EVALUATION OF SELECTED TEFF ([*ERAGROSTIS TEF (ZUCC.)* TROTTER]) VARIETIES IN OKLAHOMA

By

MICHAEL DENIS REINERT

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EVALUATION OF SELECTED TEFF

(*[ERAGROSTIS TEF (ZUCC.)* TROTTER])

VARIETIES IN OKLAHOMA

Thesis Approved:

Dr. Art Klatt

Thesis Adviser

Dr. Bill Raun

Dr. Kefyalew Desta

Dr. Sheryl A. Tucker

Dean of the Graduate College

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CHAPTER I

INTRODUCTION

The introduction of a new crop into a region is a way to help with both medical issues and it enhances the exposure of one culture to another. Teff has the potential to be one of those crops with beneficial health factors such as low gluten for individuals that are unable to consume wheat products due to gluten (gluten intolerance or Celiac disease) (Davison et al. 2010). Teff originated in Ethiopia around 4000-1000 BC and is a warm season (C4) plant with a fibrous root system (Stallknecht, 1997; Ketema, 1997). The crop was brought to the United States by immigrants just like many other crops, with people wishing to maintain part of their culture.

Teff is becoming known as a 'health' food among consumers, who are currently demanding more of the grain. East African restaurants and their cuisines are mushrooming everywhere in the US, including Oklahoma. All of these businesses depend on teff grain for the production of injera and distributors are encouraging the production of teff in the US. Many teff distributers are losing their steady supply and are looking for the local production of teff to satisfy the demand for the teff flour. The sustainable supply of teff flour for restaurants and markets catering to immigrant communities, for industries (health and baby food), and for local residents for use in different recipes requires producing the crop locally, rather than relying on a non-dependable import.

The solution to developing a plentiful supply of teff will require conducting appropriate research to identify high yielding and adaptable varieties, as well as determining appropriate management practices. In this study, several varieties of teff were evaluated for adaptation and yield in Oklahoma. Some of the varieties tested are currently being grown in other areas of the United States, such as in Oregon, Washington, and Idaho, and in addition some new varieties imported from Ethiopia were evaluated.

CHAPTER II

LITERATURE REVIEW

Benefits of Teff

As food for human consumption, teff has unique qualities in that it contains high levels of several minerals such as iron, magnesium, calcium, phosphorus, and it also contains the vitamin thiamine (National Research Council, 1996). It contains high levels of essential amino acids; especially Lysine, which is not commonly found in our traditional small grain cereal crops at such high levels (Spaenij-Dekking et al, 2005). Additionally, it is low in gluten and it can be an important component of the diet for gluten intolerant, Celiac patients (Stallknecht et al., 1993; Davison et al. 2010).

Teff makes excellent quality straw, and the straw is equally important as the grain. It is preferred more than other cereals' straw especially for animal feed because of its palatability during the dry season (Hunter et al., 2007; Nsahlai et al., 1998; Twidwell et al., 2002). Teff has been grown by different colleges and research entities around the United States and was found to have comparable nutritive value to several grasses already being grown for forage. In some cases the nutritive value was actually better than the traditional forage crops grown for animal consumption (Miller, 2010).

Agronomic Aspects of Teff

Environmentally related problems as a result of chemical pesticide usage on teff production are generally smaller than for other commonly grown cereals since teff is relatively resistant to pests and diseases, but more so because there is no herbicide directly labeled for teff (Ketema, 1997). A producer growing alfalfa with a stand that is starting to thin out can over seed the alfalfa with teff and grow the crops together to produce one more year of exceptional forage before plowing under the alfalfa (Norberg et al., 2005). Teff can also be used as a rotational crop for alfalfa for one or two years (Hunter, 2007).

In an average year with a good supply of moisture, teff can be expected to produce anywhere from 5 to 12 t ha^{-1} of total biomass (2 to 6 t a^{-1}, Girma, 2008). Teff can be harvested at a shorter height; 7.6 -10.2 cm (3-4 inches) allowing more forage for hay and will re-grow quicker than other grasses when moisture is adequate(Griggs, 2008). Within every crop there are different phenotypic and genotypic traits that benefit each variety. These differences can range anywhere from a shorter plant allowing more energy to be devoted to grain production or having a different physiological appearance so insects do not infest one variety as bad as the others. As forage biomass increases, the teff plant is expected to produce more grain yield; however, this does not prevent plant lodging (Mengesha et al., 1965). Physiological factors also help the plant during an extremely dry year because teff can produce a deeper root system for greater moisture and mineral mining. Teff has been shown to perform well with 56 to 100 Kg ha^{-1} (50-100 lbs ac^{-1}) of available nitrogen in a split application (Miller, 2010).

