm tur hian kha natna tana thil tul pathum a awm. A hmasa berah chuan khang natna hrik - fungi, bacteria leh virus-in

an ei duh zawng thlai (host) a awm a ngai a. Chutah chung thlai natna hrik – fungus, bacteria leh virus-te kha an awm a ngai leh a. Chutah khang thlai natna hrik tana khawsak nawmna tur leh inthlah punna tur thil – a hnâwng tawh chauh boruak (environment) leh a lum tawh chauh boruak (temperature) a ngai leh bawh.

Thlai natna lo darh dan :

Thlai natna thlentirtu emaw, natna thehdarhtu emaw, mamawh dan mil tak thil a awm a. Than dan pangngaia thlai a than theih tak loh bawh si chuan, thlai natna thehdarh kawngah leh khang natna (parasitic disease)-in thlai chhiatna a thlen nasat danah khang thil khan kawngro a su ta a ni. Thlai natna (parasitic disease) darh kawngah hian khang natna hrik (fungus, bacteria leh virus)-te leh an inthlah pun dan (an chi theh darh) hi a bul tumtu ber a ni. Thli te, ruahtui te, rannung te te (insect) te, mihringte leh rannung dangte pawh hi thlai natna thehdarhtu tha tak an ni thei.

Thlai natna thlentute:

- A. Fungus – Fungal diseases.
- B. Bacteria – Bacterial diseases.
- C. Virus – Viral diseases.

A. Fungal diseases:Thlai natna tam zawh, 80 percent vel hi chu fungal leh fungal lam chi dang thlen a ni. Chung thlai natna (fungal diseases)-te chu hengte hi an ni.

Sl. No.	Natna hming	Natna darh theihna	Natna tuartu thlai	Natna lan chhuah dan
1.	Ṭawih hri (botrytis rot). Grey mould (botrytis cenerea) ang chi-te hi.	Khaw vawt hnawng-ah a awm duh.	Celery, lettuce, be lam chi, brassica, fanghma, hmarchapui lian chi (capsicum), tomato-te a bei duh.	Thlai kung velah khan hmuar var (grey fungi) a lo lang a, a nem zawi nung ṭhin.



Figure: White Rust in Cabbage

Sl. No.	Natna hming	Natna darh theihna	Natna tuartu thlai	Natna lan chhuah dan
2.	Downy mildew (eng thlai bîk emaw chauh bawhtu).	Ruahtui tamna hmun hnawng, thlai hnah a huh deuh rengna leh khaw vawt lam deuh (10 – 16 degree centigrade)-ah an darh duh.	Purun sen te, lettuce-te, be lam chi-te, celery-te, spinach-te, kale-te, thlai tō sang deuh leh dam rei deuh chi (herb)-te, cucurbit-te, brassica-te leh Asian leafy brassica-te a bei thin.	A tir chuan thlai hnah kha a rawn val eng deuh a, chutah a rawn uk leh khuk a, a hnah hnuai lam a lo hmul deuh thur thin.



Sl. No.	Natna hming	Natna darh theihna	Natna tuartu thlai	Natna lan chhuah dan
3.	Vut buak leh powder phul ang maia var (powdery mildew). Heng natna thenkhat hi chuan eng thlai bik emaw hi an khawih ve lo.	Khaw lum pangngai (20 – 25 degree centigrade)-ah; downy mildew ang lo takin, hmun ro deuhah an darh duh.	Greenhouse thlai fanghma, hmazil, mai, zucchini, parsnip, beetroot, alu, thlai lian leh dam rei deuh (herb), be lam chi, um-ei, tomato, hmarchapui lian chi (capsicum), Brussel's sprout, zikhlum leh swede-ahte a tam zual duh.	Lei seh chin chung lamah te deuha a var phut deuhin a lo lang a; a tir chuan a hnah hnua lamah a rawn lang a, a hnu deuhah a pumin a rawn tuam thin. Chu hnah chu a rawn eng/kau-rau a, a uk leh a, a panin a ram a, a hnah chu a thi mai thin.



Sl. No.	Natna hming	Natna darh theihna	Natna tuartu thlai	Natna lan chhuah dan
4.	Clubroot (<i>Plasmodiophora brassicae</i>).	Hmun lum, lei thur leh (pH 7 aia thur) lei hnawngah a darh duh.	Brassica (<i>Asian leafy brassica</i>)	Thlai kha a lo eng tuar a, a ðhan a ðhu a, ni sat khawlum zual lai phei chuan a vuai deuh hnup a; a zung bul tet tut chuan leia tui leh thlai chaw a hîp hlei thei lo a, thlai thar a hlawk thei ta lo.



