# Small Grain Growth Stages and Management

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**Yield =**

**# of tillers X**

**kernels per head X**

**kernel weight**

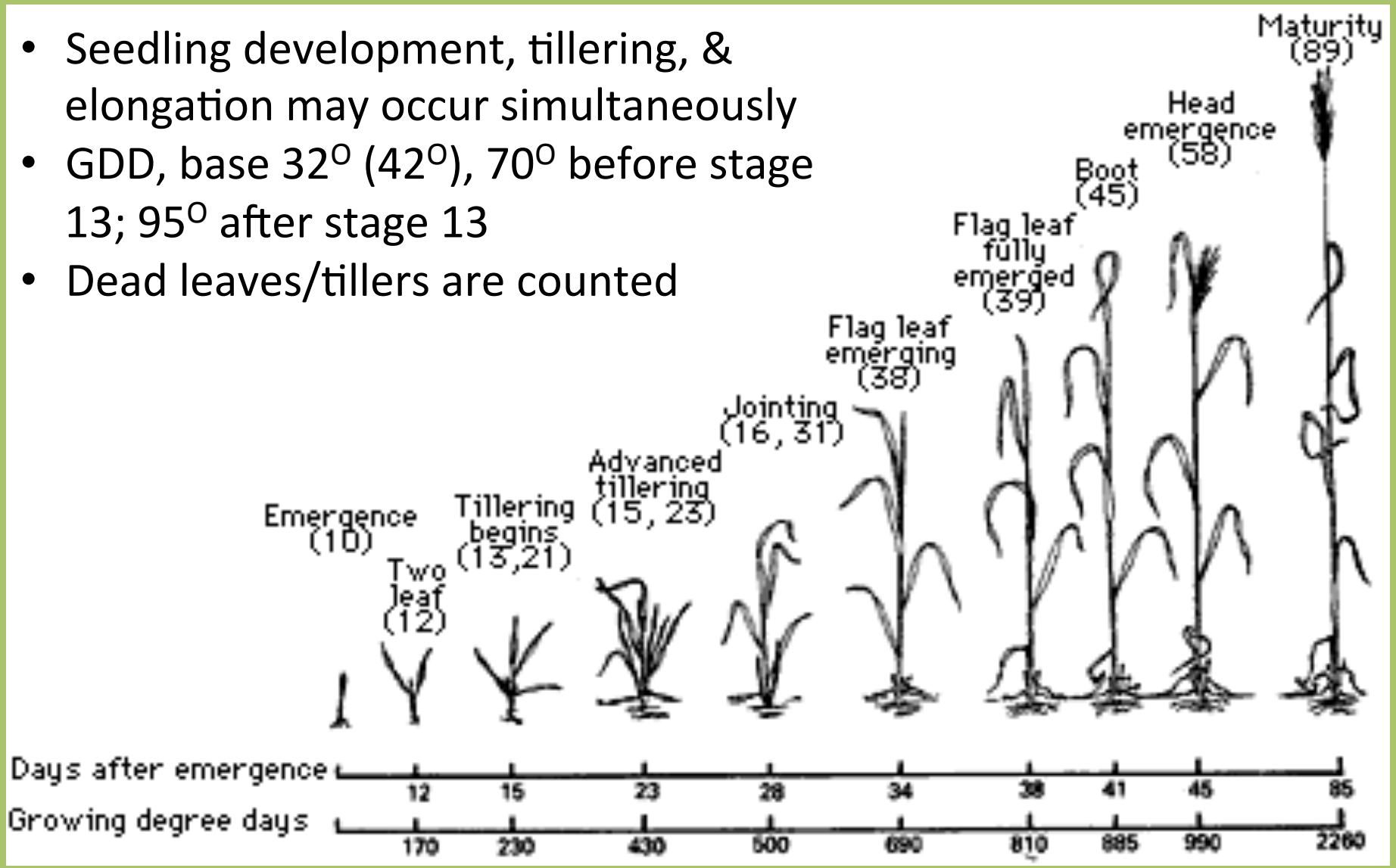
# Zadok Development & Growth Stages

- 00 – 09 germination
- 10 – 15 seedling development
- 20 – 25 tillering
- 30 – 39 stem elongation
- 40 – 49 boot
- 50 – 59 head emergence
- 60 – 69 flowering
- 70 – 77 milk
- 80 – 89 dough
- 90 – 92 ripening

