Wheat Production and Seed Preservation

Training Manual

Wheat Research Center,
Bangladesh Agricultural Research Institute

International Maize and Wheat Improvement Center

Combined by: Mirza Hasanuzzaman, Dept. of Agronomy, SAU
Good seed results in good yields

What are the characteristics of good seed?
- High yield potential
- Pure and clean
- Free from disease and insect
- Seeds are uniform size
- Germination is more than 80%

What are the benefits of using good seed?
- Higher yields
- Less disease and insect attack
- Requires less quantity of seed and costs go down
- Good seeds are not expensive but are a source of income

Good seed produces good crops
Poor seed produces poor crops

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Seed rates and germination tests

Methods of testing germination
(Use 100 wheat seeds; Conduct a germination test one week before sowing)

- Earthen pot
- Banana leaf stalk
- Wet gunny bag

Determine seed rate according to germination percentage

<table>
<thead>
<tr>
<th>Germination rate</th>
<th>80%</th>
<th>75%</th>
<th>70%</th>
<th>65%</th>
<th>60%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra seed (kg/acre)</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Total seed (kg/acre)</td>
<td>50</td>
<td>52</td>
<td>54</td>
<td>56</td>
<td>58</td>
</tr>
</tbody>
</table>

- If germination rate is 80% or more, sow 0.5 kg seed per decimal (50 kg per acre).
- If germination rate is less than 80%, use 400 g extra seed for each 1 percent reduction of germination.
- Seed with a 60% or lower germination rate should not be used.

Seed treatment

- Mix seed with fungicide like Provex/Vitavex 200 (3 g/kg seed).
- Seed treatment results in 20-22% more seedlings and increases yield by 10-12%.
Names and characteristics of recommended varieties

Characteristics of a good variety

- High yield potential
- Disease resistant
- Heat tolerant
- Produces more number of tillers
- More grains per ear

Names of recommended varieties

- BARI wheat 24 (Prodip)
- BARI wheat 23 (Bijoy)
- BARI wheat 22 (Sufi)
- BARI wheat 21 (Shatabdi)
- BARI wheat 20 (Sourav)
- BARI wheat 19 (Gourav)
**BARI Wheat 24 (Prodip)**

This variety is heat tolerant and high yielding. It was released in 2005. The variety can be cultivated in any part of Bangladesh and is suitable for optimum and late planting conditions.

**Characteristics**

- Plant height: 95-100 cm
- Number of tillers: 3-4
- Leaves: Wide and deep green
- Heading: 64-66 days
- Maturity: 102-110 days
- Spikes are long
- Grain number/spike: 45-50
- Grain color: White (amber)
- Grains are large and shiny
- 1000 kernel weight: 48-55 g
- Tolerant to Bipolaris leaf blight and resistant to leaf rust
- This variety is suitable for quality bread-making due to strong gluten
- Under late planting condition the variety can outyield Kanchan by 10-20%
- Yield under favorable conditions: 4300-5100 kg/ha

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This variety is heat tolerant and high yielding. It was released in 2005. The variety can be cultivated in any part of Bangladesh and is suitable for optimum and late planting conditions.

**Characteristics**

- Plant height: 95-105 cm
- Number of tillers: 4-5
- Leaves: Wide and deep green
- Heading: 60-65 days
- Maturity: 103-112 days
- Spikes are long
- Grain number/spike: 35-40
- Grain color: White (amber)
- Grains are large and shiny
- 1000 kernel weight: 47-52 g
- Tolerant to Bipolaris leaf blight and resistant to leaf rust
- The variety performs well under late planting condition
- Yield under favorable condition: 4300-5000 kg/ha
This variety is heat tolerant and high yielding. It was released in 2005. The variety can be cultivated all over Bangladesh and can outyield other varieties under late planting condition.

**Characteristics**

- Plant height: 90-102 cm
- Number of tillers: 4-5
- Leaves: Wide and deep green
- Heading: 58-62 days
- Maturity: 100-110 days
- Spikes are long
- Grain number/spike: 50-55
- Grain color: White (amber)
- Grains are small and shiny
- 1000 kernel weight: 36-42 g

- Tolerant to Bipolaris leaf blight and resistant to leaf rust
- This variety is suitable for quality bread making due to strong gluten
- This variety is heat and sterility tolerant
- The variety performs well under late planting condition
- Yield under favorable conditions: 3600-4800 kg/ha
BARI Wheat 21 (Shatabdi)

This variety is high yielding. It was released in 2000. The variety can be cultivated in any part of Bangladesh and is suitable for late planting also.