Sl. No.	Natna hming	Natna darh theihna	Natna tuartu thlai	Natna lan chhuah dan
5.	Pythium natna chi hrang hrang.	Lei vawt hnawng ah, 'water mould' an tih ang hian an lo awm a, dam-dawi hmang emawa tui sawi-sak loh ah an inbun nghet a, chuta tang chuan an darh thin. Tuilakte leh tui chauh hmanga thlai chin (hydroponic)-a tuite hi en chian fo tur a ni.	Thlai hnah chi hrang hrang bakah cucurbit, brassica leh lettuce-te a bei duh.	Thlai chi thlak tawh a rawn tō hma leh a tiak hlim a bei a, a thi mai thin.



6.	<i>Sclerotinia rota</i> (<i>S.sclerotiorum</i> and <i>S. minor</i>). Hming dang dang pawh vuah a ni.	Hmun hnawng vawt, thli tamna, lei hnawng-ah a awm duh. Rei tak chung (kum 10 – 15) leiah, 'sclerotia hnuhma' an tih ang hian a chambang thei.	Kan thlai chin tam zawk hian an vei thin.	Lei hnawngah thlai kung te, a hnah te, a châng pheii chuan a rah thlengin a bei a; rei lo te-ah hmuar var hi hmul nem deuh angin a lo lang a; chutah rawt dum, lungte ang maia sak deuhah arawn inlet thin.
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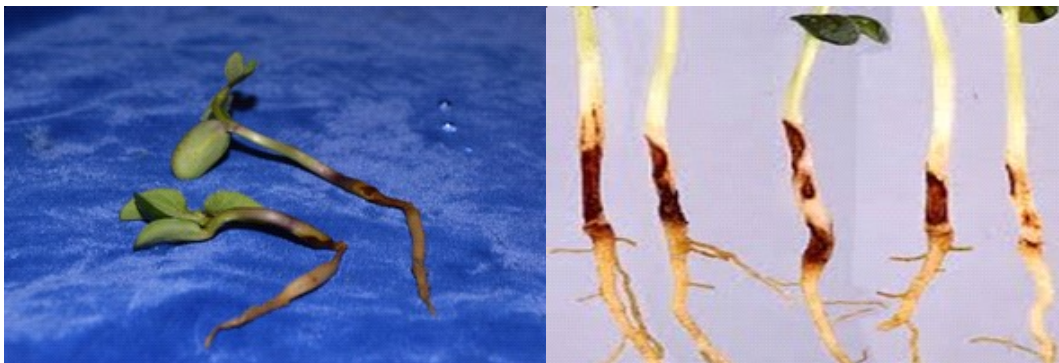
Sl. No.	Natna hming	Natna darh theihna	Natna tuartu thlai	Natna lan chhuah dan
7.	<i>Sclerotium</i> ṭawih hri (<i>Sclerotium rolfsii</i> and <i>S. cepivorum</i>)	<i>S. rolfsii</i> hi chu hmun lum hnawngah a darh duh. <i>S. cepivorum</i> thung chu lei vawt (14–19 degree centigrade) leh lei rô lam deuhah a darh duh thung.	<i>S. rolfsii</i> hian thlai chi hrang hrang – be lam chi te, a zung thlum chi te, carrot-te, alu te, tomato te, hmarchapui lian (capsicum) te, cucurbit-te a bei duh. <i>S. cepivorum</i> chuan purun sen leh var leh chutiang lam chi (shallot, spring onion leh leek) ang chi chauh a bei thung.	<i>S. rolfsii</i> hian a kung bul lam leh a zung a ṭṭawih a; a hrikin a beihna chu hmuar zai sei hian a hual deuh sung ṭhin a, a uk deuh bawk ṭhin. <i>S. cepivorum</i> chuan thlai a tieng, kaurau a, a vuai a; a bul vâwng chung chiah velah khan hmul ang mai hmuar a lang a, rawt dum sak a rawn awm leh ṭhin bawk.
8.	<i>Fusarium</i> vuai leh ṭawih hri (wilt and roth). Chi hrang hrang – <i>F. solani</i> te, <i>F. oxysporium</i> -te a awm.	Hmun lum leh sa-ah a darh duh.	Thlai chi hrang hrang – brassica, carrot, cucurbit, purun sen, spring onion, alu, tomato, kung nei deuh chi (herb), bepui leh be lam chi a bei duh.	Thlai zung leh a zung leh a kung inzawmna lai vel kha a ṭawih a, a vuai ta ṭhin. Cucurbit rah leh alu dah ṭhat pawh a bei bawk ṭhin.