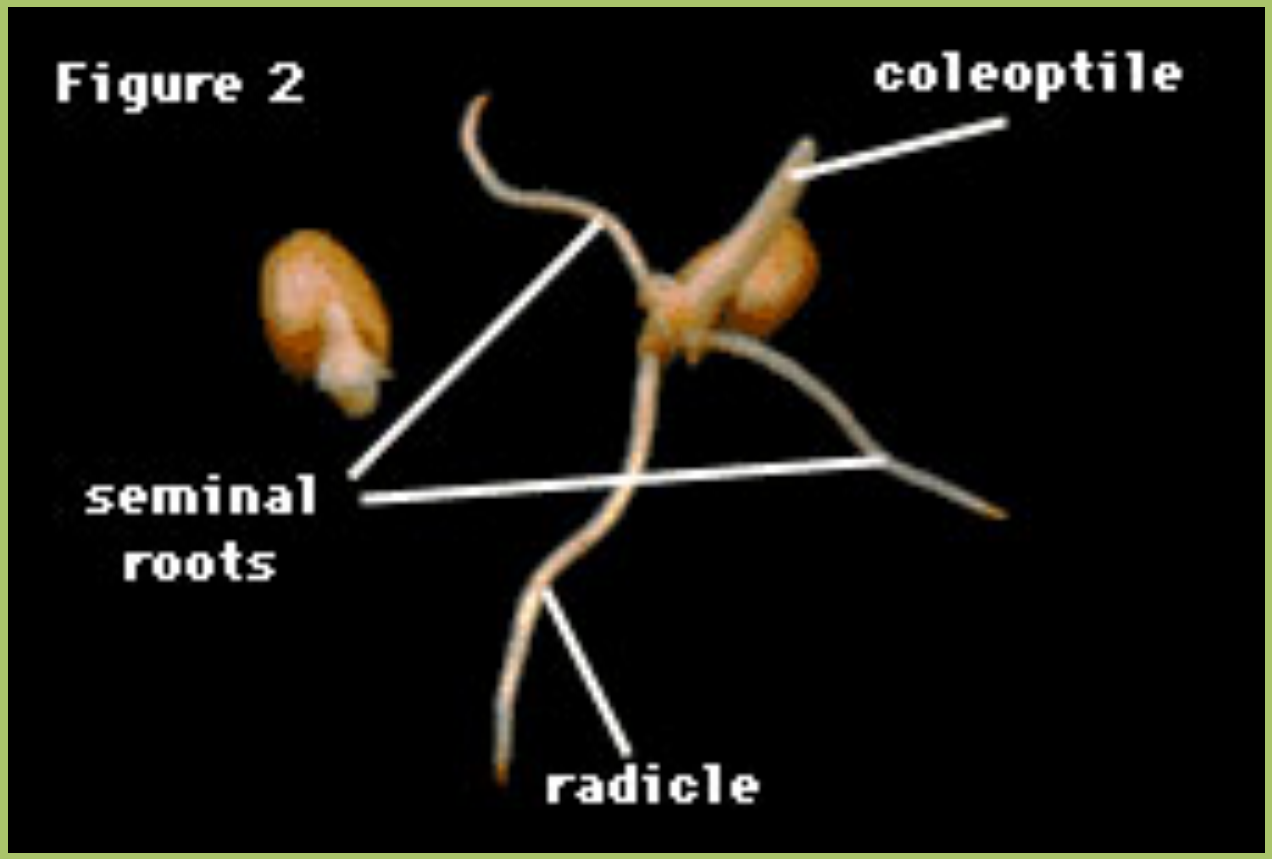
**Table 2-1.** Wheat Growth Stages

| Stage | General Description | Scale | | Additional Comments |
|---|---|---|---|---|
| | | Feekes | Zadoks | |
| Germination | Dry seed | | 00 | |
| | Start of imbibition | | 01 | |
| | Imbibition complete | | 03 | Seed typically at 35 to 40% moisture. |
| | Radicle emerged from seed (caryopsis) | | 05 | |
| | Coleoptile emerged from seed (caryopsis) | | 07 | |
| | Leaf just at coleoptile tip | | 09 | |
| Seedling Growth | First leaf through coleoptile | 1 | 10 | |
| | First leaf unfolded | | 11 | |
| | 2 leaves unfolded | | 12 | |
| | 3 leaves unfolded | | 13 | |
| | 4 leaves unfolded | | 14 | |
| | 5 leaves unfolded | | 15 | |
| | 6 leaves unfolded | | 16 | |
| | 7 leaves unfolded | | 17 | |
| | 8 leaves unfolded | | 18 | |
| | 9 or more leaves unfolded | | 19 | |
| Tillering | Main shoot only | | 20 | |
| | Main shoot and 1 tiller | 2 | 21 | |
| | Main shoot and 2 tillers | | 22 | |
| | Main shoot and 3 tillers | | 23 | Many plants will only have 2 or 3 tillers per plant at recommended populations. |
| | Main shoot and 4 tillers | | 24 | |
| | Main shoot and 5 tillers | | 25 | |
| | Main shoot and 6 tillers | 3 | 26 | Leaves often twisting spirally. |
| | Main shoot and 7 tillers | | 27 | |
| | Main shoot and 8 tillers | | 28 | |
| | Main shoot and 9 tillers | | 29 | |

