

## **Appendix C-5:**

# **Manual of Summer Sesame Cultivation**





# Summer Sesame Cropping Manual in Pyay

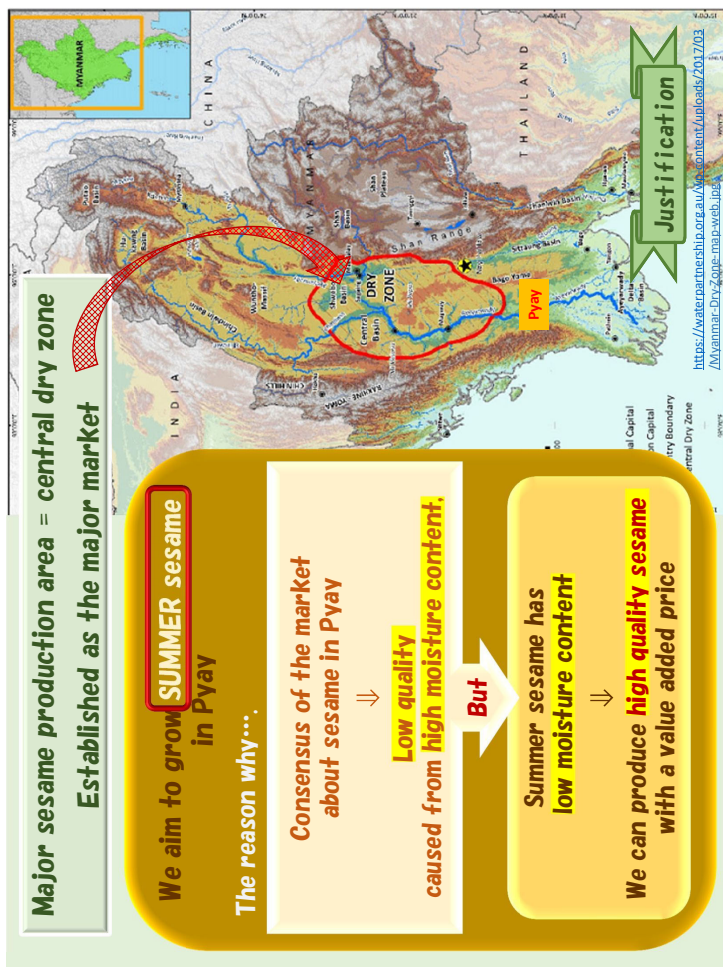
Ver. 1

November 2017



Project for Profitable Irrigated Agriculture in Western Bago Region (PROFIA)

## 1. Why SUMMER sesame ?



## What is high quality black sesame?

= Criteria of black sesame quality =

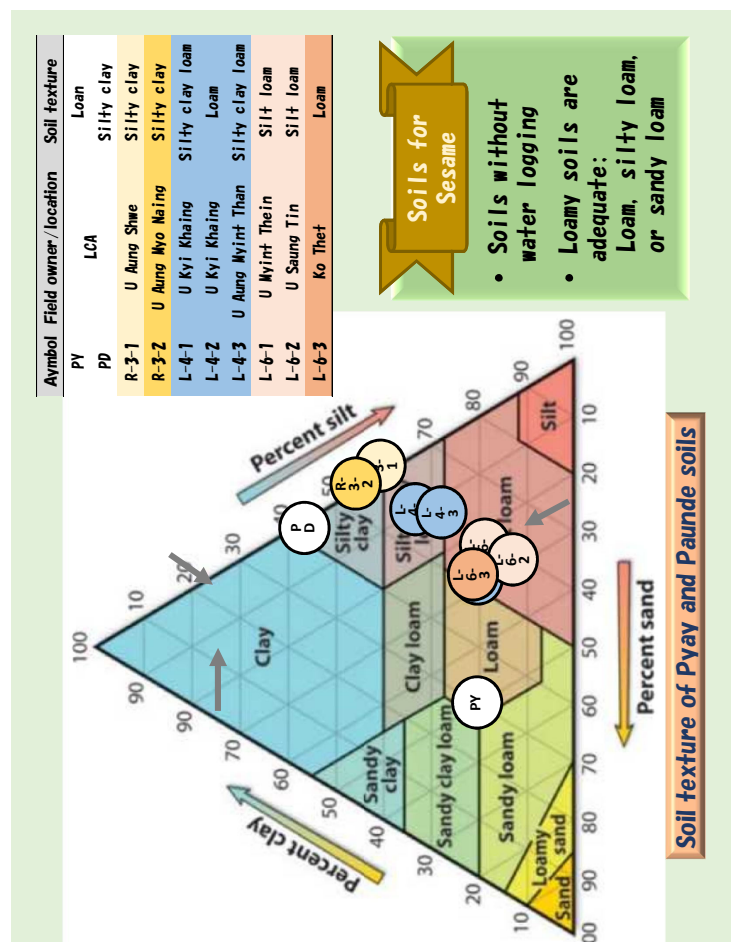
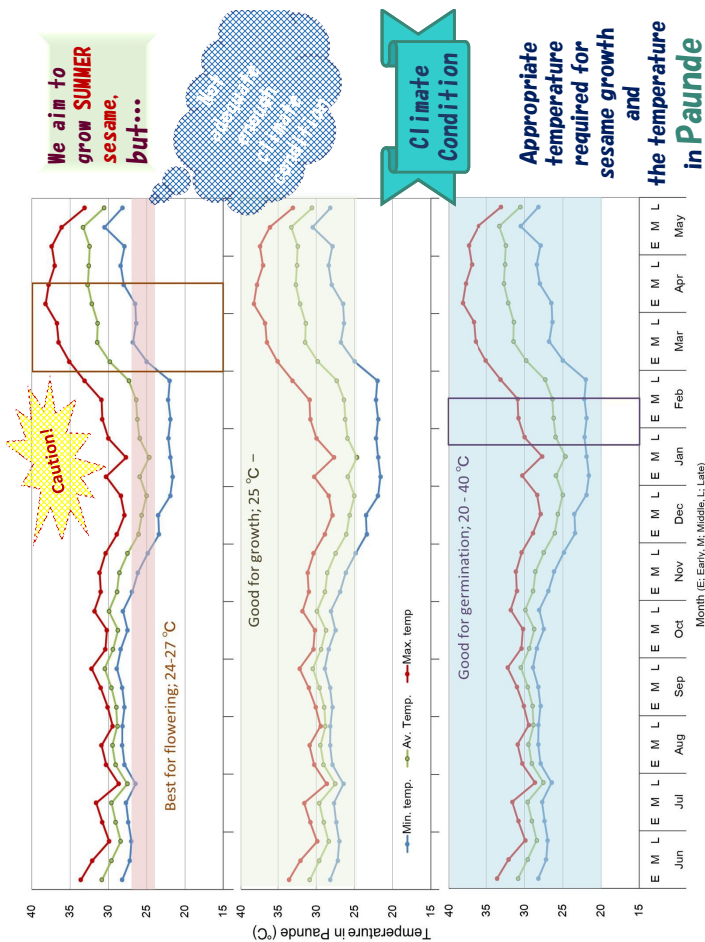
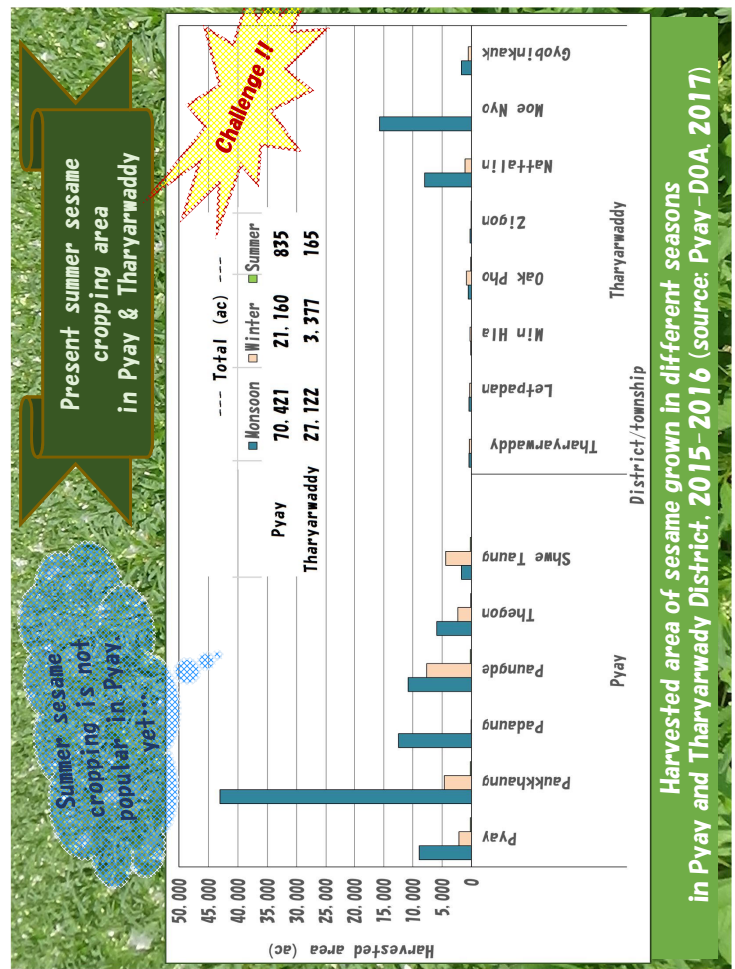
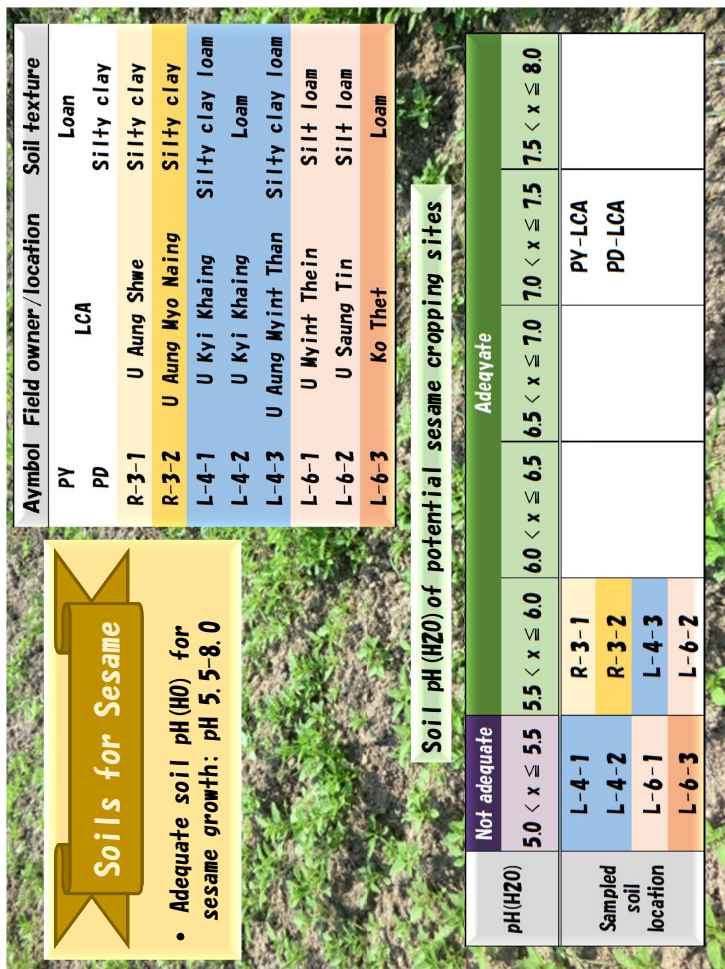
- ✓ Free from inhibited chemical residues
- ✓ No smell of fungus
- ✓ Low acid value (less than 3.0)
- ✓ Less than 5% of different color grains
- ✓ Well matured grains
- ✓ Bluish black color