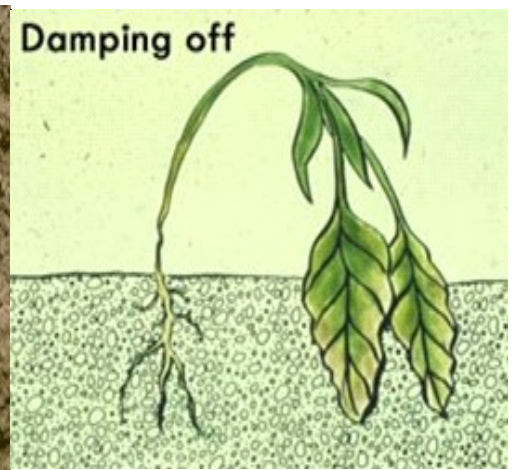
Sl. No.	Natna hming	Natna darh theihna	Natna tuartu thlai	Natna lan chhuah dan
9.	Ṭawih hri (<i>Botrytis roth</i>). Grey mould (<i>Botrytis cinerea</i>) ang chi-te hi.	Khaw vawt hnawngah a awm duh.	Celery, lettuce, be lam chi, brassica, fanghma, hmarchapui lian chi (capsicum), tomato-te a bei duh.	Thlai kung velah khan hmuar var (grey fungi) a lo lang a, a nem zawi nung ṭhin.
10.	Anthrachnose (<i>Colletotrichum spp.</i> Lettuce-ah chuan <i>microdochium panattonianum</i>).	Khaw vawt hnawngah a darh duh.	Lettuce, celery, be lam chi, cucurbit, tomato, hmarchapui lian chi (capsicum), alu leh artichoke mum chi a bei duh.	Thlai hnah, kung leh rahte a vuai sâwng a, a huh tui hluam ṭhin.



11.	Tawih hri (<i>Rhizotocnia solani</i>). Hming dang pawh vuah a ni: lettuce-ah chuan a bul tawih (bottom rot) a ni a, brassica-ah chuan wire stem tih a ni.	Khaw lum hnawn laiin a awm duh. Ei hmuhna tur thlai dang nei lo pawhin leiah rei tak a dam thei.	Lettuce, alu, brassica, be lam leh bepui lam, beet, carrot, hmarchapui lian chi (capsicum), tomato leh cucurbit-te a bei duh.	Thlai chi dang dangah a lan dan a dang a; mahse a zung, a hnah, a kung, a bulbal leh a rah a bei vek a; an sawng vuai a, tlu-in a thi mai thin.
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12.	Vuai sawng hri (Damping off). Pythium te, <i>Rhizoctonia</i> te, <i>Phylophthora</i> leh, <i>Fusarium</i> / <i>Aphanomyces</i> -te hi an ni.	Khaw vawt leh lei hnawngah a awm duh. Shore fly-te, fungus thosi (gnat) te hian pythium hri leh fusarium hri hi an theh darh thei.	Thlai hnah chi hrang hrang, brassica, carrot, beetroot, cucurbit, bawkbawn, tomato, coriander, spring onion leh be lam chite a bei duh.	Thlai tiak hlim kung leh zung kha a thi a; tichuan a vai thih a, a thar pawh a hlawk thei ta lo.
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13.	Cavity spot. (<i>Pythium sulcatum</i>).	Lei thur lamah; carrot chawh hun dawn chiah velah a darh duh.	Carrot hri bil deuh a ni.	A tak a hliam vangin khwar khampei sawl te deuh, rawng eng deuhin a hual vel a awm thin.
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14.	A bulbal (tuber) hri. Chi hrang hrang a awm.		Alu leh kawlbahra	Hâwng khawrô sak hri chi hrang hrang – common scab, powdery scab leh <i>Rhizoctonia</i> vel vangin alu hawng a hrisel lovin a himdam lo. Kawlbahra pawh a hawng hrisel lo vangin a khir bur thei.
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15.	Sen ro hri (rust). Chi hrang a tam mai. Vaimîm (sweetcorn)-a <i>Puccinia sorghi-te</i>, belam chi (bean)-a <i>Uromyces appendiculatus-te</i>, spring onion-a <i>Puccinia allii</i> angte hi.	A chi hi hla tak takah thlî-in a thehdarh thin. Ruahtui tlemna, hmun vawt deuh leh tlema lum deuhah pawh a tam duh.	Vaimîm (sweet corn), bean, purun sen, spring onion, beet, celery, silverbeet, andive thlai angte hi a bei duh.	A hnah hnuai lamah emaw, a kuhmumah emaw pawng sen uk te deuh a rawn awm a; chuta tang chuan a chi (spore) sen uk deuh a rawn chhuak thin. Khaw vawtah chuan a chi chu a dum pawh a ni thei.
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B. Bacteria avanga natna (Bacterial Disease) :

Sl. No.	Thlai natna	Natna darh theihna	Natna tuartu thlai	Natna lan chhuah dan
1.	Black rot. (<i>Xanthomonas campestris</i> pv, <i>campestris</i>)	Khaw lum hnâwnghah	Brassica.	A hnahah khwar / dâm, 'V' ang deuh, a var uk ațanga a eng thlengin a awm thei a; a rei chuan a ramin a ro ta țin a. A hnah hrisel ta lo vang khan a thisen zam ve kha a lo dum țin.