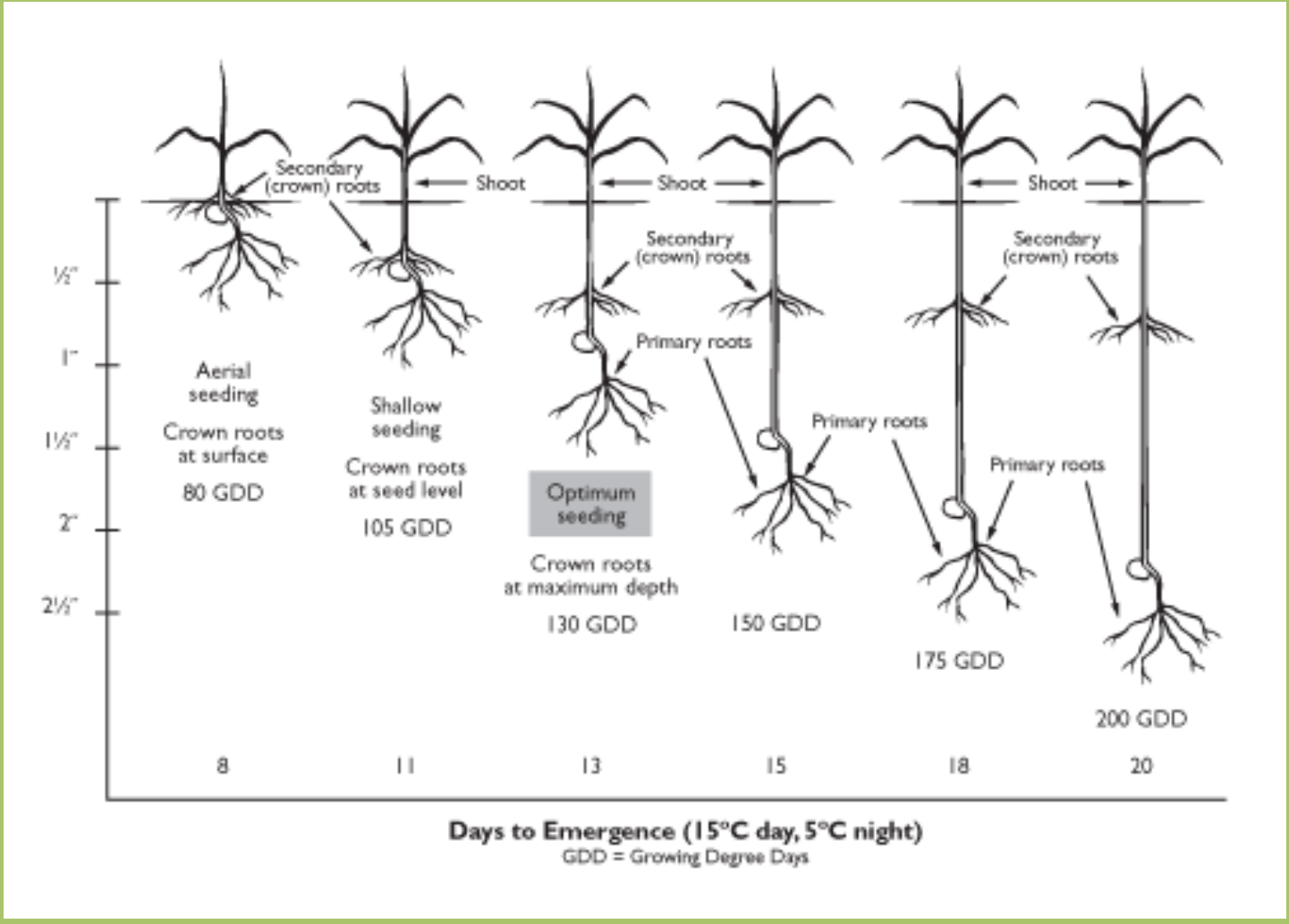
- Seedling development, tillering, & elongation may occur simultaneously
- GDD, base $32^{O}$ ($42^{O}$), $70^{O}$ before stage 13; $95^{O}$ after stage 13
- Dead leaves/tillers are counted