In order to receive uniform germination with teff, the soil should be firm with adequate moisture and teff seed should be planted no deeper than 6 mm (1/4 in, Miller, 2010). The area that is being planted should be free of weeds because teff does not compete well against weeds at a juvenile age, and weed pressure can lead to significantly lower yields of both grain and forage (Debelo, 1992). After planting, light irrigation is ideal to help establish the crop and the root system (Stallknecht, 1993). Teff has a very small seed (1.25 million seeds per pound) and is normally seeded at the rate of 3.3 million seeds per hectare. Teff is not one of the world's main cereal crops grown for human consumption (Davison, 2006). However, this is potentially a quick growing crop for small niche farmers in the wheat belts of USA, Canada, and Australia, who are able to produce a crop with limited inputs, but with high returns for both livestock and human consumption (Stallknecht et. al., 1993; Ketema, 1997).

Teff is becoming a very good alternative crop in many states. Teff grows and completes its life cycle very fast; about 90 to 100 days from emergence to maturity in normal years. Teff gives reasonable yield when other cereals' yield is depressed significantly due to low moisture conditions. Teff's performance under these conditions are attributed to its fast growth and hastened physiological maturity, plus effective use of residual moisture. If not utilized for grain, it can be grazed by cattle, horses, or harvested for hay at any growth stage. Unlike common cereals grown in Oklahoma, teff has the ability to tolerate seasonal water logging conditions. The crop grows well in Veritsols such as Osage clays that have a water logging condition when precipitation is high.

CHAPTER III

OBJECTIVES

We hypothesized that teff can be an alternative crop in water stressed production systems. In addition, it has the potential to reduce the risk of farming by increasing crop options, specifically since teff is a dual purpose crop with fast growth and tolerance to moisture stress. The goal of this study was to evaluate the possibility of adding crop diversity and creating economic opportunities by adding teff into the cropping system of small farmers in Oklahoma and neighboring states. Specific objectives were to:

- Evaluate under field conditions the suitability of grain and forage yields of various teff varieties newly imported from Ethiopia as well as varieties already being grown in the continental US.
- Assess varieties yield potential under greenhouse conditions.
- Assess seed production, biomass production, and plant height of varieties under greenhouse conditions.
- Evaluate different planting dates of one variety (Desie) under field conditions to determine optimal planting time.

CHAPTER IV

MATERIALS AND METHODS

Variety study

We evaluated the performance of 10 and 15 varieties of teff in the field in the summer of 2010 and 2011, respectively. In both years, field studies were conducted at Lake Carl Blackwell (Port silt loam-fine-silty, mixed, thermic Cumulic Haplustolls) and the Stillwater Agronomy Research Station (Kirkland silt loam- fine, mixed, superactive, thermic Udertic Paleustolls), Stillwater, OK.

In the summer of 2010 we evaluated 10 varieties which were obtained from seed of a previous study of Dr. Kefyalew Desta. This study was established before the seed from Ethiopia arrived in the fall of 2010. However, the results from only four of these varieties are included in this research to complement the 2011 field trials and all three greenhouse trials. The two greenhouse (fall of 2010 and spring of 2011) studies allowed us to triple the seed stock of each variety for the 2011 field studies.

In the greenhouse, we evaluated 15 varieties under non-limiting water and nutrients and under optimal temperature conditions. The experimental design for this controlled study was a completely randomized design (CRD) with six replications. The plants were grown in pots 20.32cm (eight inch diameter), which permitted taking grain and forage yields along with the plant heights. Pots were seeded at a rate of 30 seeds per pot. Dry weight (grams per pot) was recorded to give a biomass measurement (seed included). We then threshed out the seed and took varietal grain yields. Additionally, we scouted each pot for insect and disease infestation, particularly for bird cherry oat aphid (*Rhopalosiphum padi* L.) based on previous observations (Michael Reinert, personal observation).