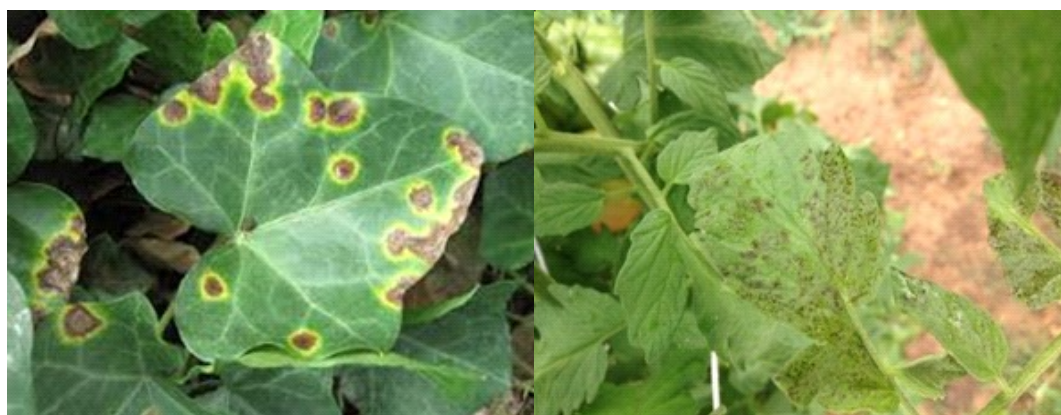
2.	Bacterial canker (<i>Clavibacter michiganensis</i> pv. <i>michiganensis</i>).	Khaw lum pangngai, boruak hnawngah a darh duh.	Tomato, hmarchapui lian chi (capsicum) leh hmarcha a bei duh.	A tiak tir an thi a; a lian deuh tawh pawh an vuai a, an thi mai țin. Thlai upa deuh hnah a eng / kaurau a, a chanve chauhte a vuai țin. A nget chu a kungah leh a rahah a awm țin. A nget beih lai kung chung chu a rawng a danglam bîk.
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3.	Bacterial soft rot (<i>Pseudomonas</i> spp., <i>Erwinia</i> spp.)	Hmun lum hnawngah a darh duh	Lettuce, brassica, cucurbit, tomato, hmarchapui lian chi (capsicum), alu, kawlbahra, carrot leh thlai lian deuh chi (herb) a bei duh.	Thlai zîk, parbawr/ broccoli par ang te, a zung ei chi-te, a kung te, a hnahte kha a huh a, a nal a, a nem bîk thin. A rim pawh a chhe hial thei.
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4.	Bacterial leaf spot / bacterial spot. (<i>Xanthomonas campestris</i> . chi hrang deuh pawh a awm thei)	Tui lak hnar leh thli tamna hmunah a hluar thei.	Lettuce, cucurbit, tomato, hmarchapui lian chi (capsicum).	Lettuce hnah chungah a buang uk aṭanga a dum bial lian tak, a tira lang tlang theia intan a awm. Tomato leh hmarchapui lian chi-ah chuan a hnah leh kungah mawm deuh rawn dum chho zel te, a raha thil bial, a lai chang, sak deuh a awm thei. Cucurbit hnah hnuai kha te deuhin a huhin a mawm a, a hnah chung lam chu a eng / kau-rau baw a; a raha a huh lai deuh aṭangin tui var uk lam a chhuak thei baw.
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5.	Vuai hri (Bacterial wilt). <i>Ralstonia solanacearum</i> .	Khaw lum hmun, lei hnawng leh tui luan hul zung zungna awm lo hmun. Natna a luh tawh chuan khaw lum leh khaw rô vang khan a thawk chakin a darh zau rang a, thlai pawh a vuai thuai thin.	Alu, tomato, hmarchapui lian chi (capsicum) leh bawkbawn hi a bei duh.	A vuai a, a eng thut a, a than a thu thin. A val leh a eng pawh awm hmasa loa vuai thuaia thi ta mai pawh an awm. A thisen zam ve kha a sen uk deuh a, a tui deuh hluam a; a kung leh a bulbal a thlen chuan thil tui var hi a rawn hnam thin.
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C. Viral diseases :

Virus a kai thei chi thlaite leh a khawih chhiat dante :

Natna hrik thehdarhtu - Fanghmir bawng (Aphid).