**Science black: 120,000 Ks/3 bst**  
**Ordinary black: 110,000 Ks/3 bst**  
(The price at the end of May, 2017)

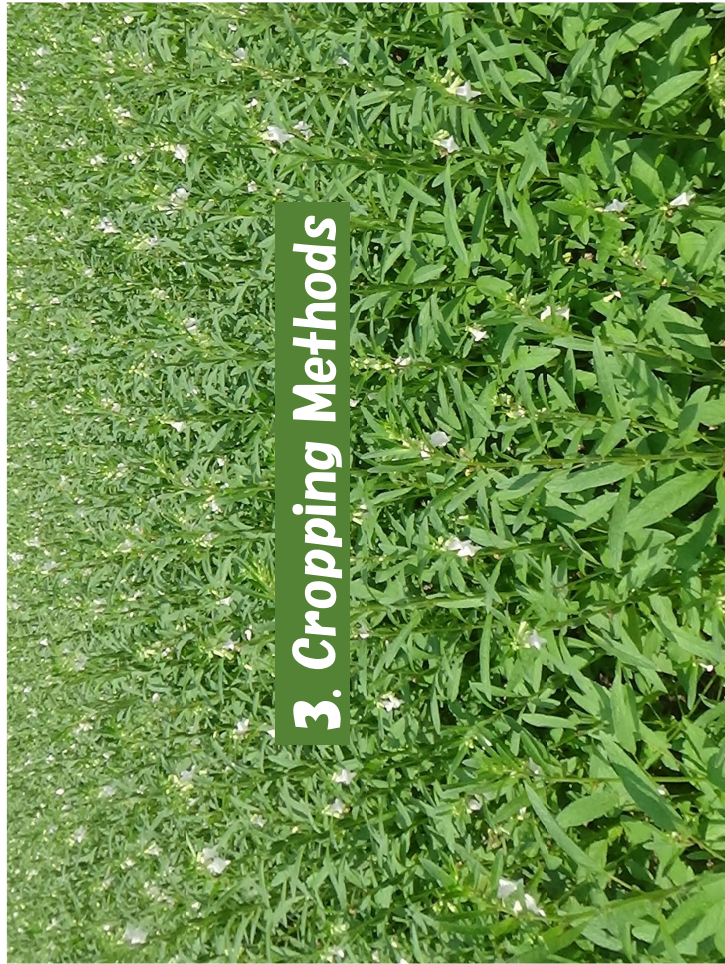












### 3. Cropping Methods



#### 3-1. Land Preparation

**Major production areas**  
Sesame is grown with **natural soil moisture**

**We aim to grow SUMMER sesame**  
Sesame is grown with **irrigation water**

**Land Preparation**

**PROFIA experience**

- Sowing time irrigation was not appropriate ⇒ Hardly moisten the soil
- Gravity irrigation was not enough ⇒ Further hose irrigation was done

⇓

**Two times of submergence at land preparation should be done!!**

**Land Preparation**

< 1<sup>st</sup> Irrigation & plow >

- 1<sup>st</sup> field submergence for 1 week with 4 inches deep
- Drying the fields for 1 week
- Plow

⇓

< 2<sup>nd</sup> Irrigation / harrow, & fertilization >

- 2<sup>nd</sup> field submergence for 1 week with 4 inches deep
- Drying the fields for 1 week
- Cow dung application
- Basal fertilization
- Harrow and leveling

⇓

**Soon after !!**

< Ditch making >

- Make ditches every 4 ft for both of irrigation and drainage

⇓

**Seeding**  
**Leveling**



**11 May 2017**  
**Thailand variety**  
**Ridge width: 15 ft**

**Dich for drainage**

**5 May 2017**  
**Sin Yadanar-3**  
**Ridge width: 7 ft**

**Land Preparation**

**Sesame fields after heavy rain on 16 & 17 April 2017**

**Sesame fields after heavy rain  
on 16 & 17 Apr. 2017**

**11 May 2017**  
**Thailand variety**  
**Ridge width: 15 ft**

## Dich for drainage

**5 May 2017**  
**Sin Yadanar-3**  
**Ridge width: 7 f**

**3-2. Fertilization**

**Land Preparation**

**Coordination with monsoon paddy growers**

The irrigation should be started from the middle of December to harvest within April!

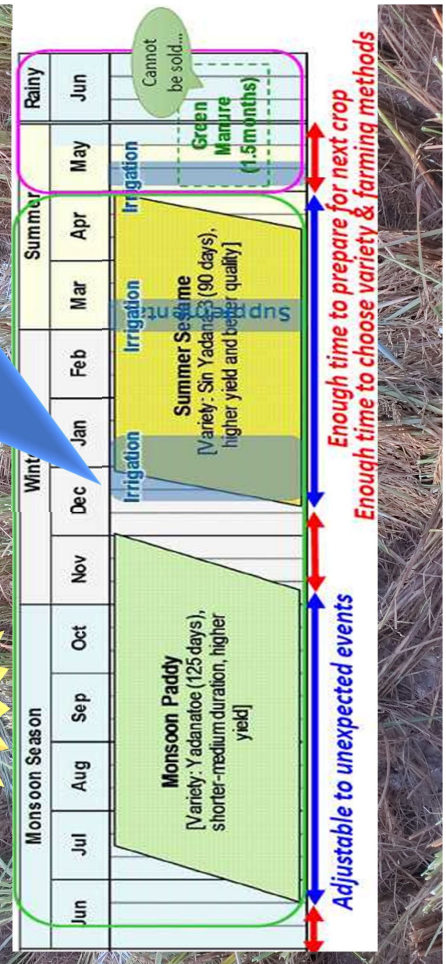
| Monsoon Season   |     |     |     | Winter |     |     | Summer     |   |     | Rainy      |   |     |
|--|-----|-----|-----|--------|-----|-----|------------|---|-----|------------|---|-----|
| Jun  | Jul | Aug | Sep | Oct    | Nov | Dec | Jan        | Feb   | Mar | Apr        | May   | Jun |
| <b>Monsoon Paddy</b><br>[Variety: Yadanotoe (125 days), shorter-medium duration, higher yield] |     |     |     |        |     |     | Irrigation | <b>Summer Sesame</b><br>[Variety: Sin Yadanotoe (90 days), higher yield and better quality] |     | Irrigation | <b>Green Manure (1.5 months)</b><br>Cannot be sold... |     |

**Adjustable to unexpected events**

**Enough time to prepare for next crop**  
**Enough time to choose variety & farming methods**

The irrigation should be started from the middle of December to harvest within April!

## Coordination with monsoon paddy growers



Enough time to prepare for next crop  
Enough time to choose variety & farming methods

### Adjustable to unexpected events

- **Not needed fertilization in case residual fertilizer is effective.**
- **Apply additional fertilizer just after weeding in case the initial**

- Apply additional fertilizer just after weeding in case the initial sesame growth is poor.

| Fertilization  |                        |                         |
|--|------------------------|-------------------------|
| Application time   | Organization           | Magunway-DAR            |
|  | Fertilizer             | Cow dung<br>cart        |
| Land preparation<br><br>Sowing<br><br>Weeding/thinning<br><br>Initial bud formation<br><br>Flowering | Urea<br>lb/ac Bag/ac   | T-super<br>lb/ac Bag/ac |
|  | Potash<br>lb/ac Bag/ac | Foliar spray            |
|  | 5 - 10                 | -                       |
|  | -                      | -                       |
|  | -                      | -                       |
| Every 2 weeks until flowering  | 28                     | 1/4                     |
|  | 28                     | 1/4                     |
|  | 28                     | 1/4                     |
|  | -                      | -                       |
|  | -                      | -                       |

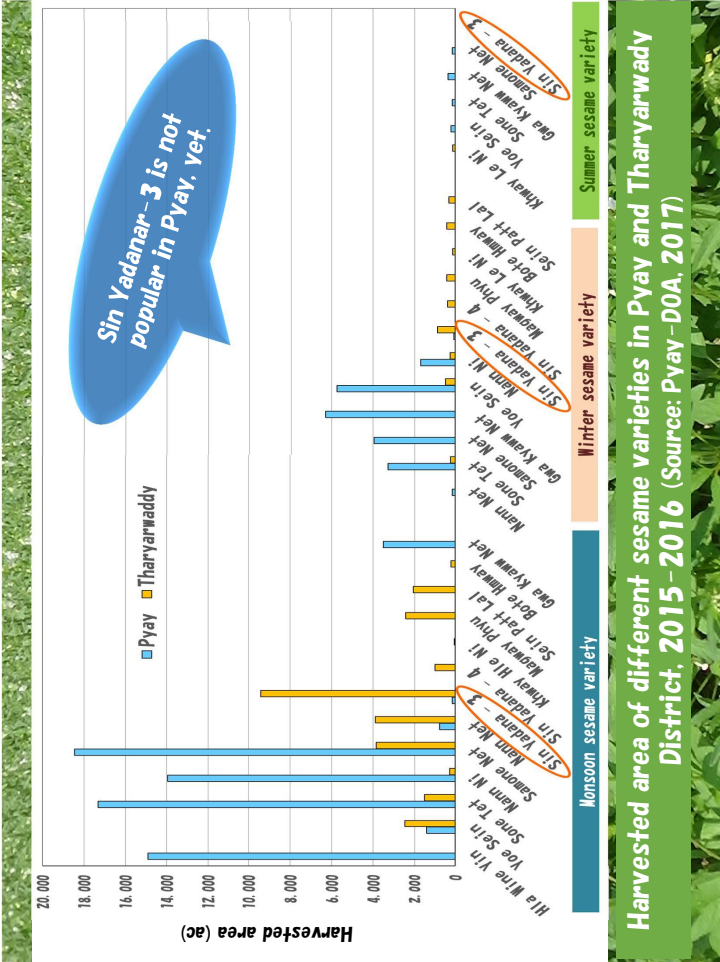
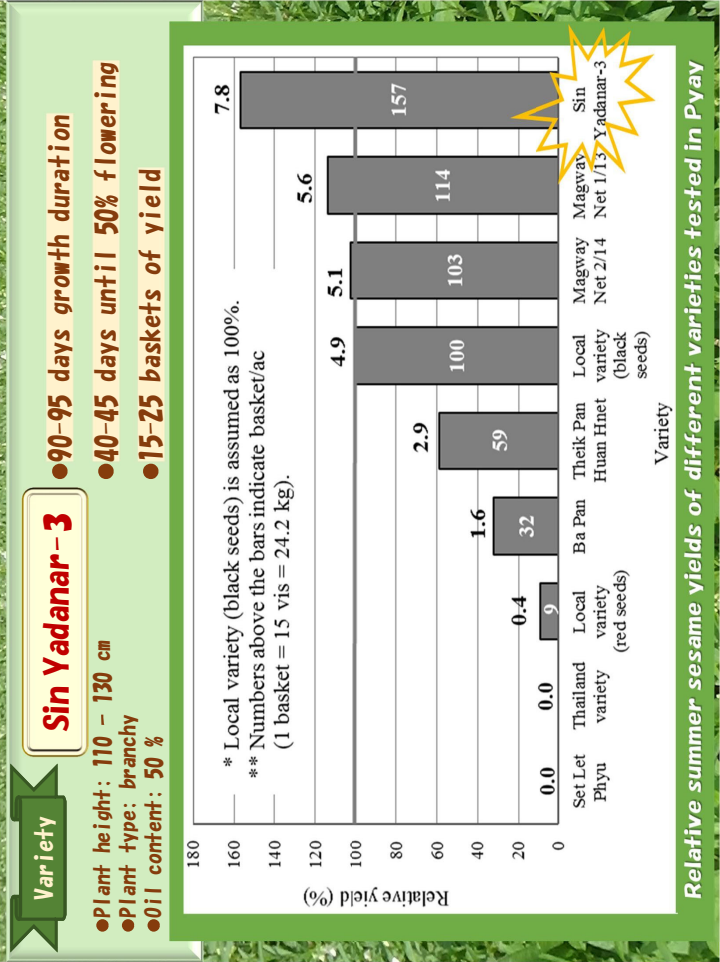
● Not needed fertilization in case residual fertilizer is effective.  
● Apply additional fertilizer just after weeding in case the initial sesame growth is poor.

| Organization          | Maguway-DAR |       |        |         |        |        |                               |
|-----------------------|-------------|-------|--------|---------|--------|--------|-------------------------------|
| Fertilizer            | Cow dung    | Urea  |        | T-super |        | Potash | Foliar spray                  |
|                       | cart        | lb/ac | Bag/ac | lb/ac   | Bag/ac | lb/ac  | Bag/ac                        |
| Land preparation      | 5 – 10      | -     | -      | -       | -      | -      | -                             |
| Sowing                | -           | 28    | 1/4    | 56      | 1/2    | 28     | 1/4                           |
| Weeding/thinning      | -           | 28    | 1/4    | -       | -      | -      | -                             |
| Initial bud formation | -           | 28    | 1/4    | -       | -      | -      | Every 2 weeks until flowering |
| Flowering             | -           | -     | -      | -       | -      | -      | -                             |

- **Not needed fertilization in case residual fertilizer is effective.**
- **Apply additional fertilizer just after weeding in case the initial**

- Apply additional fertilizer just after weeding in case the initial sesame growth is poor.