# Germination - stage 07



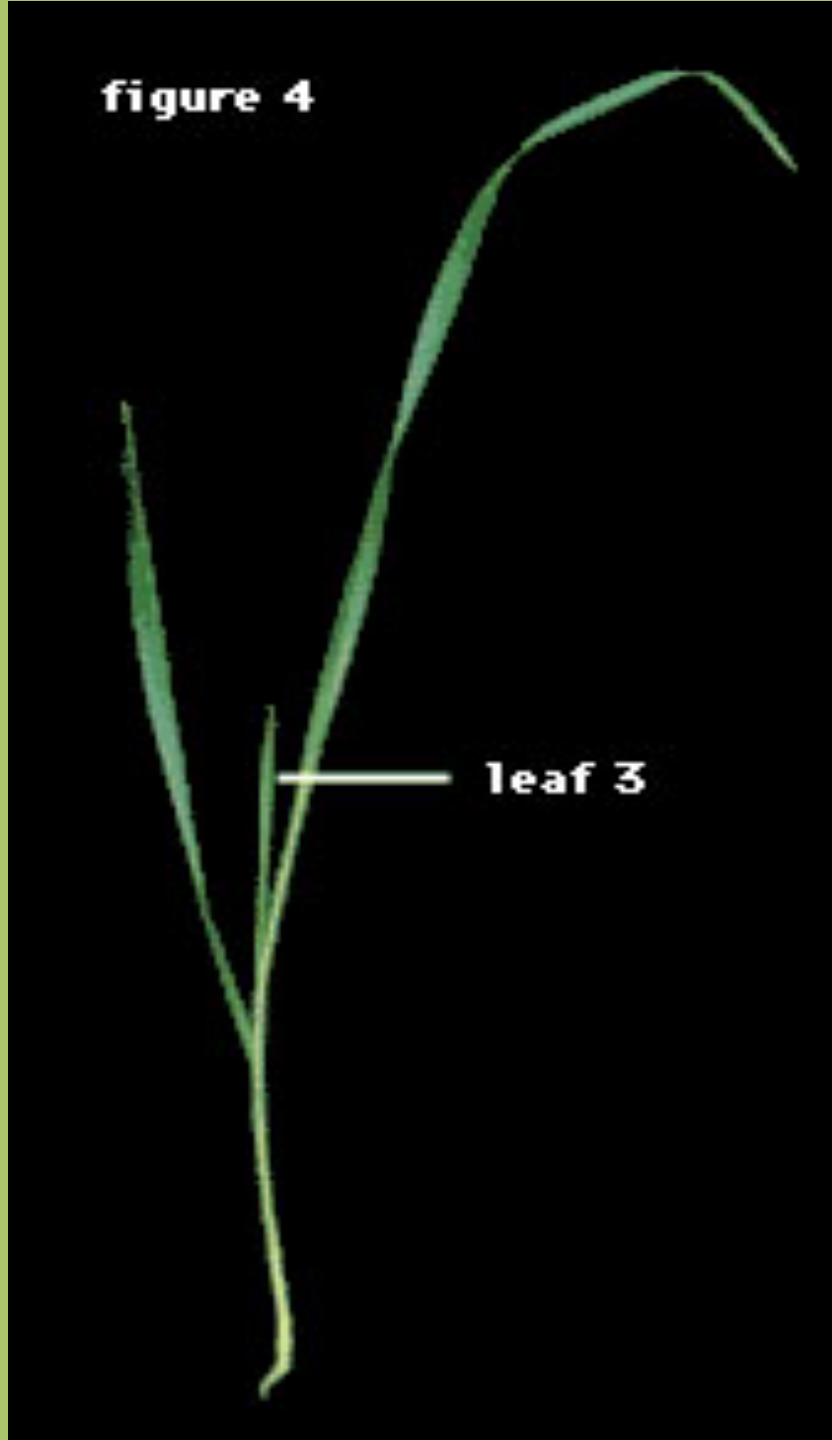

- Seminal roots emerge from the coleoptile node
- Coleoptile will extend no more than 3”