Virus	A awmna thlai	Natna lan tan dan
Bean common mosaic virus	Bean	A hnah a râng a, a kir a, a sâwng te a; a kung than pawh a thu thin.
Cucumber mosaic and potato mosaic virus	Hmarchapui lian chi (capsicum), tomato, alu, celery	Hnah hring tha lo, vuai, rang, kir. Thlai a thang tha lo.

Carrot virus Y	Carrot	Carrot zung a khawih chhe nasa a, a zung pawh a tawi.
Potato leafroll virus	Alu	A thang tha lo; a hnah hnuaiahnung kha a tlangah a inzial chho; a rawng a dang a, a hun hma-in a thi mai.

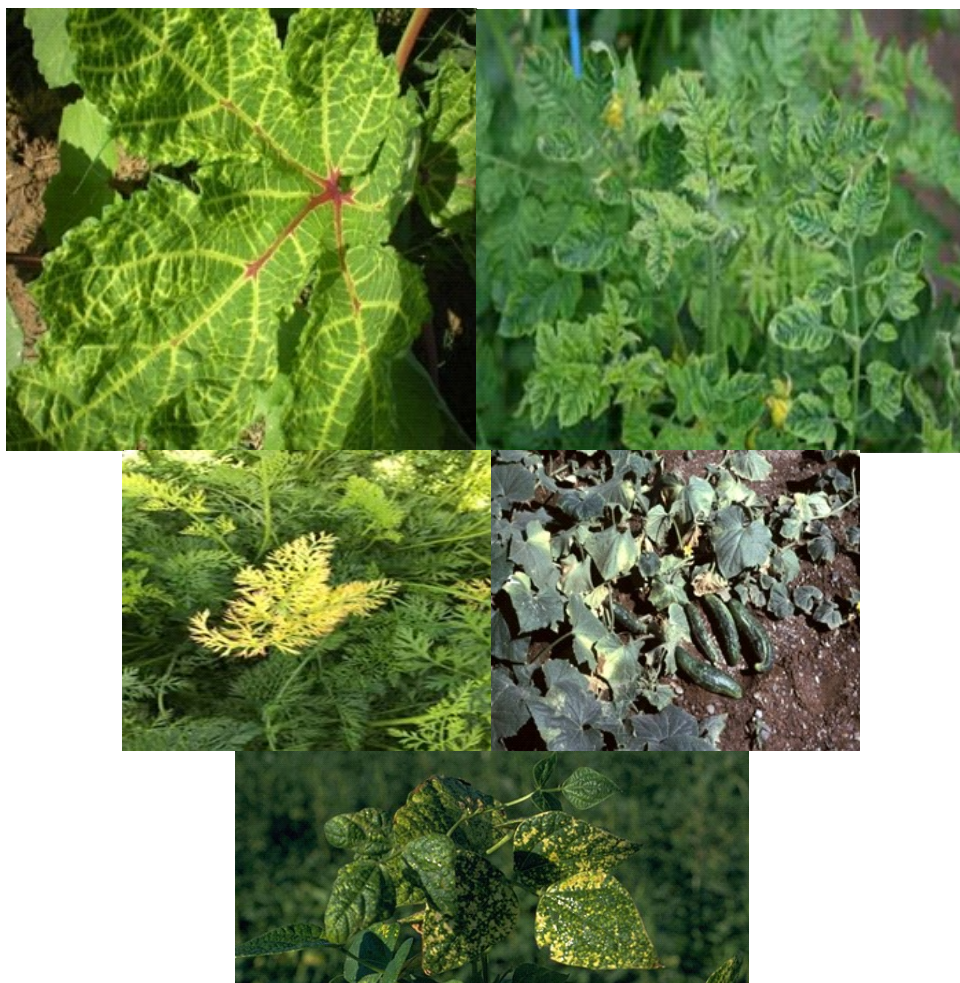


Figure 1 Viral Diseases of different crops

Natna hrik thehdarhtu – thrip (ranning te leh dum).

Virus	A thehdarhtu	A awmna thlai	Natna lan tan dan
Tomato Spotted Wilt Virus (TSWV).	WFT, tomato thrip leh onion thrip.	Hmarchapui lian chi (capsicum), tomato, bawkbawn, lettuce, celery, be lam chi, alu, sweet basil.	A hnaha val bial, inrîn, rang, hring tha lo leh rawng dang awm
Iris Yellow Spotted Virus	Onion thrip chauh.	Purun sen, purun var, leek, spring onion, thlai lian deuh chi (herb).	Mit ang deuh leh kil neia val hi hnahah leh purun sen parfungah a lang a; a rang nasa-in a eng kaurau thin.
Capsicum Chlorosis Virus (CaCV)	Melon (hmazil) trip leh tomato thrip.	Hmarchapui lian chi (capsicum), tomato, hmarcha.	Hmarchapui lian chi (capsicum)-ah chuan a hnah tlang leh a thisen zam karah a inzial kir. Tomato hnah chu a pawng tik tek a, rawng dangin a kâp a, a rang thin.