In 2011, all 15 varieties of teff were planted at Lake Carl Blackwell and at the Agronomy Research Station, Stillwater, OK on May 18th and 19th, 2011. Plots were 1.5 m wide and 3 m long (≈5' x 10'). The experiment was laid out in a randomized complete block design with two replications. Teff was manually planted in each plot at a seed rate of 10 kg ha^{-1} and lightly irrigated thereafter until the crop was completely established. Given the drought conditions we encountered in the 2011 summer, all plots received supplemental irrigations throughout the season as needed.

Soil samples were taken before planting to correct nutrient deficiencies (nitrogen N, phosphorous P, and potassium K). Nitrogen was top-dressed as needed (observation of yellowing of leaves) near the booting stage using Urea (46-0-0). The nutrient requirements for this new crop in Oklahoma were based on a study that evaluated the crop's response to N application along with the other major nutrients P and K (Girma et al., 2012). According to the results of the fertility study, a maximum of 67 kg ha^{-1} N (59.8 lbs/acre) is needed for a grain yield goal of 1.2 t ha^{-1}. P recommendations should be based on soil test results using the weeping love grass recommendations previously developed at Oklahoma State University (Zhang and Raun, 2006). Urea (N) was broadcasted by hand. Broadleaf weeds were controlled with 2,4-D while no herbicide was found to eliminate the grassy weeds and not injure the teff due to taxonomically similarities.

Measurements taken included plant height, percent lodging, and forage and grain yields. At maturity teff was harvested manually using sickles from 1 m^2 (3.3'x 3.3'), dried in an oven at 42˚C (107˚F) for 7-10 days. In 2011; visual observations were collected in the field on plant fertility needs based on yellowing of plant leaves. The visual observations also focused on scoring insect pressure (aphids), assessing plant vigor, and seed development/uniform pollination in the panicle.

In the greenhouse, all plants in each pot were harvested by hand. The greenhouse samples were hand threshed since they were small samples and then were cleaned by hand as well. This limited the potential for seed loss. The threshed and cleaned teff seed was weighed to determine grain yield. Field samples were threshed and cleaned using a custom made belt thresher (Noble Foundation Forage Laboratory), and cleaned using an air-screen cleaner (Westrup Inc., Plano, TX).

Data were subjected to ANOVA using GLM/MIXED procedures in SAS. Significance was declared at $p<0.05$ probability level for all variables unless specified. The relationships between some measured variables were evaluated using correlation analysis.

Planting date study

The planting date study was initiated on the 27th of May, 2011 in the Agronomy Research Station in Stillwater, Oklahoma. The variety Desie was planted in a 4.87 m x 19.8 m (≈16' x 65') plot. These plots were grown for comparison of forage grasses already being used in Oklahoma for livestock.

The strips were planted with a John Deere 450 Series grain drill equipped with a grass seed box. The drill rows were spaced at 15 cm (6 inches) apart. Every two weeks a new plot was planted giving us different growth stages of the crop for forage analysis. The plots were watered for establishment. Once a week, water was applied to help reduce water stress, unless rain was received.

The forage samples were taken once the plant developed a head, maximizing plant height, but before the plant started the process of senescence. The sample area consisted of 3 randomly selected samples within each plot in the planting area of 10x10 cm (≈4 x4 in). The sample area was marked with flags to take the re-growth from the same area sampled the first time. Data were processed and analyzed in the same manner as the variety study.

CHAPTER V

RESULTS

The results were obtained over two years in the field. In the first season (2010) only four varieties were reported and in the second summer growing season the same four varieties were tested plus an additional eleven. This made a total of fifteen varieties in the field in 2011 and for two of the greenhouse studies. In the first greenhouse (fall 2010) and field trial (summer 2010) we did not have seed of the variety Desie.

Greenhouse Height Comparison

In all greenhouse trials teff plant height significantly differed ($p<0.0001$) among teff varieties. Height ranged from 94-141, 89-121, and 62-78 cm for each growing season, respectively. The results for all varieties are reported in Figure 1. The mean results, pooled over the three growing seasons, are reported in Figure 2.

Greenhouse Seed Weight Comparison

Seed weight was recorded for each growing season. The maximum and minimum yields were Unknown; 144.63 g/m^2, DZ-01-974; 256.14g/m^2, Unknown; 160.39 g/m^2, DZ-01-128; 280.38 g/m^2, and DZ-01-196; 46.06 g/m^2, DZ-01-99; 118.78 g/m^2 respectively for each growing season. During the third growing season, there were significant differences in seed production between varieties ($p < 0.0001$). Results by variety are reported in Figure 3, with the varietal mean average for all years reported in Figure 4.