Characteristics

- Plant height: 95-100 cm
- Number of tillers: 5-6
- Leaves: Light green
- The flag leaf is semi-droopy and light green in color
- Heading: 65-68 days
- Maturity: 105-112 days
- Grain number/spike: 40-45
- Grain color: White (amber)
- Grains are large
- 1000 kernel weight: 46-48 g
- If the spikes become yellow at ripening, the peduncle and flag leaf remain green for a few days longer
- Tolerant to Bipolaris leaf blight and resistant to leaf rust
- The variety performs well under late planting condition
- Yield under favorable conditions: 3600-5000 kg/ha

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**BARI Wheat 20 (Gourav)**

This variety is high yielding. It was released in 1998. The variety performs well under late planting condition in comparison to other varieties.

**Characteristics**

- Plant height: 90-102 cm
- Number of tillers: 5-6
- Leaves: Deep green
- Under excess soil moisture, the lower leaves become yellow at seedling stage
- The flag leaf is narrow, erect and slightly curved
- Heading: 60-65 days
- Maturity: 100-108 days
- Spikes are long and its tip is narrow
- Grain number/spike: 45-50
- Grain color: White (amber)
- Grains are large and bright
- 1000 kernel weight: 40-48 g
- Tolerant to Bipolaris leaf blight and resistant to leaf rust
- Under late planting conditions the variety out yields Kanchan by 20%
- The variety matures a few days earlier than Kanchan
- Yield under favorable conditions: 3600-4800 kg/ha
BARI Wheat 19 (Sourab)

This variety is high yielding. It was released in 1998. The variety is suitable for optimum and late planting conditions.

Characteristics

- Plant height: 90-100 cm
- Number of tillers: 5-6
- Leaves: Wide, droopy and deep green
- The flag leaf is waxy
- The stem is strong and does not lodge very often
- Heading: 60-70 days
- Maturity: 102-110 days
- Spikes are long
- Grain number/spike: 42-48
- Grain color: White (amber)
- Grains are medium to large in size
- 1000 kernel weight: 40-45 g
- Tolerant to Bipolaris leaf blight and resistant to leaf rust
- Yield under favorable condition: 3500-4600 kg/ha

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Kanchan

It was released in 1983. This variety was highly accepted by farmers and covered about 80-85% in mid nineties.

But recently the cultivation of this variety has been decreasing due to high levels of Bipolaris leaf blight and leaf rust infections.

Steps to be taken

- Replace Kanchan with other new varieties.
- If the seeds of new variety are not available, then cultivate Kanchan during the optimum period (November 15 to 30). The disease incidence will be lower if planted in optimum conditions.
- Seed treatment by Provex/Vitavex 200 (3 g/kg seed) can reduce the leaf blight disease.
- If sprayed with Till 250 EC (0.5 ml/liter water) at the time of heading and two weeks after heading will effectively control leaf blight and leaf rust diseases.

BARI

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Optimum planting periods and wheat yield

- The optimum time for wheat planting is from November 15 to 30. In the northern districts, the period can be extended one more week due to cooler temperatures.
- Yield will reduce 18 kg/acre/day if planting is done after the optimum planting date.

Land preparation

- Wheat planting will delayed if Aman rice is not harvested immediately after ripening or left in the field after harvest.
- Prepare land using a power tiller or draft power. If plowed more, soil moisture will be lost.
- Apply light irrigation if moisture levels in the field are low. Prepare land under optimum moisture levels.
- After harvesting Aman rice, optimum wheat planting can be done by power tiller operated seeder. This equipment can plow the field, sow seeds in line, and plank the field simultaneously in a single pass.
### Apply balanced fertilizer

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>Quantity of fertilizer</th>
<th>Per acre (kg)</th>
<th>Per decimal (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urea</td>
<td>60-70</td>
<td>600-700</td>
<td></td>
</tr>
<tr>
<td>Top dress</td>
<td>30-35</td>
<td>300-350</td>
<td></td>
</tr>
<tr>
<td><strong>Top dress</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSP</td>
<td>60-70</td>
<td>600-700</td>
<td></td>
</tr>
<tr>
<td><strong>MP</strong></td>
<td>40-45</td>
<td>400-450</td>
<td></td>
</tr>
<tr>
<td>Gypsum</td>
<td>45-50</td>
<td>450-500</td>
<td></td>
</tr>
</tbody>
</table>