Natna hrik thehdarhtu – Whitefly :

Virus	A thehdarhtu	A awmna thlai	Natna lan tan dan
Begarno virus – Tomato Yellow Leaf Curl Virus (TYLCV).	Silverleaf whitefly	French bean, cucurbit, hmarchapui lian chi (capsicum), hnim chi hrang tam tak.	Thlai a thang tha lova, a hnah a tial rang a, a uai thla-in a sawng a, a rah a chhe bik.
Beet Pseudo-Yellow Virus (BPYV)	Greenhouse whitefly	Lettuce, beet, endive, fanghma, hnim chi hrang hrang.	Fanghma upa deuh hnah chu a tial rang a, a thisen zam inkar a lo-eng a, a no deuhah a kai darh a, a than a chawl der thei.

Tomato Torrado Virus (ToTV)	Greenhouse le silverleaf whitefly	Hmarchapui lian chi (capsicum), bawkbawn, hnim – amaranthus-te, atriplex-te, chenopodium leh malva-te.	A hnah khawi lai emaw a thi a, chung chu a tla awng a, a hnah khawi maw lai thi awng leh kir chuatin a zui thuai thin.
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Natna hrik theh darhtu – Tobamovirus:

Rannung te (insect)-in an theh darh lova, boruakah a cham ve reng mai a ni.

Virus	A awmna thlai	Natna lan tan dan
Tobacco mosaic virus	Bawkbawn, tomato, bok choy, choy sum, um-ei (bitter melon), Chinese mustard, long melon, snake bean, China zikhlum.	A hnah a khawrin a kir a, a hnahte a tla baw a, a kawlh thei hial.
T o m a t o mosaic virus	Tomato, hmarchapui lian chi (capsicum).	
Pepper mild mottle virus	Hmarchapui lian chi (capsicum), hmarcha.	A hnah khawr leh kir satliah deuh.

Damdawi hlo (chemical) tel lova thlai natna enkawl dan (Integrated disease management with Agro-ecological):

Tih thin dan (practices):

- Thilnung atanga lak chhuah damdawi hman (bio-extracts).
- Thilnung dang hmanga beih (biological control).
- Natna hrik do chak thlai chin (resistant varieties).
- Thlai chi sawisak hmasak (seed treatment).

a. Thilnung aṭanga lak chhuah damdawi hman dan:

Sawhthing ro leh bawnghnute aṭangin

Hmanrua	Hman tam dan tur	Siam / buatsaih dan	Tul dang
Sawhthing ro den dip	200 gm	Tui 2 lt leh sawhthing dip 100 gm kha, liter khat a nih thlenga chhuan tur.	Siam sa a dah that reng theih loh.
Tui	2 ltr	Bawnghnute kha a hrana chhuan so tur. An daih hnuah kan thil chhuan pahni chu chawhpawlh tur. Tui 200 lt hnute pawlha, kah nana hman tur.	
Bawng/Lawi hnute	5 ltr		

Asofoetida leh bawng zun

Hmanrua	Hman tam dan tur	Siam / buatsaih dan	Tul dang
Asofoetida	200 gm	Tui 100 lt nen uluk taka chawhpawlh a, ni khat dah a, kah nana hman tur.	Siam sa a dah reng theih loh
Bawng ek	1 Kg		
Bawng zun	1 lt		

Bawng Zun

Hmanrua	Hman tam dan tur	Siam / buatsaih dan	Tul dang
Bawng zun	1 lt	Tui 50lt pawlh a, kah nana hman	Bawng zun dah reng hi a that zawk avangin a dah reng theih a ni.



Figure : Karanj Leaf (Left), Cow – Dung (Right)



Figure: Putush Leaf (left) Cow urine (Right)

b. Thilnung dang hmanga beih (biological control):

Nunna nei hmanga thlai natna beih nan chuan khuanu kutchhuak khawvela awm sa kha, thlai ei chhetu rannung hlauh turin emaw, an chet theih loh nan emaw hman tur a ni.

Hmanrua	A hlo / damdawi siam chhuah pakhat emaw, a aia tam emaw hmanga thlai natna thlentu natna hrik beih theihthe.
Copper	<i>Altemaria, Erwinia, Pseudomonas, Xanthomonas, Cercospora, Colletotrichum, Powdery mildew, Downy mildew, Phytophthora, Pythium. Mycosphaerella, Phomopsis, Taphrina, Elsinoe, Gnomonia, Fusicladium, Nectria, Phyllosticta, Diclocarpon, Albugo, Guignardia, Botrytis, Exobasidium, Entomosporium, Pestalotia, Phoma, Cristulariella.</i>
Thlai atanga hriak sawr chhuah	Powdery mildew

Potassium bicarbonate	Powdery mildew
Potassium silicate	Powdery mildew, pythium, botrytis, fusarium.
Sulfur	Powdery mildew.