No statistical analysis was calculated for the first two greenhouse studies (fall 2010 and spring 2011) for seed weight and plant biomass because the six pots were not harvested individually. The six pots in the greenhouses were bulked and then measurements were taken. For the last greenhouse season (fall 2011), the pots were measured individually, so analysis was possible.

Greenhouse Plant Weight Comparison

Plant weight was recorded for each growing season (Fall 2010, Spring 2011, and Fall 2011 respectfully). The minimum and maximum yields were DZ-01-99; 565.6g/m^2, DZ-01-974; 831.43g/m^2, DZ-01-1681; 712.25g/m^2, DZ-Cr-255; 1006.36g/m^2, and DZ-01-354; 430.66g/m^2, Kuncho; 594.28g/m^2 respectively for each growing season. During the third growing season the amount of plant biomass produced by the varieties was highly significant ($p < 0.0009$). Results by variety are reported in Figure 5, and the varietal means for all three years are reported in Figure 6.

Field Trial Stillwater Oklahoma 2010

The total biomass produced by the varieties in Stillwater in 2010 was not significant ($p = 0.0501$). There was a significant difference between reps ($p = 0.02$); however, the varieties themselves were not significantly different from one another ($p = 0.9$). The amount of total biomass ranged from variety DZ-01-196 producing 1.76

kg/m^2 and variety DZ-01-974 producing 2.45 kg/m^2 as a max yield. Results from all varieties are reported in Figure 7.

Field Trial Lake Carl Blackwell 2010

The total plant biomass between varieties showed no significant differences within the trial. Total plant biomass produced ranged from 3.01 kg/m^2 for variety DZ-01-196 to a low of 2.63 kg/m^2 for DZ-01-354. Results for the total biomass of all varieties are reported in Figure 7.

Field Trial Stillwater Oklahoma 2011

Plant height among varieties did not show a significant difference. The plant heights ranged from 57.17 cm for Desie to 81.75 cm for Kuncho. Plant height of each variety is given in Figure 8. The grain yield of the varieties was not significantly different. Seed weights ranged from 0.35 g/m^2 for variety DZ-01-354 to 7.95 g/m^2 produced for DZ-01-974. The varietal seed weights are displayed in Figure 9. The amount of total plant biomass did not differ significantly. The amount of total biomass produced ranged between 0.34 kg/m^2 for DZ-Cr-255 to 0.99 kg/m^2 for Kuncho. The total biomass for all varieties is displayed in Figure 10.

Field Trial Lake Carl Blackwell 2011

The plant height of the varieties measured at Lake Carl Blackwell in 2011 was significantly different (p=0.0206). The heights varied from 52.09 cm for DZ-01-1281 to 65.34 cm for variety DZ-Cr-387 (Kuncho). All varietal heights are reported in Figure 11. The seed weight of the varieties showed no significant difference. The amount of seed varied from 7.8 g/m^2 produced by Desie to 0.250 g/m^2 produced by variety DZ-01-1278. Seed weight for all varieties is reported in Figure 12. The varietal total biomass showed no significant differences. The varietal total biomass produced ranged from 0.27 kg/m^2 for variety DZ-01-196 to 0.545 kg/m^2 for variety DZ-01-787. Varietal biomass for all varieties is reported in Figure 13.

CHAPTER VI

DISCUSSION

Greenhouse Comparisons

The variety Kuncho performed very well. It is tall and produces a lot of biomass; however, it only performed marginally for seed production across all growing seasons. In 2010, Kuncho was the tallest variety, but was out produced in biomass by variety DZ-01-974, as seen in Figure 1. Kuncho was the only variety to perform consistently for plant height, biomass, and seed weight. The other varieties performed marginally well; however, the "Unknown" variety consistently performed very poorly. Its performance was probably due to the harsh growing conditions in Oklahoma. The "Unknown" variety could be poorly adapted to the hot and dry weather conditions in Oklahoma.

Kuncho is a variety that originated in a warmer climate so the climatic differences did not affect this variety as negatively as the "Unknown" variety but instead enhanced its performance. Seed production of Kuncho was less than expected. Some of the variation between the varieties can be explained by their location in the greenhouse. The heat was not equally distributed between the two tables used in the greenhouse. One table had air temperatures about five degrees cooler than the other table which delayed germination and reduced vigor of the 36 pots grown on the cooler table (data not shown). The entries on the cooler table also developed more slowly.