### Thinning & Weeding

**(Broadcasting)**

- Timing: within 15 days after sowing
- Uses 5 rake harrow and pass it with right angle and horizon directions against ridge to make 3-4 plants/hill
- Make the diches into the shape again
- Weeding should be done manually within a month.

Final population should be **100,000 pIs / ac**

**(Line seeding)**

- Timing: 1<sup>st</sup> time = 15 days after sowing ⇒ 3 – 4 plants/hill
- 2<sup>nd</sup> times = after 6 leaves emergence ⇒ 1 plant/hill

1st thinning

2nd thinning

### Weeding & Earthing-up

- Should be done within a month

### Seeding

- More than 80% germination ratio of seeds should be used
- Spacing: branch type variety  
Between rows x between hills = **15 inches x 4 inches**
- Seed amount  
Broadcasting: **2 - 3 pvi / ac (3.0-4.5 kg / ac)**  
Line seeding: **1.5 - 2 pvi / ac**

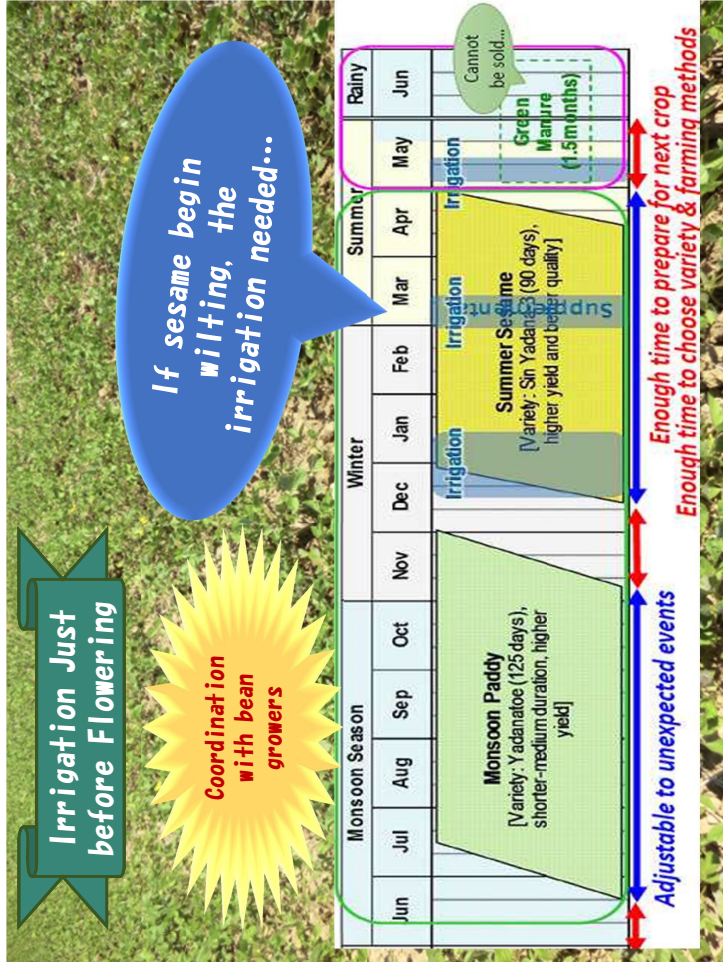
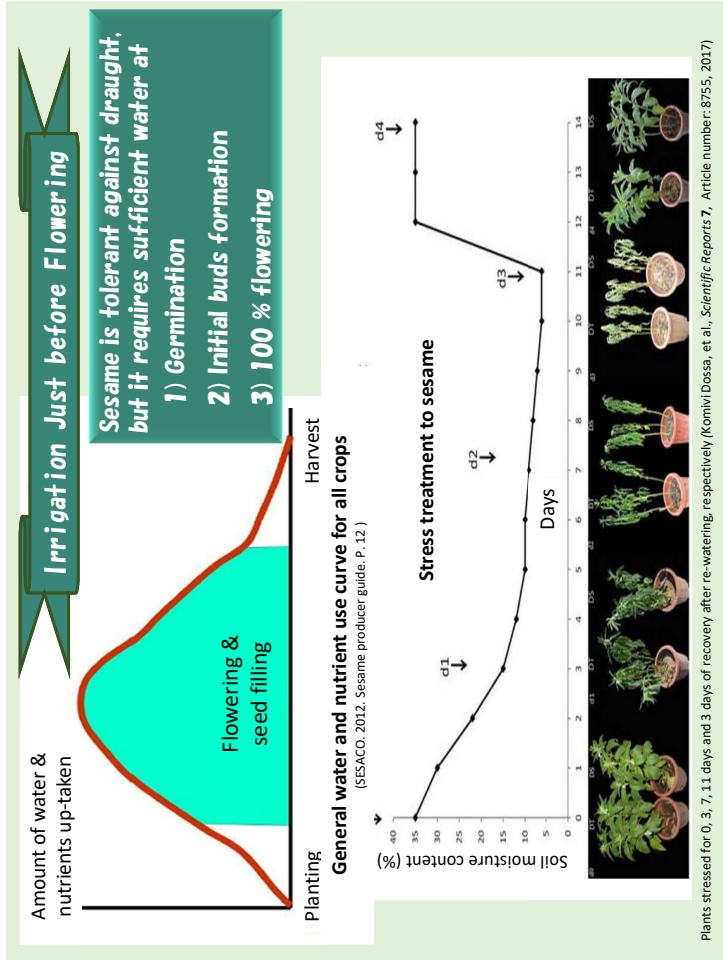
Do seeding soon after land preparation !!

Too much ! It is hard thinning...



**3-5. Irrigation Just before Flowering**

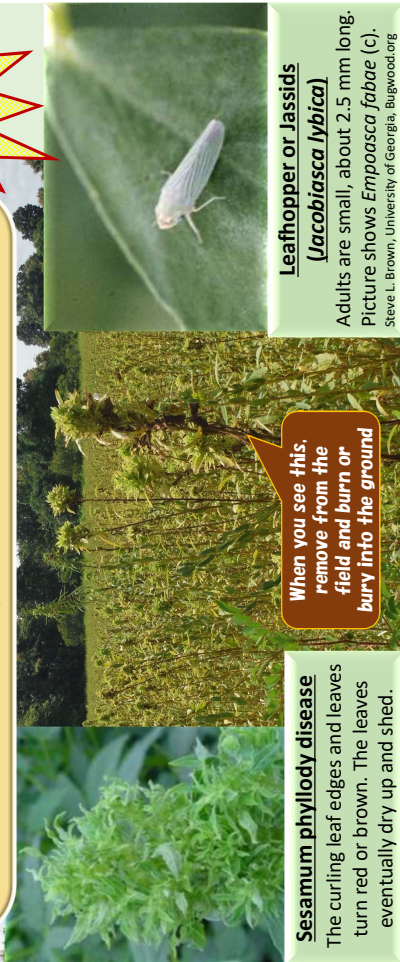






## Sesamum Phyllody

- **Sesamum Jassid** which can spread the disease must be controlled.
- **Infection Period** : Mainly in June for monsoon sesame
- **Summer sesame**: One (1) times **preventive insecticide application**  
 ✓ 15 days after sowing: DOZER 70%(60 cc/ ac)  
 (Imidacloprid contained chemical should be used only this time)
- **Monsoon sesame**: Two (2) times **preventive insecticide application**  
 ✓ 15 days after sowing: DOZER 70%(60 cc/ ac)  
 ✓ One month after sowing: Dimethoate



**Sesamum phyllody disease**  
The curling leaf edges and leaves turn red or brown. The leaves eventually dry up and shed.

When you see this, remove from the field and burn or bury into the ground

**Leafhopper or Jassids**  
(*Jacobiasca lybica*)

Adults are small, about 2.5 mm long. Picture shows *Empoasca fabae* (C).  
Steve L. Brown, University of Georgia, Bugwood.org

No residual chemicals !!

## Pest & Disease Control

## Pest & Disease Control

### Boll worm

**Infection Period** : All cropping period  
**Damage symptom**: Larvae are inside of tender pods and eat the inside.

#### **Control & Protection:**

- Pick up by hand and crush the eggs, larvae, and/or adults,
- Clean weeds around the field,
- Practice alternative cropping.

#### **Chemical protection:**

**Spray Phenthoate (500 cc/ ac)**  
 ✓ when 5% of pods of the whole sesame plant is damaged, or  
 ✓ when eggs are found in sesame leaves or flowers.



## Pest & Disease Control

### Sesamum Leaf Roller

**Infection Period** : Mainly affect in July for monsoon sesame and early winter for winter sesame

**Control & Protection**: Remove and burn insect effected leaves

**Chemical protection**: **Spray Diazinon (500 cc/ ac), or Dimethoate (200cc/ acre)**  
 ✓ when one larva per plant is found in 6 ft spacing of sesame field.



### Common hairy caterpillar

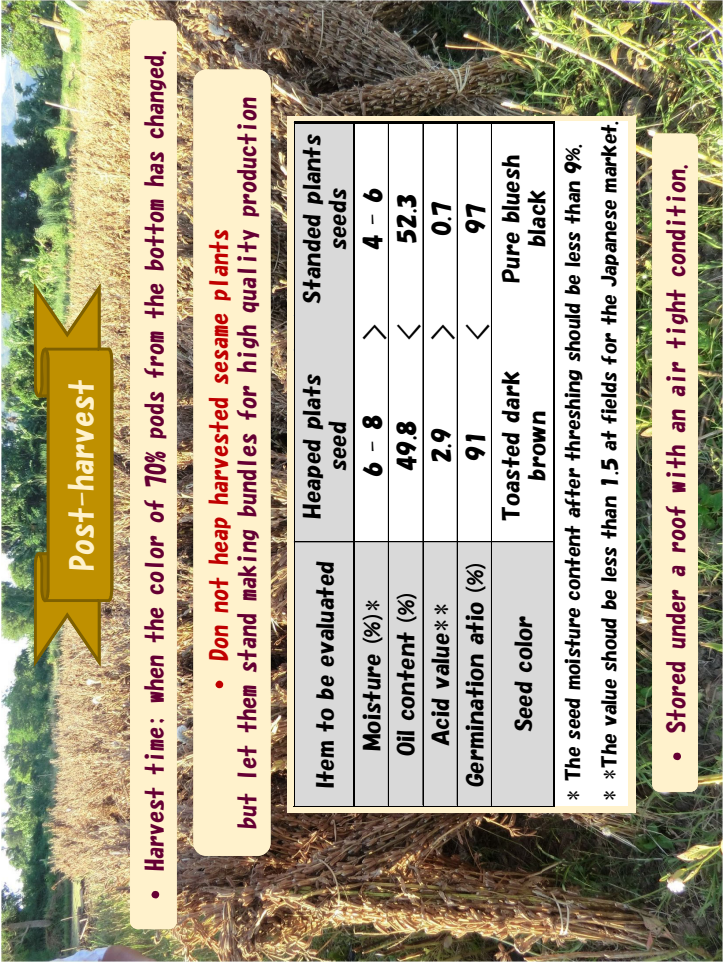
**Infection Period** : All cropping period

**Damage symptom**:  
Larvae nibble and damage leaves.

**Control & Protection**:  
Pick up and crush the eggs,

**Chemical protection**:  
Use **Diazinon (500cc/ ac)**, or **Phenthoate (500 cc/ ac)**  
 ✓ when larvae are found over 30-50 numbers per 12 plants.





• Harvest time: when the color of 70% pods from the bottom has changed.

