

Introduction

First-grains is the term used to describe early ancestors of wheat and other modern day grain varieties. These ancient grains include three main types: spelt, emmer and einkorn. There are many differences between first-grains and modern wheat, one of which is the seed. First-grains seeds are hulled, like barley, though the hulls are much larger (figure 1). Unlike common spring wheat, none of these ancient grains are free threshing, meaning that the seeds do not break free from the hull when harvested¹. Also, spelt and emmer commonly have two seeds in a single hull and can produce two plants from that hull¹. This is a significant difference and can affect certain factors such as seeding rates and population targets. To better understand these ancient grains, seed counts, seed weights and germination tests were studied to look at the differences between these crops.



Figure 1. (Left to right) Seeds/hulls of Wheat, Spelt, Emmer, and Einkorn

Methods

Table 1. Crop descriptions of seed used

| Crop | Wheat | Spelt | Emmer | Einkorn |
|------------|-------|--------|--------|-----------|
| Variety | SY605 | Origin | Lucile | Stone Age |
| Hull | No | Yes | Yes | Yes |
| Seeds/Hull | 1 | 2 | 2 | 1 |

Seed Counts (seeds/hull)

Seed counting was done for spelt, emmer and einkorn to determine whether one or two seeds were in the hulls and how often that occurred. 150 hulls for each variety were counted, then dehulled and seeds were counted.

Germination Test

Germination tests were performed two different times for spring wheat (control), spelt, emmer and einkorn. There were nine seeds/hulls (Fig. 1) of each crop placed into a germination plate on top of a saturated germination paper (Fig. 2). The squares were wrapped in parafilm, placed in an incubator set at 20°C and left until germination (5-6 days). Three replicate plates of each seed type were done for each test, giving a total of 6 plates and 54 seeds per crop. The plants that germinated were counted (Fig. 3).



Figure 2. Germination square with spelt hulls.

Figure 3. Germinated plants of all 4 crops. From left to right spring wheat, spelt, einkorn, emmer.



Seed Weight (seeds/lb)

Five sets of 1,000 seeds/hulls of each crop were counted using an Agriculex Inc. seed counter and weighed in grams. Seed weight was calculated by dividing seed number by weight giving seeds per gram. These weights were used to make further calculations.

In-Field Stand Assessment

Stand counts were performed in test plots by counting plants in a 1m row, 3 times for each plot. Population was calculated by taking the sum of the stand counts for one plot and dividing it by ((row spacing (ft.) x sample size (ft.) x number of rows)/sq. ft/a). This population number was compared to the target population (Fig.4).

Results

Small percentage of ancient grains may be free threshing or not viable

In both spelt and emmer, 272 seeds were counted from 150 hulls, with 300 seeds being the expected number. In einkorn, 148 seeds were counted from 150 hulls, with 150 seeds being the expected number. Approximately 9% of spelt and emmer seeds and 1% of einkorn seeds are either free threshing or did not mature.

Spelt and emmer have lower germination rates than wheat and einkorn

The germination tests indicated that spring wheat and einkorn both germinated at 100% in both trials. Spelt germinated at approximately 90% and emmer germinated at approximately 92%. It was assumed that spelt and emmer had two seeds in each hull, but two plants did not always germinate from one hull, possibly because the seed threshed free and possibly because it was not viable.

Actual field populations were lower for einkorn and emmer than expected based on actual seeding rate

Spring wheat, spelt, emmer, and einkorn were seeded in a dryland study at a rate of 60 lbs/a with a target population of 640,000. Using the data collected, the actual seeding rate and the target population were compared (Table 2).

Table 2. Average seed weight of each crop and calculated seeds/a at a 60lb/a seeding rate

| Crop | Average Seeds/lb | Target Seeding Rate | Actual Seeding Rate | Actual Avg. Population |
|--------------|------------------|---------------------|---------------------|------------------------|
| Spring Wheat | 10,604 | 640,000 | 636,240 ± 146 | 708,111 ± 65,476 |
| Spelt | 8,201 | 640,000 | 492,060 ± 349 | 493,318 ± 101,756 |
| Emmer | 11,407 | 640,000 | 684,420 ± 170 | 592,453 ± 67,084 |
| Einkorn | 17,356 | 640,000 | 1,041,360 ± 601 | 658,544 ± 93,674 |

Discussion

Understanding seed differences between modern wheat and first-grains can be very crucial for growers and eliminate confusion that comes with growing a new crop. Knowing that seed weights differ can impact seeding rates and adjusting correctly can help ensure that the desired target populations are achieved. In the graph below (Fig. 4), target populations were not met because all seed was treated the same, leading to lower populations in emmer and spelt than expected. Being aware of two seeds in a hull vs. one seed can also yield more accurate results. Dealing with and planting these hulled ancient grains is not an easy task, but understanding seed counts, weights, germination rates and other data can maximize success.

Actual Field Populations

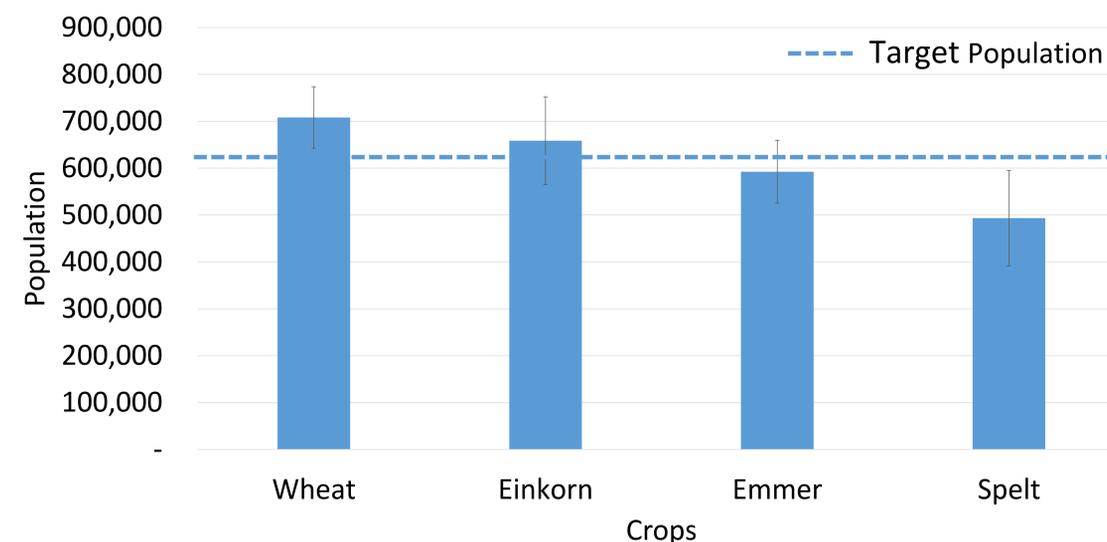


Figure 4. Actual field populations based on stand counts performed on dryland trial on 6/12/19. Seeded at 60 lb/a with target population of 640,000 (blue line).

Sources

1. Stlkalnecht, G., Gilbertson, K., & Ranney, J. (n.d.). Alternative Wheat Cereals as Food Grains: Einkorn, Emmer, Spelt, Kamut, and Triticale. Retrieved from <https://hort.purdue.edu/newcrop/proceedings1996/V3-156.html>

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