- Before land preparation, apply cow dung/compost evenly 3000-4000 kg/acre (30-40 kg/decimal) before land preparation.
- Broadcast basal urea and other fertilizers during final land preparation.
- If there is boron deficiency in the soil, apply boric acid at the rate of 2.5 kg/acre (25 gm/decimal). Mix it with other fertilizers and apply during the final land preparation. In the light soils in greater Rangpur and Dinajpur regions, boron application will reduce spike sterility.
- If zinc is not applied in the previous crop then apply zinc sulphate 5 kg/acre or 50 gm/decimal (36% zinc content) during the final land preparation.
- If pH is 4.0 to 5.0%, apply 800 kg/acre of dolochun. If pH is between 5.0 to 6.0%, then reduce dolochun to 400 kg/acre. Apply dolochun 2 weeks before wheat planting.
**Broadcast or line sowing**

- Broadcast seed uniformly after last plow and then ladder.
- Line sowing can be done easily by a power tiller operated seeder.
- Spacing of 20 cm between rows will facilitate other management practices, including weeding.
- If there is low depression, wait for few days and proceed for sowing.

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**Fertilizer application at final plowing**

**Broadcast seed**

**Line sowing**

**Seed sowing by power tiller operated seeder**

**Make channels 20-25 ft apart for drainage of rain and excess irrigation water**

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## Bird control and irrigation

### Drive off the birds 10 to 12 days after sowing

![Image of birds and person applying pesticide](image1)

### Irrigation

- Avoid excess irrigation.
- If the rain is adequate do not irrigate.
- After first irrigation or after rain, apply top dress of urea in the afternoon.

**Apply light irrigation at three leaf stage**  
*(17-21 days after sowing)*

<table>
<thead>
<tr>
<th>Right method</th>
<th>Wrong method</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image2" alt="Irrigation watered field" /></td>
<td><img src="image3" alt="Irrigation overwatered field" /></td>
</tr>
</tbody>
</table>

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Irrigation stages

After first irrigation remove weeds when the soil is workable

Apply 2nd irrigation at heading stage
(50-55 days after sowing)

Apply 3rd irrigation at primary grain filling stage
(70-75 days after sowing)

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Problems in the field

Check rat infestation in the field. Take appropriate measures if there is rat infestation.

Rogue weeds and other varietal admixtures starting from heading to maturity
Optimum time of wheat harvest

- **Green plants** (not ready for harvest)
- **Matured wheat plants** (time for harvest)
- **Dry matured wheat plants** (immediately harvest)
- **Over matured and the lodged plants** (too late for harvest)
Wheat harvest

Harvest wheat on sunny days

Matured wheat plants  Harvesting by hand  Harvesting by machine

Threshing by beating  Threshing by machine

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Seed drying and cleaning

- Before storing, dry the seeds in the sun for a few days.
- Separate bold seeds using a sieve.
- Cool the seeds after drying if storing in a non-metallic container.
- Chew the seeds with teeth to be sure that the seeds are properly dried.
- Moisture should be lower than 12% before storing.

**Dry the seeds in the sun**

**If the seed is crushed by teeth there will be a sound**

**Cooling the sun-dried seeds**

**Use sieve 1.75 to 2.5 mm**

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Seed preservation methods

Use clean and leak proof covered containers

Fill the containers up fully with seeds

Do not leave any empty room inside the container

- Metal containers, such as oil drums, biscuit tins, etc., are suitable for proper seed preservation. If metal containers are not available, use a plastic drum, thick polythene bag, or big earthen jar, etc.
- Paint the outside of the metal container/earthen jar twice and then dry it.
- Fill the container completely with the seeds, without leaving empty space.
- Tighten the lid of the container so that no air can pass inside.
- The seed containers should be kept on wooden platforms not very close to the soil.
# Wheat production and seed preservation - summary

## Land Selection
For wheat cultivation, select high or medium high land, where water will drain out by mid- to late October. There should be adequate soil moisture by mid-November before planting. Loam, silt loam and clay loam soils are most suitable. Soils that are more sandy or highly saline are unfit for wheat cultivation.

## Land Preparation
Land should be prepared by properly plowing and laddering so that good seed bed can be made. After sowing, create channels so that rain or excess irrigation water can be drained out easily.

## Variety Selection
Newly released wheat varieties should be selected for better yields. Recent varieties include Prodip, Bijoy, Sufi, Shatabdi, Sourav, and Gaurab. These varieties are tolerant to heat, Bipolaris leaf blight, and resistant to leaf rust diseases. Kanchan has become highly susceptible to leaf blight and leaf rust diseases, so this variety should not be selected for cultivation.