• Don not heap harvested sesame plants but let them stand making bundles for high quality production

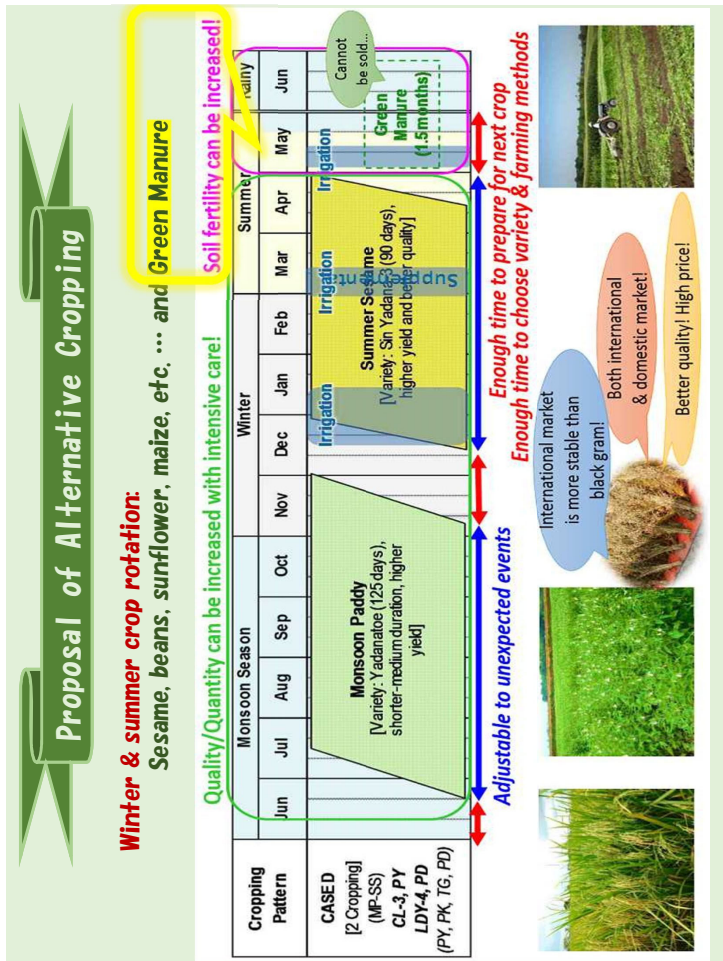
| Item to be evaluated | Heaped plants seed | Standed plants seeds |
|----------------------|--------------------|----------------------|
| Moisture (%)*        | 6 - 8              | 4 - 6                |
| Oil content (%)      | 49.8               | 52.3                 |
| Acid value**         | 2.9                | 0.7                  |
| Germination atio (%) | 91                 | 97                   |
| Seed color           | Toasted dark brown | Pure bluish black    |

\* The seed moisture content after threshing should be less than 9%.  
 \*\* The value should be less than 1.5 at fields for the Japanese market.

• Stored under a roof with an air tight condition.













## **Appendix C-6:**




# **Manual of Seed Selection by Salt Water**











## Working Manual on Seed Selection by Salt Water

| Seed Selection by salt water |   |   |
|------------------------------|---|---|
| 0                            | <p><b><u>Objective:</u></b></p> <ul style="list-style-type: none"> <li>- To separates immature and ill filled seeds and select good quality seeds.</li> <li>- Increase germination rate and increase paddy yield</li> </ul> <p><b><u>Timing:</u></b> Pre-seedling stage</p> | <p><b><u>Preparation (materials):</u></b></p> <ul style="list-style-type: none"> <li>a. Paddy Seed</li> <li>b. Bucket (large)</li> <li>c. Pet bottle</li> <li>d. Salt (2 viss)</li> <li>e. Raw Egg (1 peace)</li> <li>f. Net</li> <li>g. Water (4 gallon)</li> </ul>                            |
|                              | Process   | Description   |
| 1                            |   | Put 4 gallon (16 letters) of cold water in a bucket.  |
| 2                            |    | <p>Put a fresh egg in water, then add salt little by little into the water and allow it to dissolve.</p> <p>Usually, 2viss (3.2kg) of salt is enough for 4 gallon (16litters) of water.</p>   |
| 3                            |    | <p>Watch the egg to rise up as solution density increases. Stop adding salt when the fresh egg floats with standing form.</p> <p>(if you already know ratio of salt and water, you can dissolve salt in water at first, then put a fresh egg to see it's already floats with standing form)</p> |



|   |   |  |
|---|---|--|
| 4 |    | Put a net in the bucket. The net is used for a separator.  |
| 5 |    | Put paddy seeds in the solution, and wait a moment.  |
| 6 |   | Now, light seed flow on the salty water and the remaining (sunken seeds) is the good quality seeds.                                      |
| 7 |  | Scoop floating seeds by bamboo basket or maund, and eliminate them.  |
| 8 |  | Enwrap the sunken seeds with net, and wash them with pure water immediately. Then, dry and shade them for nursery preparation or sowing. |



Note:

## 1. Advantages

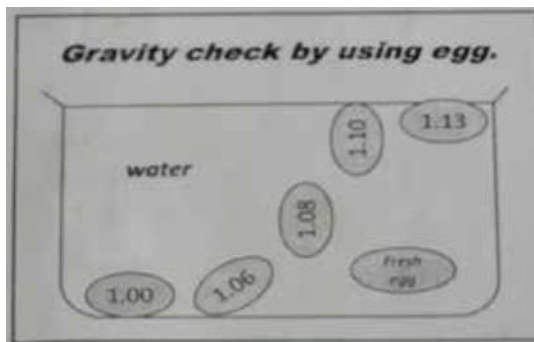
Advantages of utilizing salt-water-seed selection methods are

- Achieve a strong vigorous seedling, resistance to pests and diseases as a good quality seed was obtained.
- Able to eliminate and prevent seed borne diseases
- Able to remove undesirable weed seed
- Unselected seed can be used as animal feed

## 2. Caution

Taung Pyan and Sticky varieties should soak half an hour in normal water condition, if this method will use.

## 3. Gravity check using fresh egg



## 4. Amount of salt or Ammonium Sulfate in 10L water



| Type of Rice                   | Salt   | Sulfate Ammonium | Specific gravity |
|--------------------------------|--------|------------------|------------------|
| Glutinous rice                 | 2.0 kg | 3.0 kg           | 1.13             |
| Non-glutinous rice             | 1.6 kg | 2.2 kg           | 1.08             |
| Brewer's rice (big size grain) | 0.9 kg | 1.1 kg           | 1.06             |







## ဆားရေစိမ့်၍ မျိုးစေ့ရွေးချယ်နည်း လမ်းညွှန်

| ဆားရေစိမ့်၍ မျိုးစေ့ရွေးချယ်ခြင်း |   |  |
|-----------------------------------|---|--|
| ၀။                                | <p><b>ရည်ရွယ်ချက်</b></p> <ul style="list-style-type: none"> <li>- ကျန်းမာသန်စွမ်းမှုမရှိသည့် မျိုးစေ့များအား ဖယ်ရှားရန်နှင့် အရည်အသွေးကောင်းမွန်သော မျိုးစေ့များရွေးချယ်ရန်</li> <li>- အပင်ပေါက်နှုန်းနှင့် အထွက်နှုန်းတိုးစေရန်</li> </ul> <p><b>အချိန်</b><br/>ပျိုးခင်းမပြင်မှီအချိန်</p> | <p><b>လိုအပ်ပစ္စည်းများပြင်ဆင်ခြင်း</b></p> <p>(က) စပါးမျိုးစေ့<br/>(ခ) ရေပုံးကြီးကြီး (၁ ပုံး)<br/>(ဂ) သောက်ရေသန့်ဘူးခွံ (၁ ဘူး)<br/>(ဃ) ဆား (၂ ပိဿာဝန်းကျင်)<br/>(င) လတ်ဆတ်သည့်ကြက်ဥ (၁ လုံး)<br/>(စ) ပိုက်စိမ်းစ (၁ ခု)<br/>(ဆ) ရိုးရိုးရေ (၄ ဂါလံ)<br/>(ဇ) ပလတ်စတစ်ဇာက (၁ ခု)</p>  |
|                                   | လုပ်ငန်းစဉ်ပြပုံ  | ဖော်ပြချက်   |
| ၁။                                |   | <p>ရိုးရိုးရေ ၄ ဂါလံ (ရေသန့်ဘူး ၁၆ ဘူးစာ)ကို ရေပုံးကြီးထဲသို့ ထည့်ပါ။</p> <p>(ဆား ၂ ပိဿာနှင့် ရေ ၄ ဂါလံဆိုသည်မှာ စပါး ၁ ပြည်မှ ၄ ပြည်ပမာဏ အတွက်သာဖြစ်ပြီး စပါး ၄ ပြည် ထက်ပိုပါက စပါး ၁ ပြည်လျှင် ရေ ၁ ဂါလံနှုန်းဖြင့် ရေကို ထပ်တိုးထည့်သွားရမည်ဖြစ်ပြီး ဆားပမာဏကိုလည်း လိုအပ်သလိုထပ်တိုး အသုံးပြုသွားရမည်ဖြစ်သည်။)</p>   |
| ၂။                                |    | <p>ရေထဲသို့ကြက်ဥကိုထည့်ပါ။ ထို့နောက် ရေထဲသို့ ဆားနဲ့ချင်းစီထည့်၍ ရေတွင်ပျော်ဝင်အောင် မွှေပေးပါ။ ကြက်ဥရေပေါ်တွင် ပေါ်လာသည်အထိ ဆားကို နဲ့ချင်းစီ အကြိမ်ကြိမ် ထည့်ပေးပါ။ ဆားတစ်ကြိမ်ထည့်မွှေပြီးတိုင်း ကြက်ဥပေါ်မပေါ် စောင့်ကြည့်ပါ။ ထိုသို့စောင့်ကြည့်ရာတွင် ရေငြိမ်သည်အထိ စောင့်ရမည်။</p> <p>(ယေဘုယျအားဖြင့် ရေ ၄ ဂါလံလျှင် ဆား ၁ ပိဿာခွဲဝန်းကျင်ထည့်ပါက ကြက်ဥပေါ်လာလေ့ရှိသည်။)</p> |
| ၃။                                |    | <p>ကြက်ဥသည် ရေမျက်နှာပြင်ပေါ်တွင် ဒေါင်လိုက်အနေအထားဖြင့် ပေါ်လာပြီး ရေပေါ်တွင်ပေါ်နေသည့် အပိုင်းသည် ဒဂါးစေ့အပိုင်းခန့်ပေါ်လာလျှင် ဆားထပ်ထည့်ရန် မလိုတော့ပါ။</p> <p>(အကယ်၍ ရေ ၄ ဂါလံအတွင်း ထည့်ရမည့် လိုအပ်သည့်ဆားပမာဏကို ကြိုတင်သိရှိပြီးဖြစ်ပါက ၎င်းလိုအပ်သည့် ဆားပမာဏထည့်ပြီးမှ ကြက်ဥကို ရေထဲသို့ထည့်၍ စမ်းသပ်နိုင်ပါသည်။)</p>   |



|    |   |   |
|----|---|---|
| ၄။ |    | ပိုက်စိမ်းစကို ရေပုံးထဲသို့ အောက်ခံအဖြစ်ထည့်ပါ။   |
| ၅။ |    | မျိုးစေ့များကို ဆားပျော်ရည်ထဲသို့ထည့်လိုက်ပါ။   |
| ၆။ |   | မျိုးစေ့အချို့ အောက်ခြေသို့နစ်မြုပ်သွားပြီး အချို့မှာ မူ ရေပေါ်တွင် ပေါ်ကျန်ခဲ့သည်ကိုတွေ့ရမည်။ နစ်မြုပ်သွားသည့် မျိုးစေ့များမှာ ကျန်းမာသန်စွမ်းသည့် အဟာရပြည့်ဝသည့် မျိုးစေ့များဖြစ်သည်။   |
| ၇။ |  | ရေပေါ်တွင်ပေါ်နေသည့် မျိုးစေ့များမှာ ကျန်းမာသန်စွမ်းသည့် စပါးပင်ရရှိမည်မဟုတ်သဖြင့် ၎င်းတို့ကို ဖယ်ရှားပစ်ပါ။  |
| ၈။ |  | နောက်ဆုံးအဆင့်အနေဖြင့် အောက်တွင်ခံထားသည့် ပိုက်ကိုမ၍ လက်ရွေးစင်မျိုးစေ့များကို ဆယ်ယူပါ။ ၎င်းပိုက်ဖြင့် ထုပ်ထားသည့်အတိုင်းပင် ဆားငန်ရည်များ ပြောင်စင်သွားသည်အထိ ရိုးရိုးရေဖြင့် အထပ်ထပ်ဆေးကြောပါ။<br>ထို့နောက် တောင်သူများ လုပ်လေ့ရှိသည့် မျိုးစေ့ပြင်ဆင်မှု ပုံမှန်လုပ်ငန်းစဉ်များကို ဆက်လက်၍ လုပ်ဆောင်နိုင်ပြီဖြစ်သည်။ |