‘Biological control’ chu thlai natna hrik beih nana thil nung chi dang hman hi a ni. Biological control agents (hmanrua/hlo/damdawi) BCAs-te chu hman theih maiin Environmental Protection Agency (EPA)-in a chhinchhiah thlap a, a chhinchhiahna (label) atang mai chuan chungte chu damdawi hmanga rannung thahna hlo (chemical pesticide) nen pawh a inang viau. BCAs thenkhat chu a hnuaia mi hi a ni a; chumi hmanga thlai natna hrik beih theih pawh tar lan a ni a, mahse a damdawi zinga pakhat emaw tal hi chu khuahkhirh (controlled) a ni thin.

Biological Control	Heng damdawi chi khatin emaw, a aia tamin Agent (type of organism) emaw a beih theih thlai natna hrikte.
<i>Agrobacterium radiobacter</i> (bacterium)	<i>Agrobacterium tumefaciens</i> (crown gall)
<i>Ampelomyces quisqualis</i> (fungus).	Powdery mildew
<i>Bacillus subtilis</i> (bacterium)	<i>Pythium</i> , <i>Fusarium</i> , <i>Phytophthora</i> .
	<i>Rhizoctonia</i> , Powdery mildew.
	<i>Colletotrichum</i> , <i>Erwinia</i> , <i>Pseudomonas</i> , <i>Xanthomonas</i> , <i>Diplocarpon</i> , <i>Cercospora</i>
<i>Gliocladium catenulatum</i> (fungus)	<i>Pythium</i> , <i>Rhizoctonia</i> , <i>Botrytis</i>
<i>Streptomyces lydicus</i> (actinomycete, fungus ang deuh bacteria)	<i>Pythium</i> , <i>Fusarium</i> , <i>Phytophthora</i> , <i>Rhizoctonia</i> , <i>Botrytis</i> , Powdery mildew, Downy mildew, <i>Sclerotinia</i> , <i>Verticillium</i>

<i>Streptomyces Griseoviridis</i>	<i>Botrytis, Alternaria, Phomopsis, Pythium, Fusarium, Phytophthora</i>
<i>Trichoderma harzianum</i> (fungus).	<i>Pythium, Fusarium, Phytophthora, Rhizoctonia, Botrytis</i> , Powdery mildew, Downy mildew, Sclerotinia
<i>Trichoderma virens</i> (fungus)	<i>Pythium, Fusarium, Phytophthora, Rhizoctonia, Botrytis</i> , Powdery mildew, Downy mildew, <i>Sclerotinia</i>

***Trichoderma viridae* hman dan:**

***Trichoderma viridae* / *Harzianum*:**

Trichoderma spp., hi fungi chi khat, mi dang ringa ei hmu (parasite) ve tho, kan huan/lo lei zawng zawnga awm ve deuh vek a ni. Tin, hmun dang–thing tawih, mawih-ahte pawh a awm ve bawh. An khawsak dan tam tak bakah hmun lum (tropical)-ah chuan fungi dang ban (hypha) a va ban a, a va vet a, an chaw (protein) kha a va eisak a, an taksa ti-mur bang (cell wall) a va tihchhiatsak thin. Hetiang chi-a thlai natna thlentui beih (mycoparasitism) hian kha natna thlentui (fungi) kha a than thattir thei lo a, kha natna hrik chet dan kha a tikhawbaw zo ta thin a. Hemi atana hman chi (mycoparasite) fungi hian a va beihte timur bang (cell wall) tichhe thei thil tui (enzyme) a siam chhuak a, chumi hmang chuan a va beih fungi kha a verh kua a, an chaw kha a rinsak ta hmiah hmiah mai thin a ni.

He fungi hmanga thlai natna beih theihthe:

Pythium spp., *Ganoderma spp.*, *Rhizoctonia solani*, *Fusarium spp.*, *Botrytis cinerea*, *Sclerotinia spp.*, *Ustilago spp.*, etc.

He damdawi (fungi) hman zin dan tur:

Thlai than thattir (ommamental) nan chuan vawi hnih vawi thum a hman theih a, thlai tawih chi chinna hmun zawl rem (lawn)-ah leh hmun danga thlai chinnaah chuan vawi li vawi nga hman mai tur. Thlai a naupan no laia hman hian thlaiin than a pek that a ngaih hunah a veng him zual thei.

Engtia tam nge hman tur:

Thlai chinna tur lei-ah: Hectare (1000sq. mt)-ah 5kg kha lei tihthatna (organic fertilizer) nen, thlai natna hrik awm lohna eng chi nen pawh hman theih a ni.