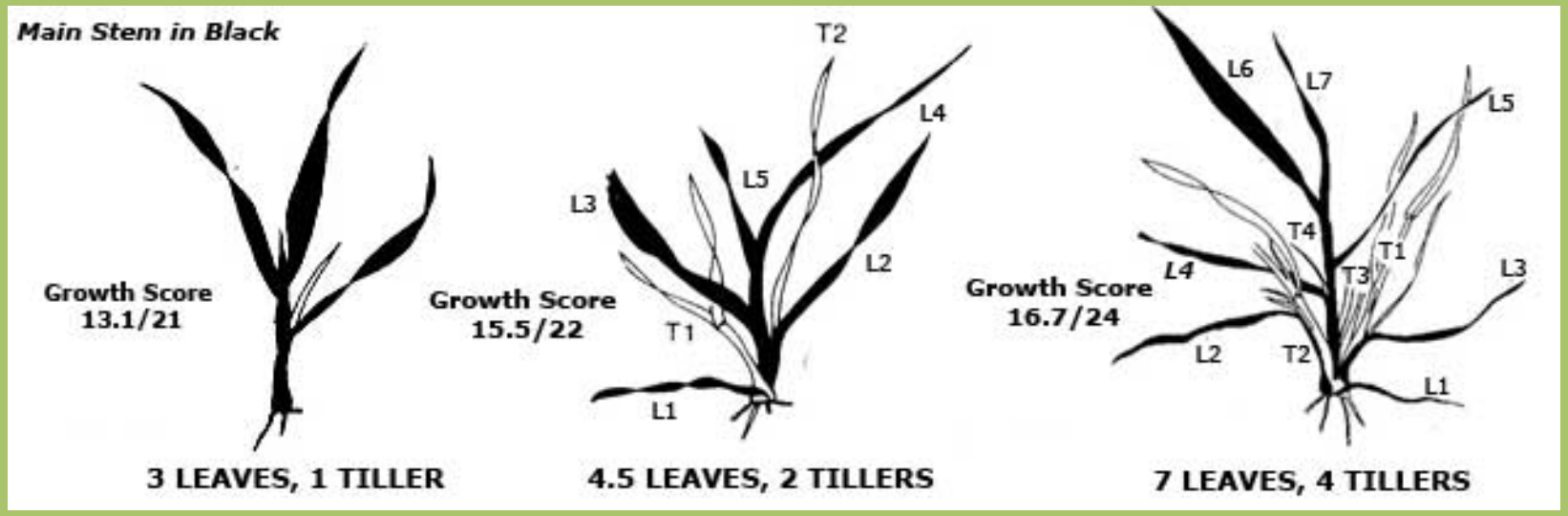

- Subcrown internode between the coleoptile node & subcrown node does not elongate if seed is planted 1" deep. It can elongate up to 4 inches.
- Second root system, crown roots emerge from subcrown & other nodes
- Complete emergence, 1st leaf is 50% emerged from coleoptile & expanding
- Growing point remains at the crown until stem elongation.

## Seedling Development – stage 13

- 730 GDD to develop 6 leaves if planted early enough
- Leaves develop on main shoot (3-4 days/leaf) while tillers develop simultaneously
- Tillering begins after 3 leaves develop (stage 13)
- Applying nitrogen at planting to promote tillering



# Tillering – stage 21 - 24




- More tillers with nitrogen, cool temps, light, low seeding rate.
- Tillering last about 2 weeks
- > 1 tiller may form from each leaf axil
- Some tillers typically die after 4 weeks depending on stress.
- Seed heads begin developing @ 4-leaf stage on each tiller & before stem elongation.
- Growing point protected from growth regulator herbicides

## Nitrogen

- Nitrogen at planting promotes tillering and in early spring for winter annuals will promote final tillering.
- Nitrogen after tillering increases grain protein (good or bad depending on use)
- Split N applications reduce lodging
- N is needed throughout the growing stages (fertilizer or nutrient cycling)
- Applying manure or compost to the crop may increase weeds. Apply manure & composts months before the crop
- Measuring soil organic matter and nitrates will help you manage nitrogen
- Traditionally we do not plant small grains after a sod to prevent lodging.

## Stem Elongation – stage 30

- Internodes elongate, hollow
- Growing point rises above the soil
- Seed head continues developing, nutrient sink
- Growth regulator herbicides can cause crop damage
- Apply additional N at jointing to increase protein and yield

## Boot (40) & Heading Stages (50)

- Flag leaf collar visible
- Head swelling in flag leaf sheath
- Most of photosynthate for grain comes from flag leaf & penultimate leaf
- Number & kernel length determined already
- Barley flowering begins in the boot & ends when head fully emerges (less head blight)
- Wheat flowers after head emergence
- One day to fertilize a floret
- Pollination 1 week, except in rye (2 weeks)