### အကျိုးကျေးဇူး

ဆားရည်စိမ်၍ မျိုးရွေးချယ်ခြင်းနည်းကို အသုံးပြုခြင်းအားဖြင့် ရရှိနိုင်သော အကျိုးကျေးဇူးများမှာ -

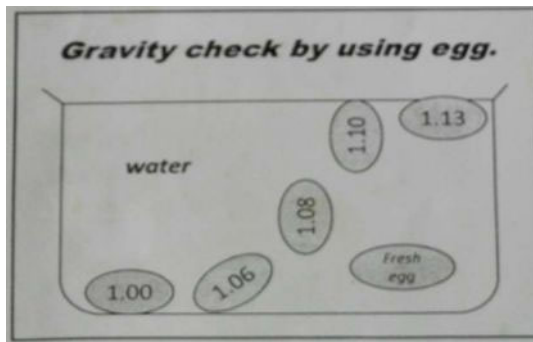
- အရည်အသွေးကောင်းမျိုးစေ့များ ရရှိပြီး သန်မာသောပျိုးပင်များရရှိသဖြင့် ကိုယ်ခံအားကောင်းပြီး ပိုးမွှားရောဂါဒဏ်ပိုမိုခံနိုင်ခြင်း
- မလိုလားသော မျိုးစေ့ဆောင်ရောဂါများ ဖယ်ရှားနိုင်ခြင်း
- မလိုလားသော ပေါင်းမျိုးစေ့များဖယ်ရှားနိုင်ခြင်း
- ပယ်လိုက်သောမျိုးစေ့များကို အခြောက်ခံပြီးကြိတ်ခွဲ၍ တိရိစ္ဆာန်အစာအဖြစ်အသုံးပြုနိုင်ခြင်း

### သတိပြုရန်

တောင်ပုံနှင့် ကောက်ညှင်းစပါးမျိုးများကို ဤနည်းဖြင့်ရွေးချယ်လျှင် ရိုးရိုးရေတွင်နာရီဝက်ခန့် အရင်စိမ်ပြီးမှသာ ဆားရည်စိမ်ခြင်းပြုလုပ်ပါရန်။

### မှီငြမ်းမှတ်ချက်

၁။ ကြက်ဥကိုအသုံးပြု၍ ဆွဲငင်အားကိုဆန်းစစ်ခြင်း



၂။ ဆန်အမျိုးအစားအလိုက် ရေ ၁၀ လီတာတွင် ထည့်ရမည့် ဆား (သို့) အမိုနီယမ်ဆာလဖိတ်

| ဆန်အမျိုးအစား                | ဆား<br>(ကီလိုဂရမ်) | အမိုနီယမ်<br>ဆာလဖိတ်<br>(ကီလိုဂရမ်) | ဆွဲငင်အား |
|------------------------------|--------------------|-------------------------------------|-----------|
| စေးကပ်မှုများသောဆန်          | ၂                  | ၃                                   | ၁.၁၃      |
| စေးကပ်မှုအသင့်အတင့်ရှိသောဆန် | ၁.၆                | ၂.၂                                 | ၁.၀၈      |
| အရက်ချက်ဆန် (အရွယ်အစားကြီး)  | ၀.၉                | ၁.၁                                 | ၁.၀၆      |







## **Appendix C-7:**

# **Report for Soil Moisture Content Test**





# **Project for Profitable Irrigated Agriculture in Western Bago Region**

## **Report for Soil Moisture Content Test**

**June, 2021**

**Sanyu Consultants Inc.**







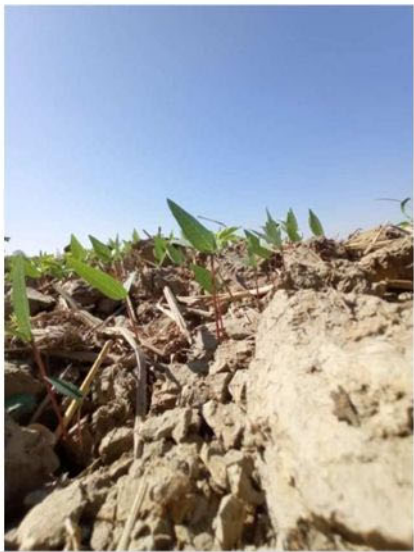





## Pictures

### 1. Black Gram Test field (Pyay )





#### 1.1 Plot No.1

|   |   |
|---|---|
|    |   |
| <p>Field condition of Plot No.1. Two days after sowing seed. November 21, 2020.</p> | <p>Digging sampling pit. November 21, 2020.</p>   |
|   |                                        |
| <p>Installation of samplers. November 21, 2020.</p>                                 | <p>General view 12 days after sowing seed. December 1, 2020.</p>  |
|  |                                       |
| <p>Growth condition of crop. 12 days after sowing seed. December 1, 2020.</p>       | <p>Growing condition of black gram. Ground height 9 cm, Root depth 9 cm. 12 days after sowing seed. December 1, 2020.</p> |





|  |   |
|--|---|
|     |   |
| <p>Growing condition of black gram. 19 days after sowing seed. December 8, 2020.</p> | <p>Growing condition of black gram. Ground height 7 cm, root depth 9 cm. 19 days after sowing seed. December 8, 2020.</p>                                       |
|    |    |
| <p>General view of the field. 26 days after sowing seed. December 15, 2020.</p>      | <p>Growing condition of black gram. 26 days after sowing seed. Ground height 9 ~ 16 cm, root depth 3 ~ 14 cm. 26 days after sowing seed. December 15, 2020.</p> |
|   |   |
| <p>Field condition 33 days after sowing seed. December 22, 2020</p>                  | <p>Growing condition of black gram 33 days after sowing seed. December 22, 2020</p>   |



|  |  |
|--|--|
|   |    |
| <p>Growing condition of black gram. 36 days after sowing seed. Ground height 12 ~ 14 cm, root depth 14 cm. 33 days after sowing seed. December 22, 2020.</p> | <p>General view of Plot No.2, 63 days after sowing seed. January 21, 2021.</p>   |
|    |   |
| <p>Growing condition of black gram, 63 days after sowing seed. Some are flowering, some are bearing fruit. January 21, 2021.</p>                             | <p>Growing condition of black gram, 63 days after sowing seed. Ground height 30 ~ 38 cm, root depth 15 ~ 24 cm. 63 days after sowing seed. January 21, 2021.</p> |







## 1.2 Plot No.2

|   |  |
|---|--|
|  |  |
| <p>General view of Plot No.2. One day after sowing seed. November 26, 2020.</p>     | <p>Soil profile of sampling pit. One day after sowing seed. November 26, 2020.</p>   |



|   |   |
|---|---|
|    |     |
| <p>General view of Plot No.2, 8 days after sowing seed. December 3, 2020.</p>   | <p>Growing condition of black gram. 8 days after sowing seed. December 3, 2020.</p>   |
|   |    |
| <p>Growing condition of black gram, 8 days after sowing seed. Ground height is 6 cm, root depth is 4cm. December 3, 2020.</p>   | <p>Growing condition of black gram, 16 days after sowing seed. December 11, 2020.</p> |
|    |   |
| <p>Growing condition of black gram 16 days after sowing seed. Ground height is 12 cm, root depth is 5cm. December 11, 2020.</p> | <p>Growing condition of black gram, 23 days after sowing seed. December 18, 2020.</p> |



|  |   |
|--|---|
|   |   |
| <p>Growing condition of black gram 23 days after sowing seed. Ground height is 14 ~ 17 cm, root depth is 6 ~ 8cm. December 18, 2020.</p> | <p>General view of Plot No.2, 29 days after sowing seed. December 24, 2020.</p>   |
|    |    |
| <p>Soil profile of sampling pit. 29 days after sowing seed. December 24, 2020.</p>   | <p>Growing condition of black gram 29 days after sowing seed. Ground height is 7 ~ 12 cm, root depth is 6 ~ 12cm. December 24, 2020.</p>  |
|   |   |
| <p>General view of Plot No.2, 64 days after sowing seed. January 28, 2021.</p>   | <p>Growing condition of black gram 64 days after sowing seed. Ground height is 28 ~ 30 cm, root depth is 30 ~ 35cm. January 28, 2021.</p> |



### 1.3 Plot No.3

|  |  |
|--|--|
|     |    |
| <p>General view one day after sowing seed. December 1, 2020.</p>                     | <p>Soil profile of sampling pit. 10 days after sowing seed. December 10, 2020.</p>   |
|    |   |
| <p>Growing condition of black gram 10 days after sowing seed. December 10, 2020.</p> | <p>Growing condition of black gram 10 days after sowing seed. Ground height is 7 cm, root depth is 8cm. December 10, 2020.</p>           |
|   |    |
| <p>Growing condition of black gram 23 days after sowing seed. December 23, 2020.</p> | <p>Growing condition of black gram 23 days after sowing seed. Ground height is 5 ~ 8 cm, root depth is 7 ~ 9 cm . December 23, 2020.</p> |



|   |   |
|---|---|
|    |   |
| <p>Growing condition of black gram 36 days after sowing seed.<br/>January 5, 2021.</p>  | <p>Growing condition of black gram 36 days after sowing seed. Ground height is 15 cm, root depth is 13 ~ 15 cm .<br/>January 5, 2021.</p> |
|   |    |
| <p>General view of plot No.3, 66 days after sowing seed.<br/>February 4, 2021</p>   | <p>Soil profile of sampling pit. 66 days after sowing seed.<br/>February 4, 2021.</p>   |
|    |   |
| <p>Growing condition of black gram 66 days after sowing seed.<br/>Ground height is 26 ~ 37 cm, root depth is 15 ~ 25 cm .<br/>February 4, 2021.</p> |   |

## **Pictures**

## **Contents**

|   |           |
|---|-----------|
| <b>1. Back ground -----</b>                             | <b>1</b>  |
| <b>2. Test Result of 2020/21 Dry Season -----</b>       | <b>2</b>  |
| <b>2.1 Black Gram Field Soil Moisture Content -----</b> | <b>2</b>  |
| <b>(1) Location Map -----</b>                           | <b>2</b>  |
| <b>(2) Sampling -----</b>                               | <b>3</b>  |
| <b>(3) Test Result -----</b>                            | <b>3</b>  |
| <b>(4) Growing Condition -----</b>                      | <b>10</b> |
| <b>(5) Consideration -----</b>                          | <b>11</b> |
| <b>3. Overall Findings -----</b>                        | <b>12</b> |
| <b>3.1 Black Gram -----</b>                             | <b>12</b> |
| <b>3.2. Sesame -----</b>                                | <b>13</b> |
| <b>3.3 Onion -----</b>                                  | <b>13</b> |
| <b>3.4 Others -----</b>                                 | <b>14</b> |
| <b>4. Irrigation Method -----</b>                       | <b>14</b> |
| <b>4.1 Furrow Irrigation -----</b>                      | <b>14</b> |
| <b>4.2 Tube Irrigation -----</b>                        | <b>15</b> |



## 1. Background

In Western Bago area, rice is grown in almost all irrigated area in the rainy season. On the other hand, in the dry season, because of limited water source, rice can be grown only in 20 to 30 % of the area. Therefore, many farmers in the area which water can not be supplied grow other upland crops such as black gram, green gram and sesame without irrigation. PROFIA aims increase of profit through crop diversification, effective use of irrigation water and improving quality and yield. It is considered to be possible to improve yield utilizing irrigation for upland crops, but effective irrigation method is not verified. Therefore, PROFIA team conducted a series of soil moisture content test as follows;

- ① May, 2018: sesame field test
  - Water holding capacity after 24 hours
  - Soil moisture content (daily consumptive use of water)
  - Intake rate
  - Flow velocity (furrow)
  - Dry density
  - Particle size analysis
- ② November 2018 to March 2019: black gram field test
  - Intake rate
  - Soil moisture content
  - Dry density
  - Particle size analysis
- ③ January to May 2019: Onion field test
  - Intake rate
  - Soil moisture content (daily consumptive use of water)
  - Dry density
  - Particle size analysis
- ④ May 2019: sesame
  - Soil moisture content
- ⑤ November 2019 to February 2020: black gram field test
  - Soil moisture content
  - Dry density
  - Particle size analysis
- ⑥ February to April 2020: sesame field test
  - Intake rate
  - Soil moisture content
  - Dry density
  - Particle size analysis

⑦ November 2020 to February 2021: black gram field test

- Soil moisture content
- Dry density

In 2020-2021 dry season, All of the work was done by local staff and C/P. The last sampling of black gram fields and all sampling of sesame fields were not carried out due to social turmoil.