Thlai chi sawngbawl naah : Thlai chi 1kg-ah 4 – 5gm kha, a hnawng tura tih anga hnawnga hman tur.

Thlai tiak sawngbawl naah : Phun hmain thlai tiak pakhatat 100gm hman tur.

a. Thil awm remchang chi hrang hrang dang (natna do chak thlai chin angte) hman dan:

Thlai chi tur sawngbawl dan:

Rannung te (insect) beih theih mai tur chi leh natna hrik pai sa thlai chi chin hian nasa takin thar chhuah a nghawng danglam thin. Thlai chi sawngbawlin a tum ber chu thlai chi leh a chinna tur leia thlai natna hrik awm sa sawngbawl nana damdawi (biological) leh damdawi tur (chemical) hman a ni. Hei hian thlai chin kha natna lakah a veng a; thlai a hriselin a thang duang a, hlawk zawkin a thar theih thin. Thlai a tiak kimin a rawn tiak rual tha thin. Kan sawi tawh ang khan damdawi khan thlai chi te, a tiak hlimte kha natna leh rannung lakah a veng a, a tiak tha-in a thang duang thin. Rhizobium hmanga thlai chi sawngbawl phei chuan thlai rah kawm nei chi-ina leia nitrogen boruak a pek chhuah kha a titam a, thar chhuah pawh a pung thin. Thlai chi apiang sawngbawl phei chuan thlai chi hrang a titam a, a thar pawh a hlawk bawh thin. Ram changkangah chuan thlai chi zawng zawng hi damdawiin an sawngbawl hmasa vek a, kan ramah erawh chuan kan thlai chi chin 80% hi sawngbawl loh anga chhût a ni thung. Hetia tih hian thlai tiak hlim kha thlai zuk/fawp/hîp chi rannung lakah a veng bawh.

Thlai chi sawngbawl dan chi hrang hrang:

Vut diaka hmeh hrep a, dah ro :- Hei hian thlai chi-a natna awm sa kha a tihlumin thlai chi a tihrisel a, a tiak tha duh.

A hmuar natna (fungal disease) laka thlai veng tura butter milk hmanga a chî sawngbawl hmasak (butter milk 125ml leh thlai chi 1kg).

Thlai rah chi te, a kawm nei chî te, la chi-te kha chawng (cactus/ euphorbianeriifolia) milk solution (100ml, tui 1 lt-ah) chiaah a, chin hmaa thim zinga darkar 8 chhung dah ro. Hetia tih hian thlai kung hreuhtu rannung note te, tlumpîte leh thlai râl rannung dang lakah a veng thei.

Vitex hnah te, tulsi hnah te, pongam hnah te, 3kg theuh den sawm tui sawr leh bawng ek tharlam chawhpawlh a buh chî 25kg nena chawhpawlh a, sai-ip/buaraa thun a, darkar 12 dah tur. Chumi hnuah buh chî kha

darkar chanve chhung, daihlma dah ro leh tur. Hei hian buh ÿiak kha a tihriselin, natna do theihna a pe thei.

Beejamrutha:

Bawng ek – 5 kg, Bawng zun – 5 lt, Bawngnhnute - 1 lt, chinai 250 gm leh tui 100lt chawhpawlh a, hapta hnih dah tur. Chumi hnua chhung chu thlai chî-ah theh a, daihlma dah ro leh tur.

Bawng zuna thlai chi sawngbawl:

Bawng zun 2 lt (Lawi zun hian natna [fungal disease] a beih theih zawk vangin duhthusam a ni). Bawng ek 1kg leh lei tharlam 1kg kha buh chî nen chawhpawlh a, ro tura darkar khat dah leh tur. He thil hi badam (groundnut) chî ang 30–60kg.-ah pawh a hman theih. Tin, eng thlai chî pawh, bawngnhnute leh tui, 1:9-a pawlha kah a, daihlma dah rô leh pawh a ÿha bawk.

Thlai natna (fungal disease) beih nena thlai chi sawngbawl:

Bawng zun leh ek-a hrik te te (microbe) awm hian natna hrik (fungal) chi tam tak a bei thei bawk. Tin, chuta thlai chaw ÿha awm kha thlaiin a ngeih em em bawk. Vawi hnih thum thlai pek pawh a pawl lo.

A siam/buatsaih dan:

Burah Bawng ek 5 kg, Bawng zun 5 lt leh tui 5 lt kha dah tur a ni a, tho tura ni 4 chhung dah tur a ni. Nitin chawhpawlh ÿhat ziah tur a ni a, ni 4 hnua thlit fîm a, chinai 150 gm telh leh tur. Tui 100 lt pawlh hnu-a ram acre khata kah tur.