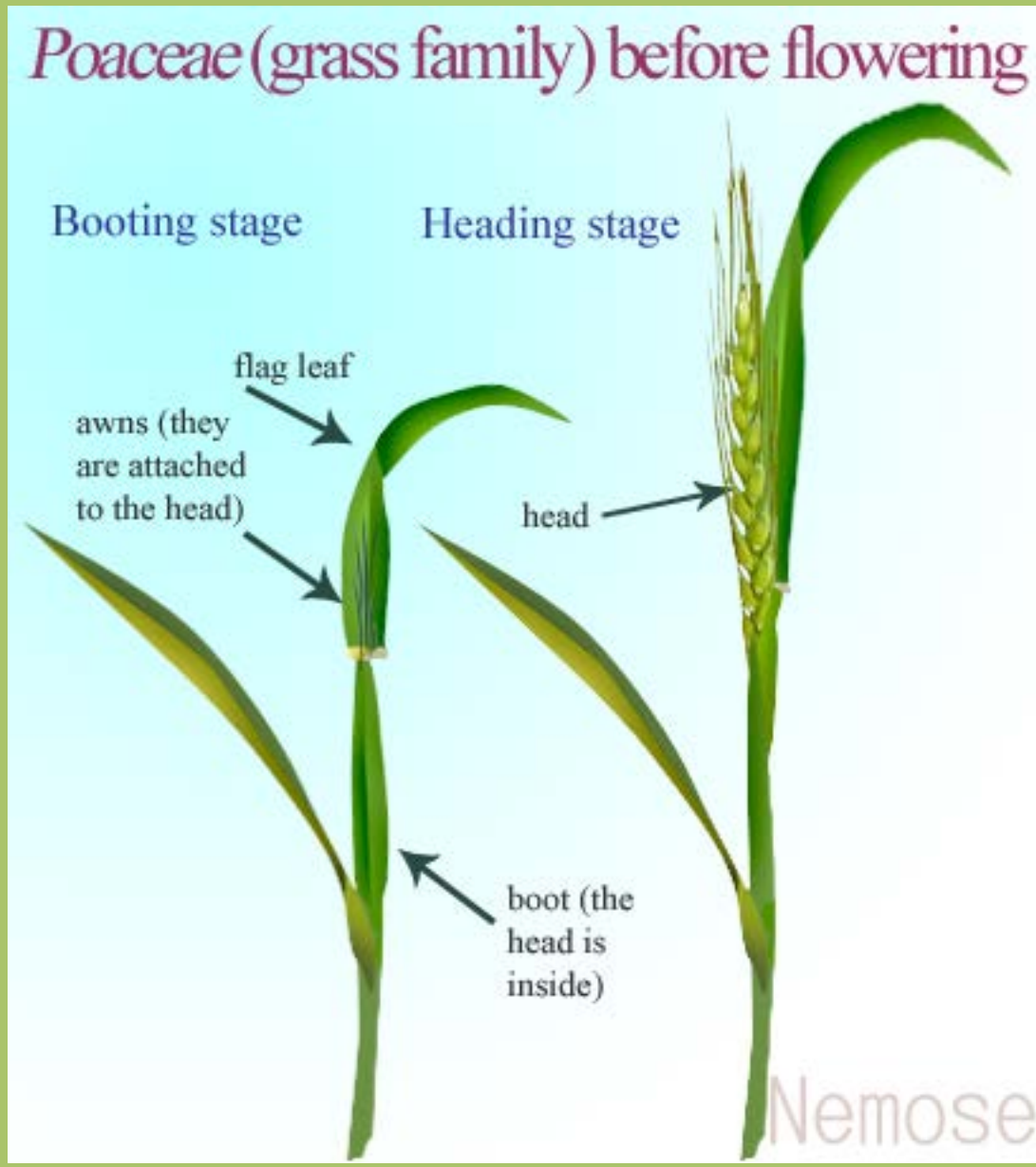


Figure 2. Stages of barley at or near spike emergences.

Figure 1. Stages of wheat at or near flowering.