These soil moisture content tests are expected to provide data for effective irrigation method.

## 2. Test Result of 2019-2020 Dry Season

### 2.1 Black Gram Field Soil Moisture Content

#### (1) Location Map



Figure 2.1 Location map of test field



Figure 2.2 Location map of sampling



## (2) Sampling

Sampling was carried out for three plots of different sowing timing. Harvesting time of paddy and sowing time of black gram of each plot are different. Generally, immediately after harvesting monsoon paddy, the field is harrowed and the seeds are sown. However, drain condition of the area was not so good and it rained after harvesting, there was some interval between harvesting and sowing. After sowing seeds, the field is not irrigated. Black gram germinates and grow with residual soil moisture only. Date of harvesting paddy and sowing black gram seed is shown in the Table 2.1..

Table 2.1 Date of sampling and days elapsed after sowing( )

|                           | Plot BG. No.1    | Plot BG. No.2    | Plot BG. No.3    |
|---------------------------|------------------|------------------|------------------|
| Harvesting date of rice   | October 28       | November 3       | November 10      |
| Sowing date of black gram | November 19      | November 25      | November 30      |
| 1 <sup>st</sup> sampling  | November 21 (2)  | November 26 (1)  | December 1 (1)   |
| 2 <sup>nd</sup> sampling  | December 1 (12)  | December 3 (8)   | December 10 (10) |
| 3 <sup>rd</sup> sampling  | December 8 (19)  | December 11 (16) | December 17 (17) |
| 4 <sup>th</sup> sampling  | December 15 (26) | December 18 (23) | December 23 (23) |
| 5 <sup>th</sup> sampling  | December 22 (33) | December 24 (29) | January 5 (36)   |
| 6 <sup>th</sup> sampling  | January 21 (63)  | January 28 (64)  | -                |

## (3) Test Result

### 1) Soil Moisture Content

To observe the temporal change of moisture content of soil, soil moisture content test was carried out. The test result is shown in the Table-2.2, 2.3, and 2.4. Change of water volume ratio and saturation ratio are shown in figure 2.3. Soil samples are taken at the depth of 5cm, 15cm, 25cm and 35cm. There was no rain during the test period.

Table-2.2 water volume ratio (%) of plot BG No.1

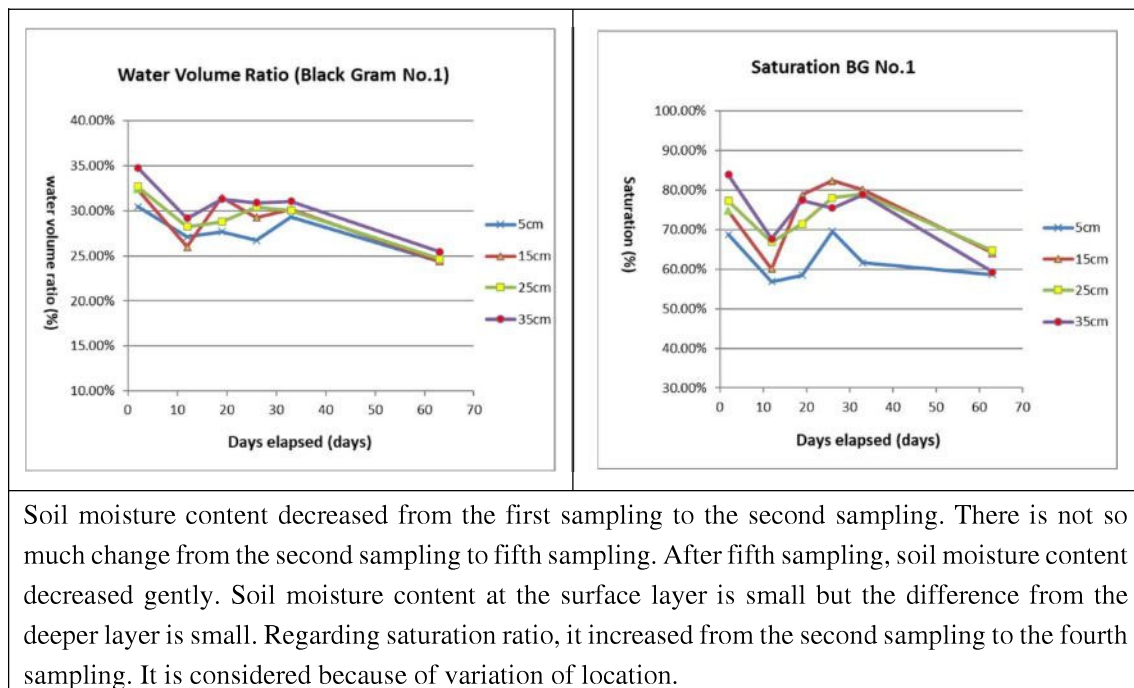
| Date | 21-Nov | 1-Dec  | 8-Dec  | 15-Dec | 22-Dec | 21-Jan |
|------|--------|--------|--------|--------|--------|--------|
| days | 2      | 12     | 19     | 26     | 33     | 63     |
| 5cm  | 30.48% | 27.13% | 27.69% | 26.74% | 29.36% | 24.42% |
| 15cm | 32.37% | 26.00% | 31.48% | 29.28% | 30.17% | 24.41% |
| 25cm | 32.72% | 28.24% | 28.78% | 30.43% | 30.05% | 24.67% |
| 35cm | 34.77% | 29.17% | 31.28% | 30.89% | 31.07% | 25.46% |

Table-2.3 water volume ratio (%) of plot BG No.2

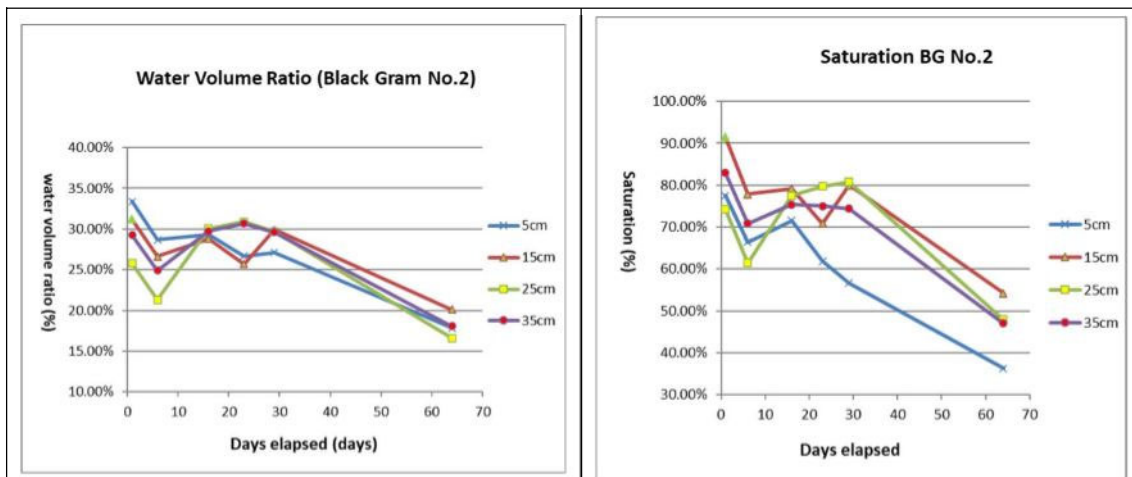
| Date | 26-Nov | 3-Dec  | 11-Dec | 18-Dec | 24-Dec | 28-Jan |
|------|--------|--------|--------|--------|--------|--------|
| days | 1      | 8      | 16     | 23     | 29     | 64     |
| 5cm  | 33.37% | 28.66% | 29.29% | 26.66% | 27.12% | 17.84% |
| 15cm | 31.20% | 26.64% | 28.82% | 25.71% | 29.91% | 20.12% |
| 25cm | 25.77% | 21.32% | 30.06% | 30.88% | 29.71% | 16.60% |
| 35cm | 29.26% | 24.90% | 29.73% | 30.69% | 29.60% | 18.06% |

Table-2.4 water volume ratio (%) of plot BG No.3

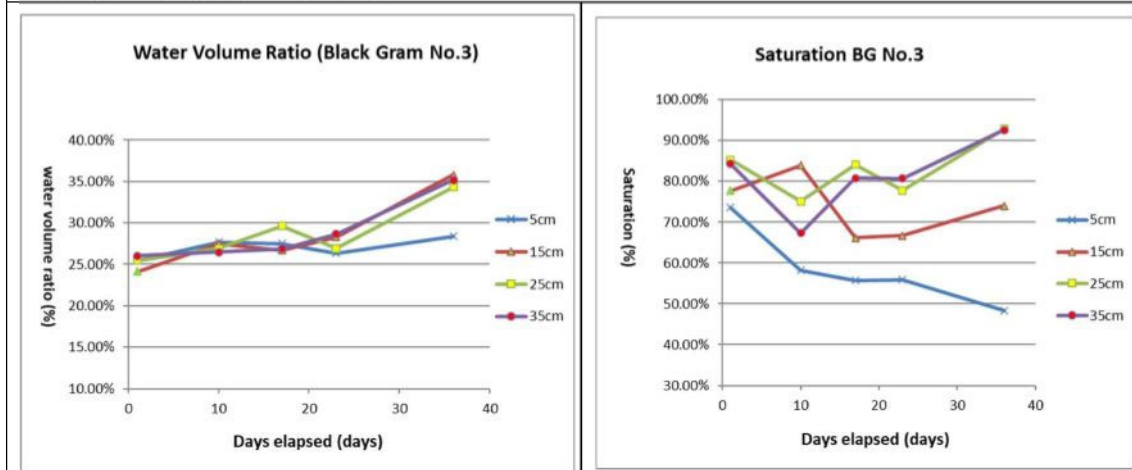
| Date | 1-Dec  | 10-Dec | 17-Dec | 23-Dec | 5-Jan  |  |
|------|--------|--------|--------|--------|--------|--|
| days | 1      | 10     | 17     | 23     | 36     |  |
| 5cm  | 25.45% | 27.68% | 27.48% | 26.36% | 28.37% |  |
| 15cm | 24.13% | 27.49% | 26.69% | 28.28% | 35.80% |  |
| 25cm | 25.47% | 26.91% | 29.61% | 26.93% | 34.32% |  |
| 35cm | 26.04% | 26.47% | 26.86% | 28.68% | 35.19% |  |







Soil moisture content of the surface layer decreased according to elapsed days but that of deeper layers of the third, fourth and fifth sampling are higher than the second sampling. This is considered because of variation of locations.



Soil moisture content of all layers increased. It is considered that there is a special feature of moisture migration mechanism at the location. However it is not confirmed. Saturation rate of the surface layer decreased according to elapsed days. Saturation rate largely depends on dry density. Generally, if the dry density is large, there is a large amount of air void and saturation rate is large.

Figure 2.3 Change of water volume ratio and saturation rate

a. BG. No.1

Change of moisture content between the first sampling and the second sampling is large. During this period, water content of four layers decreased 19.79 mm (1.979 mm/day). From the second sampling to the third sampling, moisture content increased. This is considered because of variation of location. From the third sampling to fifth sampling, water content of each layer went up and down but the difference is not so large. From the fifth sampling to sixth sampling, water content of all layers decreased gently. During this period, water content of four layers decreased 21.69mm (0.723 mm/day). The difference of water content among four layers is small at the 6<sup>th</sup> sampling. Total water

consumption in 0 – 40 cm is estimated 41.48 mm. Daily water consumption is small and moisture content at 63 days is 24.4% ~25.5% which is considered enough because germination rate and growing condition was good.