## Seed rate
Germination tests should be conducted about one week before sowing. If the germination rate is 80% or higher, use 50 kg of seed per acre. If the germination rate is lower than 80%, use 400 g of additional seed for each 1 percent reduction in germination rate. Seeds with a germination rate lower than 60% should not be used.

## Seed treatment
Seeds should be treated to control seed and soil born diseases. Before sowing, treat seeds using Provex/Vitavex 200 (3 g per kg of seed). Seed treatment results in 20-22% more seedlings and ultimately increases yield by approximately 10-12%.
Wheat production and seed preservation - summary

**Optimum sowing time**
Late planting is a main cause of reduced yields. If sown after optimum time, yield is reduced by 40-44 kg/ha (16-18 kg/acre) for each day of delay. Hence, for higher yields, plant at the optimum time. The optimum wheat sowing period is November 15 to 30. In northern regions, the period can be extended by one week due to cooler periods. Sowing should not be done after mid December. New wheat varieties outyield Kanchan by about 10-15% in optimum planting conditions and 15-20% in late planting conditions.

**Method of seed sowing**
Wheat can be planted by broadcasting or by line sowing. In line sowing, the row spacing should be 20 cm and the depth of seed should be 3-4 cm.

**Power tiller operated seeder**
After aman rice harvest, planting is delayed if using a country plow. To reduce the turnaround time between land preparation and wheat planting, use a power tiller operated seeder. Immediately after the harvest of aman, the machine can plow, plant seeds in rows, and plank the field simultaneously in a single pass, with six rows spaced 20 cm apart and planted 3-4 cm deep. Use of this machine results in good germination, little bird damage, and seed savings of 20%.

**Irrigation**
Irrigation is necessary for better wheat yields. Depending on the soil type, 2 or 3 irrigations are generally required. However, an additional 1-2 irrigations may be required if the soil is sandy. The first irrigation should be carried out at the 3 leaf stage (17-21 days after sowing). If there is excess soil moisture, the first irrigation may be delayed for a few days. Irrigate effectively so that no water stands in the field. A second irrigation should be applied at the heading stage (50-55 days after sowing) with a third irrigation at the grain filling stage (70-75 days after sowing). If rain is forecast, delay irrigation.
Wheat production and seed preservation - summary

**Fertilizer application**

Low dose fertilizer use is another reason for low wheat yields in Bangladesh. Survey results show that only 50% of farmers use the recommended doses. 600-700 g of urea, 600-700 g of TSP, 400-450 g of muriate of potash and 450-500 g of gypsum should be applied per decimal during final land preparation. After the first irrigation, apply 30-35 kg of urea per acre as a top dress. If no irrigation is done, apply all the urea at the final land preparation instead. If there is any rain at the seedling stage, broadcast urea at 30-35 kg/acre in the afternoon for good yields. If Single Super Phosphate (SSP) is available, use 2.5 times more SSP than TSP.

If there is deficiency of boron in the soil, apply 2.5 kg/acre (25 gm/decimal) of boric acid, mixed with other fertilizers at the final land preparation. If there is zinc deficiency, apply 5 kg/acre of zinc sulphate (36% zinc content) at the final land preparation. If soil pH is 4.0 to 5.0, apply 800 kg of dolochun (lime) per acre and if pH is in between 5.0 to 6.0, reduce dolochun to 400 kg/acre. Apply dolochun at least 2 weeks before wheat planting.

**Other management**

Drive birds away until 10-12 days after sowing. If birds are not driven away, seedlings will be greatly reduced. After first irrigation, weed by hand; it should be done by one month after sowing. If there is a rat infestation from heading to maturity, take appropriate measures to control rats. In some areas crow or parrot infestations are observed at maturity stage, which should be driven away.

**Disease and insect control**

Wheat has fewer diseases and insect infestations than other crops. Bipolaris leaf blight and leaf rust are the major diseases in Bangladesh. New varieties have lower disease incidence. Spraying Till 250 EC (0.5 ml/liter water) at the time of heading and two weeks after heading will effectively control these diseases, increasing yield by 15-20% and improving seed quality. Aphids and stem borers are sometimes found in wheat crops. To control aphids, spray Malathion 57EC (four teaspoons per 12.5 litres of water or follow instruction written on the bottle). To control stem borers, use Diazinon 50 or 60EC at the same rate. For wire worm, broadcast Kuratan or Sunfuran 5G at final plowing.
Use of other technologies for wheat cultivation
Beyond traditional methods, wheat can also be cultivated using other means such as zero-tillage or reduced tillage.