## Flowering – stage 60

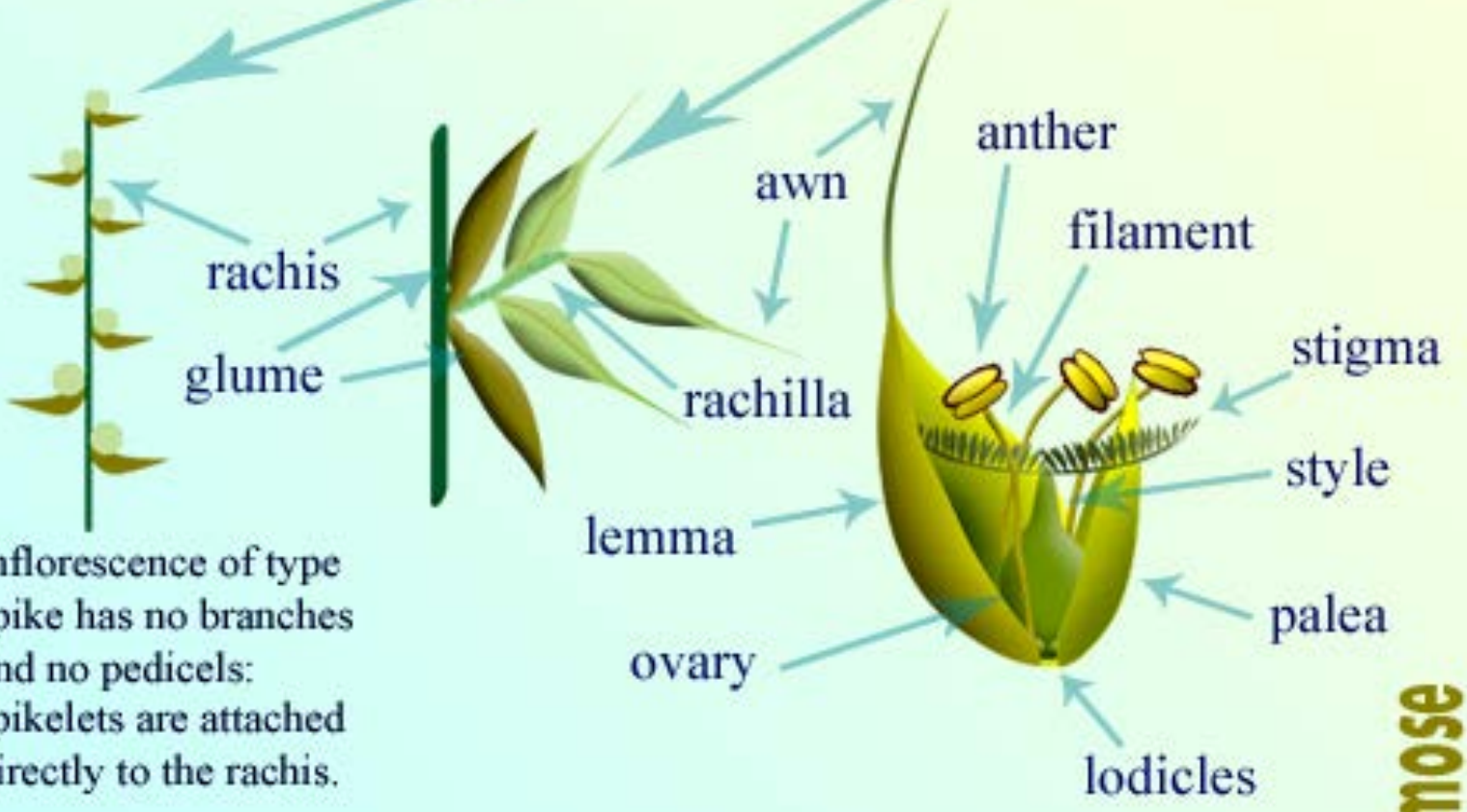
- Wheat, barley, oats self-pollinate
- Rye cross pollinates (longer time, more susceptible to ergot)
- The time to apply fungicides is at very first anthesis, but earlier is better than later
- Pollination begins in the middle of the head and moves up & down

# Monocot reproductive anatomy

Inflorescence type - **spike**

Flowering unit - **spikelet**

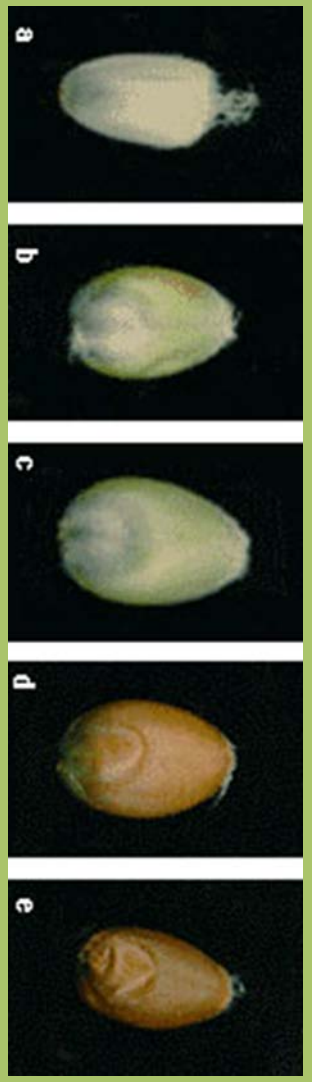
Individual flower - **floret**




Inflorescence of type spike has no branches and no pedicels: spikelets are attached directly to the rachis.