Table 2.5 Change of moisture content of B.G. No.1 2-12 days

| Depth            | 2 day  | 12 days | Change (mm) | Change (mm/day) |
|------------------|--------|---------|-------------|-----------------|
| 5 cm (0 -10 cm)  | 30.48% | 27.13%  | -3.35       | -0.335          |
| 15 cm (10-20 cm) | 32.37% | 26.00%  | -6.37       | -0.637          |
| 25 cm (20-30 cm) | 32.72% | 28.24%  | -4.47       | -0.447          |
| 35 cm (30-40 cm) | 34.77% | 29.17%  | -5.60       | -0.560          |
| Total            |        |         | -19.79      | -1.979          |

Table 2.6 Change of moisture content of B.G. No.1 33-63 days

| Depth            | 33 days | 63 days | Change (mm) | Change (mm/day) |
|------------------|---------|---------|-------------|-----------------|
| 5 cm (0 -10 cm)  | 29.36%  | 24.42%  | -4.94       | -0.165          |
| 15 cm (10-20 cm) | 30.17%  | 24.41%  | -5.76       | -0.192          |
| 25 cm (20-30 cm) | 30.05%  | 24.67%  | -5.38       | -0.179          |
| 35 cm (30-40 cm) | 31.07%  | 25.46%  | -5.61       | -0.187          |
| Total            |         |         | -21.69      | -0.723          |



BG. No.1 Test field. 63 days after sowing.



BG. No.1 Growing condition. 63 days after sowing. Root depth 15 – 24 cm.



b. BG. No.2



Change of moisture content is similar to BG. No.1. Change of moisture content between the first sampling and the second sampling is large. During this period, water content of four layers decreased 18.08 mm (2.583 mm/day). Daily consumption of water is 1.3 times of BG. No.1. From the second sampling to the third sampling, moisture content increased and the difference of soil moisture content of each layer is very small. This is considered because of variation of location. From the third sampling to fifth sampling, water content of each layer went up and down but the difference is not so large. From the fifth sampling to sixth sampling, water content of all layers decreased gently. During this period, water content of four layers decreased 43.72mm (1.249 mm/day). The difference of water content among four layers is small at the sixth sampling. Total water consumption in 0 – 40 cm is estimated 61.8 mm. Daily water consumption is small and moisture content at 64 days is 16.6% ~20.1% which is considered a little small. Germination rate and growing condition was good as BG No.1.

Table 2.7 Change of moisture content of B.G. No.2 1-6 days

| Depth            | 1 day  | 8 days | Change (mm) | Change (mm/day) |
|------------------|--------|--------|-------------|-----------------|
| 5 cm (0 -10 cm)  | 33.37% | 28.66% | -4.71       | 0.673           |
| 15 cm (10-20 cm) | 31.20% | 26.64% | -4.56       | 0.651           |
| 25 cm (20-30 cm) | 25.77% | 21.32% | -4.45       | 0.636           |
| 35 cm (30-40 cm) | 29.26% | 24.90% | -4.36       | 0.623           |
| Total            |        |        | -18.08      | 2.583           |



Table 2.8 Change of moisture content of B.G. No.2 29-64 days

| Depth            | 29 days | 64 days | Change (mm) | Change (mm/day) |
|------------------|---------|---------|-------------|-----------------|
| 5 cm (0 -10 cm)  | 27.12%  | 17.84%  | -9.28       | 0.265           |
| 15 cm (10-20 cm) | 29.91%  | 20.12%  | -9.79       | 0.280           |
| 25 cm (20-30 cm) | 29.71%  | 16.60%  | -13.11      | 0.375           |
| 35 cm (30-40 cm) | 29.60%  | 18.06%  | -11.54      | 0.330           |
| Total            |         |         | -43.72      | 1.249           |

|   |  |
|---|--|
|  |  |
| <p>BG. No.2 Test field. 64 days after sowing.</p>                                 | <p>BG. No.2 Growing condition. 64 days after sowing. Root depth 30 - 35 cm.</p>    |

c. BG No.3

Moisture content of each layer tend to increase. Moisture content increased rapidly from the fourth sampling to fifth sampling, especially in deep layers. Saturation ratio of the surface layer decreased according to elapsed days, while, saturation ratio of other layers increased. It is possible that there is a special feature of moisture migration mechanism at the location. However it is not confirmed. Germination rate and growing condition is good as BG. No.1 and BG. No.2.

|   |  |
|---|--|
|  |  |
| <p>BG. No.3 Test field. 66 days after sowing. Germination rate is very low.</p>     | <p>BG. No.3 Growing condition. 66 days after sowing. Root depth 15 - 25 cm.</p>      |



## 2) Dry Density

Dry density of samples at various depth are shown in the Table 2.9. Figure 2.4, 2.5 and 2.6 shows distribution of dry density at various depth of six locations.

Table 2.9 Dry Density of Test Field

|               | Min  | Max  | Average |
|---------------|------|------|---------|
| BG1 5 cm      | 1.40 | 1.54 | 1.47    |
| BG1 15 cm     | 1.51 | 1.67 | 1.61    |
| BG1 25 cm     | 1.54 | 1.65 | 1.60    |
| BG1 35 cm     | 1.52 | 1.66 | 1.58    |
| BG2 5 cm      | 1.36 | 1.58 | 1.49    |
| BG2 15 cm     | 1.68 | 1.77 | 1.72    |
| BG2 25 cm     | 1.63 | 1.75 | 1.70    |
| BG2 35 cm     | 1.58 | 1.73 | 1.66    |
| BG3 5 cm      | 1.11 | 1.75 | 1.40    |
| BG3 15 cm     | 1.38 | 1.84 | 1.63    |
| BG3 25 cm     | 1.68 | 1.87 | 1.75    |
| BG3 35 cm     | 1.62 | 1.85 | 1.71    |
| Average 5 cm  |      |      | 1.45    |
| Average 15 cm |      |      | 1.65    |
| Average 25 cm |      |      | 1.68    |
| Average 35 cm |      |      | 1.65    |

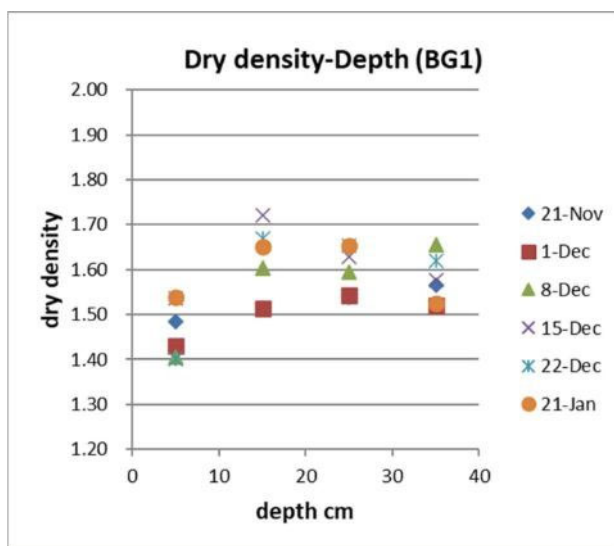


Figure 2.4 Dry density-depth (BG 1)

Dry density of the surface layer is the smallest among four layers in each sampling. And that of second layer is large. This is considered because the surface layer is harrowed and the second layer is compacted by machines. Generally, surface is harrowed only 10 cm depth.

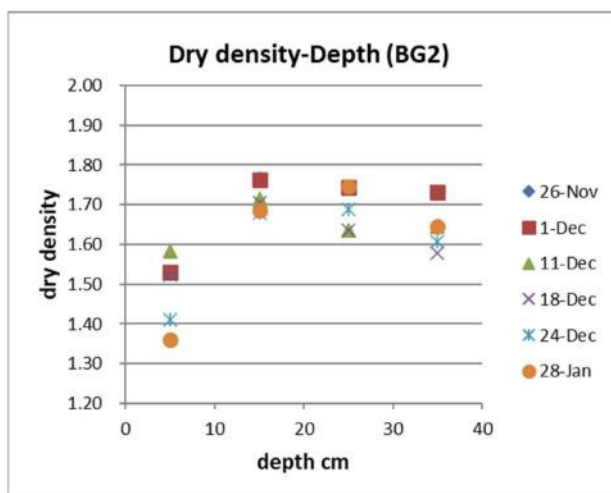


Figure 2.5 Dry density - Depth (BG 2)

As in the case in BG.1, dry density of the surface layer is the smallest among four layers in each sampling.

Dry density of the second layer is the largest except January 28.

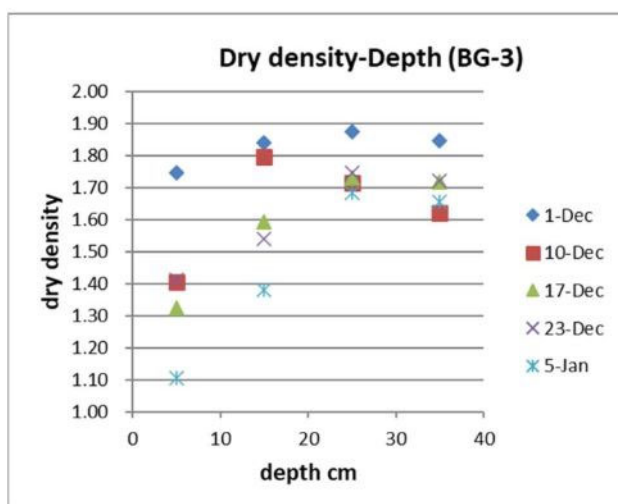


Figure 2.6 Dry density - Depth (BG 3)

The values of the first layer and the second layer are wide ranged. Dry density of surface layer is smallest among four layers in each sampling. That of the third layer is the largest except December 10. Variation of values from location to location is large.

#### (4) Growing condition

Ground height and root depth of second, fourth and sixth sampling is shown in the Table 2.10. The root depth in the initial stage is less than 10 cm and it reaches 20 to 30 cm at two months after sowing seed. There is not much difference of growth situation among three plots.



Table 2. 10 Growing condition (cm)

| Elapsed Days | 8 ~ 12 |            | 23 ~ 26    |            | 63 ~ 66    |            |
|--------------|--------|------------|------------|------------|------------|------------|
|              | Height | Root Depth | Height     | Root Depth | Height     | Root Depth |
| BG. No.1     | 9 cm   | 9 cm       | 9 ~16 cm   | 3 ~ 14 cm  | 30 ~ 38 cm | 15 ~ 24 cm |
| BG. No.2     | 6 cm   | 4 cm       | 14 ~ 17 cm | 6 ~ 8 cm   | 28 ~ 30 cm | 30 ~ 35 cm |
| BG. No.3     | 7 cm   | 8 cm       | 15 cm      | 13 ~ 15 cm | 26 ~ 37 cm | 15 ~ 25 cm |

Height: Height above ground surface, Root Depth: Length below ground surface

### (5) Consideration

Generally, moisture content decreases according to elapsed days. However, it changed up and down from the second sampling to the sixth sampling. This is considered because of variation from location to location. Moisture content of BG.3 increased and values of dry density are wide ranged. It is considered that there is a special feature of moisture migration mechanism and variation of soil structure in the area.

Generally, change of moisture content of deep layer is considered much smaller than surface layer, however, moisture content at 35 cm depth changed similarly to surface layer. This means that soil moisture of deep layer (35 cm depth) moved to upper layer and was also consumed.

According to BWID irrigation plan, crop water requirement for black gram calculated by Penman Method is 1.25 mm/day in December to 5.00 mm/day in February and total amount of water requirement during growing period is 297.01mm. On the other hand, actual water consumption in the test field is 2.0 mm/day at BG. No.1 and 2.6 mm/day at BG. No.2 in December and 0.7mm/day at BG. No.1 and 1.2 mm/day at BG. No.2 in January. Total water consumption in growing period is assumed to be 41.5 mm at BG. No.1 and 61.8 mm at BG. No.2. This is much smaller than estimation by Penman Method. However, germination rate and growing condition of all three plots were good.

Initial moisture content at the surface layer was 30.48 % at BG. No.1, 33.37 % at BG. No.2 and 25.45 % at BG. No.3. The date of harvesting monsoon paddy was October 28 in BG. No.1, November 3 in BG. No.2 and November 10 in BG. No.3. The date of sowing seed was November 19 in BG. No.1, November 25 in BG. No.2 and November 30, in BG. No.3. It rained in the area total of 11.3 mm on November 1 and 5. Moisture content of BG. No.3 is smaller possibly because of late sowing seed (sampling date).

Considering germination rate and growing condition of BG No.3, moisture content 25 % at sowing time is enough for good germination rate and growing.

Sowing date was 22 days after harvesting monsoon paddy in BG. No.1 and BG. No.2, 20 days in BG. No.3. However, test plots are located at lower part of the irrigation block and it took time for draining and it rained early days in November, excess soil moisture remained long time. In this case, it is difficult to determine the timing of sowing seed.