Zero-tillage
After the aman rice harvest, if there is sufficient soil moisture, wheat can be broadcast directly onto the soil surface. If soil moisture is inadequate, irrigate lightly and sow the seeds. Higher bird infestation is observed if sowing is done using this method. So, before sowing, coat wheat seeds with cow dung slurry for about 1-2 hours, dry the seeds in shade, and broadcast them. The seed rate should be 120 kg/ha.

Fertilizer and irrigation
Before sowing, apply the recommended dose of urea (two thirds of total urea) and other chemical fertilizers. Seeds and fertilizers can be broadcast simultaneously. After the first irrigation (17-21 days after sowing), top dress of the rest of urea (the remaining one third of the total urea) in the afternoon to ensure normal growth of the plants. If necessary, irrigate a second time at the heading stage and a third time at the grain filling stage.

Wheat cultivation with reduced tillage
Wheat planting can be done by two plowing by country plow or one plowing with a power tiller. After the aman rice harvest, plow the land completely if the soil is workable. If the soil has less moisture, irrigate lightly prior to plowing the land. Carry out seeding, fertilizer dosing and irrigation under zero-tillage conditions.

Weed control
Remove weeds within 25-30 days after sowing. Weeds can be higher in zero and reduced tillage condition, so greater weed control care should be taken. Bothua or other broad weeds can be controlled by herbicides. Spray herbicides following the bottle instructions. Herbicides will be more effective if sprayed on a sunny day.
**Wheat production and seed preservation - summary**

### Wheat seed production
Unfavorable weather during wheat harvest may hinder seed production and preservation. To overcome this situation, begin seed production programs at the optimum time. Good varieties should be selected and sown from November 15 to 30 for good seed production. For seed production, fertilizer, irrigation and other management practices should be undertaken according to recommendations. To produce high quality seed, treat seeds using a fungicide like Provex/Vitavex 200 (3 g/kg seed). As a result, seed-borne diseases will be controlled and seedlings will be strong and vigorous.

### Removal of off types
To ensure quality of seed, remove the off types and diseased plants 2-3 times from heading to maturity.

### Seed collection
If seeds need to be collected from wheat fields, mark the portion of land where strong and good plants are observed, so that proper care can be undertaken.

### Wheat harvest
For seed preservation, harvest the crop immediately after ripening.

### Power threshing
Wheat threshing is a problem for wheat expansion in Bangladesh. The wheat thresher invented by BARI is solving this problem. Freshly harvested wheat can be threshed with this machine, with 300-500 kg of wheat grains threshed in one hour.

### Wheat seed storage
Farmer-managed seed storage is very important for wheat cultivation, because a lack of seed availability means that farmers cannot sow wheat seed at optimum times. Before seed storage, dry the seeds for 2-3 consecutive days in sun so that moisture levels drop below 12%. If the seed makes a sound when crushed by teeth it is ready for storage. Clean the seeds and separate bold seeds by using a 1.75 to 2.50 mm sieve. Proper seed storage results in higher germination percentages, increasing the number of growing plants and giving higher yields.
Methods of seed preservation:

**Metal and plastic drum**

Containers, such as metal oil drums, biscuit tins, and plastic drums are suitable for seed storage. Containers should be leak-proof. Paint both the outside and inside of the container using coal tar to prevent leakage. Fill the container fully and cover it tightly. Seal the lid of the container with wax or polythene so that no air can pass inside. Hence, the moisture of the seed remains unchanged and is free from disease and insects. If stored in a plastic drum, the seeds should be cooled.

**Polythene and thick gunny bag**

Take a thick, leak-proof polythene bag, fill the bag with seed, and tie the neck of the bag. Use 2 to 3 polythene bags together if the bags are thin. It is best to then place the polythene bag holding seeds into a gunny bag. Sun-dried seeds should be cooled before storing in the polythene bag; if they are not, the seed will lose its germination due to heat generation inside the bag.

**Earthen container**

Using a large earthen jar, paint outside the jar twice with paint or tar and dry it, ensuring that air cannot pass through the small holes. As a result, seed moisture remains unchanged and there will not be any disease or insect infestations. Fill the jar completely with seed and tie the lid of the jar with polythene or other means. Wheat seed should be cooled 12 hours before storing it in the earthen jar.

**Precaution during seed storing**

Whichever container is used, it should be filled properly. There must not be any empty space in the storage container. These containers should be kept on a platform and away from the soil. If the seed comes close to soil, the seed moisture will increase, damaging the seed.

To control insects during storing, use Phostoxin tablet or Neptholine ball. If Neptholine is used, the seeds cannot be used for human consumption.
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