Nemose

# Milk (7) & Dough Stages (8)

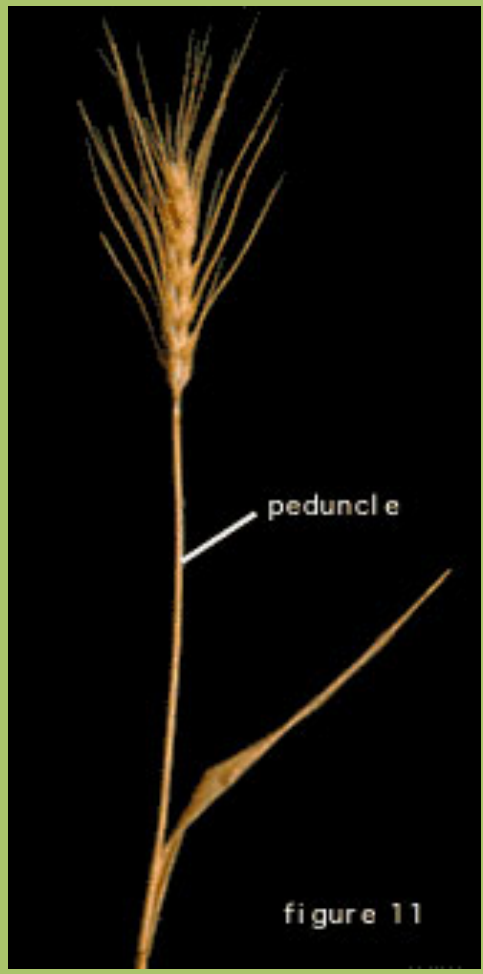



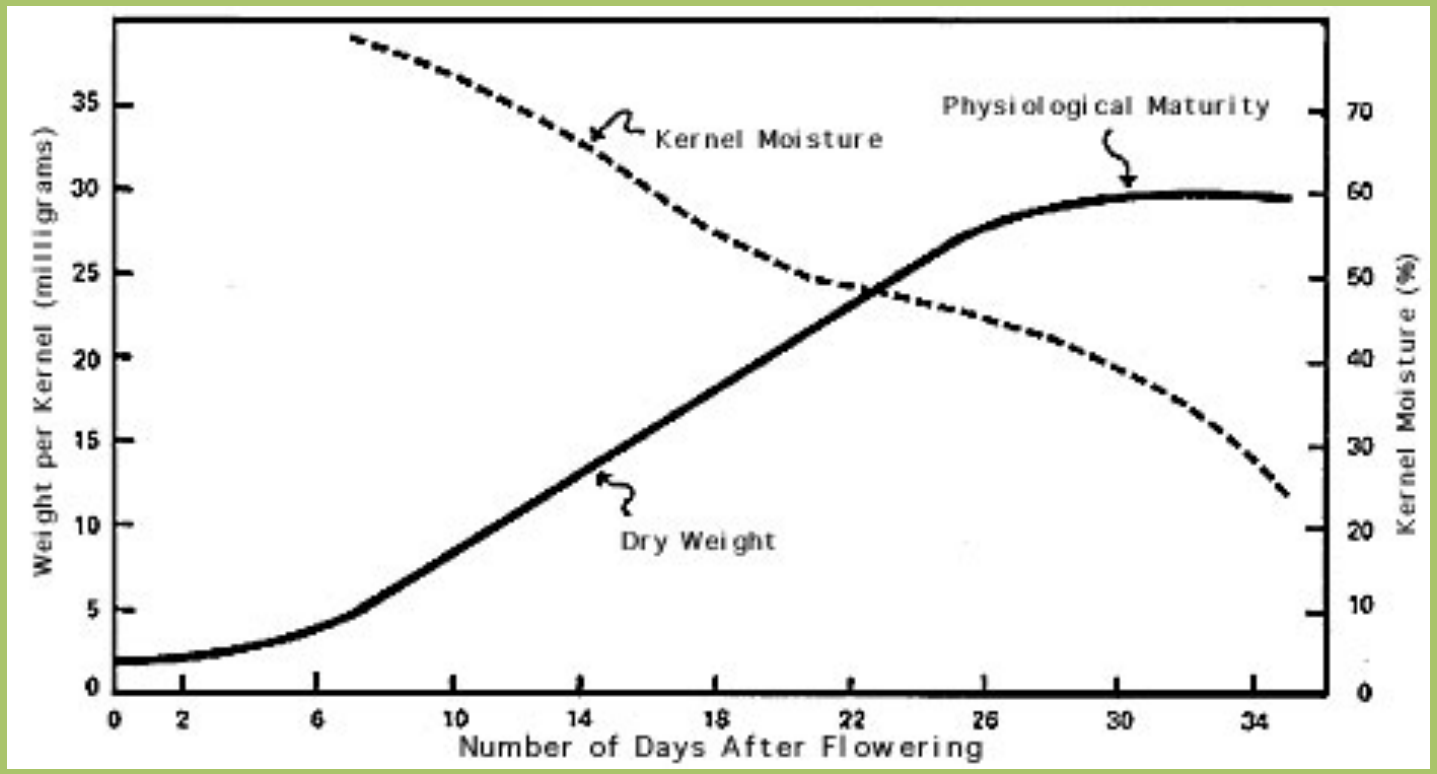

- Kernel weight, plumpness determined
- Starch more affected than protein:

  high temp & low moisture = low starch
- Health of upper canopy is critical

# Ripening – stage 9

- Fully ripe when head and peduncle have lost chlorophyll
- 25% - 35% moisture
- Pre-harvest sprouting increases with high temps just prior to seed maturity and several wetting / drying cycles.
- PHS also affected by head angle & awns which absorb more water





Physiological Maturity
Kernel Moisture
Dry Weight
Weight per Kernel (milligrams)
Kernel Moisture (%)
Number of Days After Flowering
0
5
10
15
20
25
30
35
0
10
20
30
40
50
60
70
0
2
6
10
14
18
22
26
30
34

# Questions?