### 3. Overall Findings

#### 3.1 Black Gram

In the project area, almost all black gram field is not irrigated. After harvesting monsoon paddy, the field is harrowed and then seeds are sown. After sowing seeds, the field is not irrigated until harvesting. In the case of 2020-2021 test field, seeds were sown three weeks after harvesting because of site condition. If moisture content is too much due to drain condition or rain fall, the time of sowing seeds is delayed.

For BWID irrigation systems, irrigation water requirement is calculated by Penman Method. According to the irrigation plan, crop water requirement for black gram is 1.25 mm/day in December to 5.00 mm/day in February, total amount of water requirement during growing period is 297.01mm. On the other hand, actual total water consumption in the test field is assumed to be 41.5 mm to 74.7 mm (0 -40 cm depth). The difference of drain condition would contribute to the difference of total water consumption.

Table 3.1 Total Water Consumption

|              | Plot No.1 | Plot No.2 | Plot No.3 |
|--------------|-----------|-----------|-----------|
| 2018/19 test | 72.9 mm   | -         | -         |
| 2019/20 test | 61.8 mm   | 74.7 mm   | -         |
| 2020/21 test | 41.5 mm   | 61.8 mm   | NG.       |

Initial moisture content is very important for germination. In the 2018/19 test, germination rate was not so high and growing condition was not so good. In the 2019/20 test, germination rate of plot No.1 was high and growing condition was good. Germination rate and growing condition of plot No.2 was fair. Germination rate of plot No.3 was very low and growing condition was poor. In the 2020/21 test, germination rate and growing condition of all plots were good. Sufficient moisture content at the initial stage for good germination rate presumed to be more than 25 %. If germination rate is low, additional irrigation by tube irrigation would be effective. Generally, irrigation is not required from sowing seed to harvesting.

Table 3.2 Initial Water Volume Ratio at the First Layer

|              | Plot No.1 | Plot No.2 | Plot No.3 |
|--------------|-----------|-----------|-----------|
| 2018/19 test | 20.56 %   | -         | -         |
| 2019/20 test | 29.56 %   | 17.8 %    | 17.16 %-  |
| 2020/21 test | 30.48 %   | 33.37 %   | 25.45 %.  |



### 3.2 Sesame

In the project area, almost all sesame field is irrigated before sowing and no irrigation after sowing. In Kyaukse area, the progressed sesame farming area, most of the farmers don't irrigate after sowing also. but some of the farmers practice irrigation at flowering stage or 10 days interval.

Soil moisture content test was done only in the 2019/20 dry season. Two plots were selected but the test result of plot No.1 didn't show decrease of moisture content. It is considered because variation of moisture content is large from location to location or there is a special feature of soil moisture migration mechanism at the location. As the result, only one series of test result of one plot is available. According to the test result, soil moisture content decreases rapidly until 12 days after irrigation and it decreases gently after 12 days until the final stage. After 12 days, daily water consumption is much smaller than that of Penman Method. However, growing condition was not so bad.

According to BWID irrigation plan, crop water requirement for sesame calculated by Penman Method is 1.5 mm/day in February to 6.6 mm/day in April and 3.5 mm/day at the final stage in May. Total amount of water requirement during growing period is 396 mm. On the other hand, actual water consumption in the test field is 4.44 mm/day in February and 0.15 mm/day in April and May, and total water consumption in 62 days after initial irrigation is 84 mm.

In both plot No.1 and No.2, it was observed that irrigation at 25 days after sowing promoted germination. The variation in germination from location to location was observed. Those mean that moisture content in the surface layer at sowing time was not enough or varies from location to location. According to dry density, the values at the surface layer vary widely from location to location. Which means the surface layer is not harrowed uniformly.

### 3.3 Onion

In the test field, basin irrigation was applied but spraying water was applied in the neighboring field. At the initial stage the farmer irrigated every day. Irrigation amount is approximately 1.8 mm/day (0.5 lit/s x 30 min x 2 hoses for 0.25 acre). This is almost same as daily consumptive use of water of test result. Maximum irrigation interval can be 5 days but the farmer prefers daily irrigation in this season. After flowering, the farmer irrigates once a week. After late middle season, the farmer stop irrigation. Daily consumptive use of water in the late middle stage is 1.07 mm/day. If 21.33 mm (TRAM) was supplied, irrigation interval is 20 days. In this way, actual irrigation practice relatively conforms to the test result.

According to the BWID irrigation plan, crop water requirement for vegetable gradually increases from 2.00 mm/day in November (initial stage) to 4.24 mm/day in February (final stage). On the other hand, test result shows water requirement at the late middle stage is much smaller than that of initial stage.

### 3.4 Others

The value of dry density at the surface layer varied widely from location to location. This means that the surface layer is not harrowed uniformly. Dry density of the first layer (5 cm) was the smallest and second layer (15 cm) was the largest. The large dry density is considered because of compaction by machines (harvesters and tractors). Generally, surface is harrowed only 10 cm depth.

It is desirable that more harrowing is applied and clods of soil should be broken to small pieces.



Surface condition of the field. Clods of soil are seen.

Feb. 4, 2020. CL3 LCA

## 4. Irrigation Method

### 4.1 Furrow Irrigation

Inter mediate irrigation is recommended for sesame fields. Furrow irrigation is one of irrigation methods for intermediate irrigation. Water is supplied from the water source to furrow through watercourse or pump. Furrow irrigation is applied to maize and other vegetables.

According to the test result in 2018 proposed irrigation practice is as follows;

Proposed furrow arrangement is shown in the Figure 3.1.

In case of irrigation area is 0.1 ha

Length of furrow: 20m

Irrigation amount: 24 mm

Irrigation water: 6.75 lit/s

Irrigation time: 85 minutes



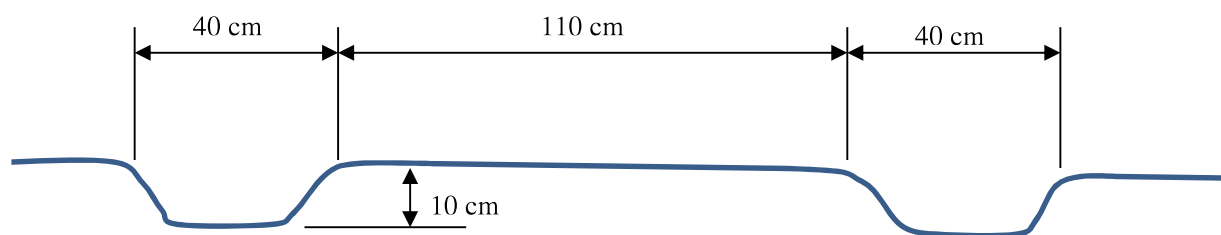


Figure 3.1 Furrow arrangement of sesame field



Furrow arrangement of sesame field

North Nawin, RMC DO

May 7, 2018.

## 4.2 Tube Irrigation

Tube irrigation is another irrigation method. Water is supplied from the water source to the field through pump and tube. Tube irrigation can be applied for inter mediate irrigation for sesame field, promotion of germination of black gram and sesame.

In case of irrigation area is 1 acre;

Irrigation time: 5.5 hours

Irrigation quantity: 17.4 mm

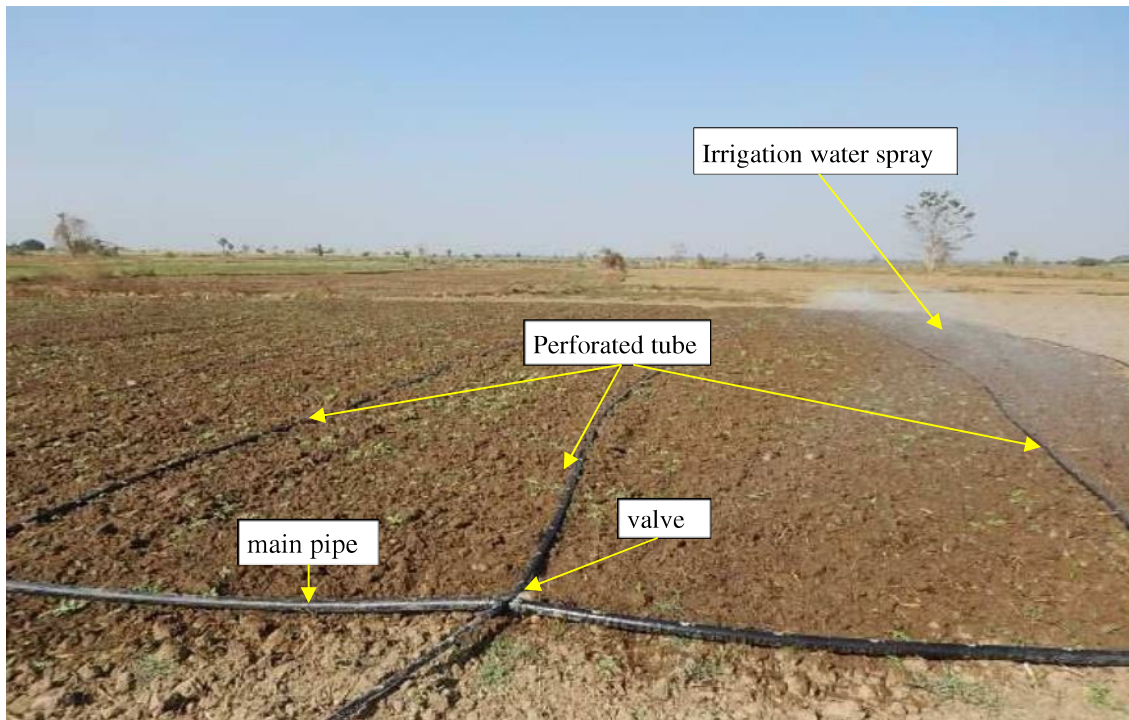


Figure 3.2 Tube irrigation system

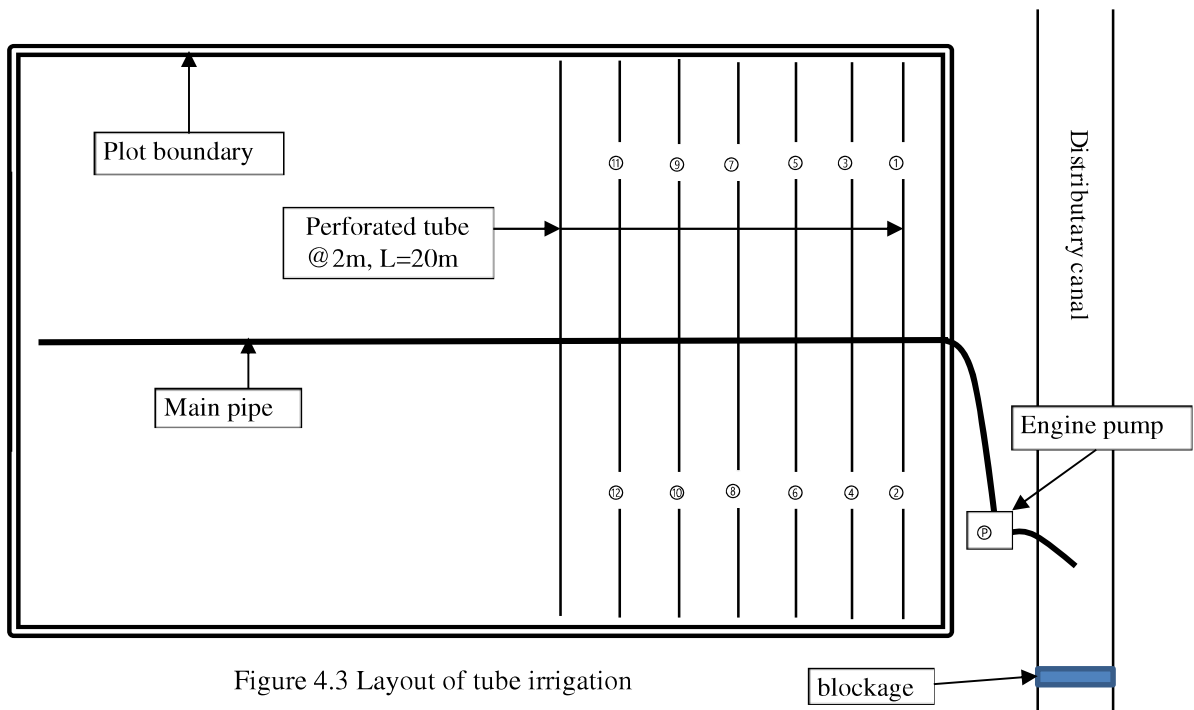


Figure 4.3 Layout of tube irrigation