The soil used was a mixture of potting soil and clay. The clay was used for its water holding properties and the potting soil provided organic matter and starter nutrients. The clay worked really well, but it made washing the roots a little more time consuming. In the third growing season, sand was substituted for the clay and the amount of potting soil was reduced. The same amount of nutrients were supplied as in the previous two growing seasons, but due to the settling of the sand, the roots had a harder time growing and this caused a loss in plant vigor, which caused a uniform reduction in plant growth in the final growing season.

Field Trial 2010.

Only four of the ten varieties planted in the field trials in 2010 were reported. The same 4 varieties were included in the field trials of 2011 and in the greenhouse studies. The field study at the Lake Carl Blackwell (LCB) station in 2010 was under irrigation, which improved plant biomass production, in comparison to the 2011 results at the same location. The varieties also were positioned adjacent to one of the irrigation wheels and this area normally holds water a couple of days longer after the irrigation was complete. Water was not a limiting factor. Lodging of the plants also occurred on all the plots because of the excess plant height. In Stillwater in 2010, there was no irrigation so the environment was more of a factor. Weeds were removed by hand when the populations started to grow at both locations. No herbicide was applied to the teff varieties during any of the variety studies. Missing measurements made the plant height and seed weight impossible to analyze statistically.

Field Trial 2011

In the 2011 summer growing season, trials of 15 varieties were planted at both locations using seed produced in the greenhouse in fall of 2010 and spring 2011. Only two reps per location were planted due to seed supplies. If we had produced more seed, more reps would have been planted in the field. The varieties received a light watering for establishment. After a month of no rain, the leaves started to curl and turn brown and irrigation was applied to bring the moisture level to the 15-year average precipitation at both locations (Stillwater; June 5.4" July 3.74" and August was 3.3" LCB; June 4.25" July 4.5" and August 4.03"). This allowed the plants to grow, but due to the extreme heat and lack of precipitation in 2011, growth was limited.

The varieties tended to grow taller at the Stillwater station than at LCB. This could be due to soil compaction at LCB, making it harder for the roots to penetrate the soil profile, so they could not mine for moisture. Every variety at LCB just grew less in comparison to Stillwater. I believe this was more of a soil issue rather than a chemical residual issue.

Planting Date Preliminary Results

The results of the planting date trial were inconclusive. Due to extremely high temperatures during both the day and night, plant growth was limited. The area planted to this study had a high weed population which limited plant growth as well. A herbicide was applied over the top to eliminate the broadleaves; however, grass species became a problem after the limited rainfall and irrigations were applied. The grass species were taxonomically similar to teff, therefore very difficult to remove with a herbicide application. Plants grown in this study never grew to the potential that was indicated by the variety study in the greenhouse. Desie was used; however, data from the variety study would recommend against using Desie. Uniform plant stand was never established, which could have been due to either planting the seed too deep or the seed being eaten by insects. After planting one area, two days later harvester ants had removed most of the seeds within a one foot diameter from their den.

CHAPTER VII

CONCLUSIONS

The objectives of this study were to evaluate teff varieties in Oklahoma's environment and to identify the top producing varieties. Upon achieving these objectives teff will be promoted at field days as an alternate food and feed crop. Two varieties, DZ-01-974 and Kuncho performed well in all three categories; plant height, seed weight, and biomass. Considering only biomass production, Kuncho, DZ-01-196, and DZ-01-974 all grew tall and produced larger amounts of biomass. Looking at seed as the end goal, variety DZ-01-974 proved to be superior.

In the field trail, Kuncho grew the tallest and also produced the most biomass in Stillwater so for grazing or hay production this would be the variety to plant, and these results were similar to our greenhouse studies. For seed production, DZ-01-974, produced the most seed in both the greenhouse and field. This variety performed well in all three categories.

Our results indicate that the best varieties for further study in Oklahoma are Kuncho and DZ-01-974. The best management practice is planting the seed on a firm surface; much like alfalfa, and then irrigating lightly, followed by a subsequent light irrigation the next day. This process tends to give the best stand count with such a small seed. Further studies of this crop for forage or seed should evaluate more varieties and planting dates in order to identify better management practices for growing teff in Oklahoma.

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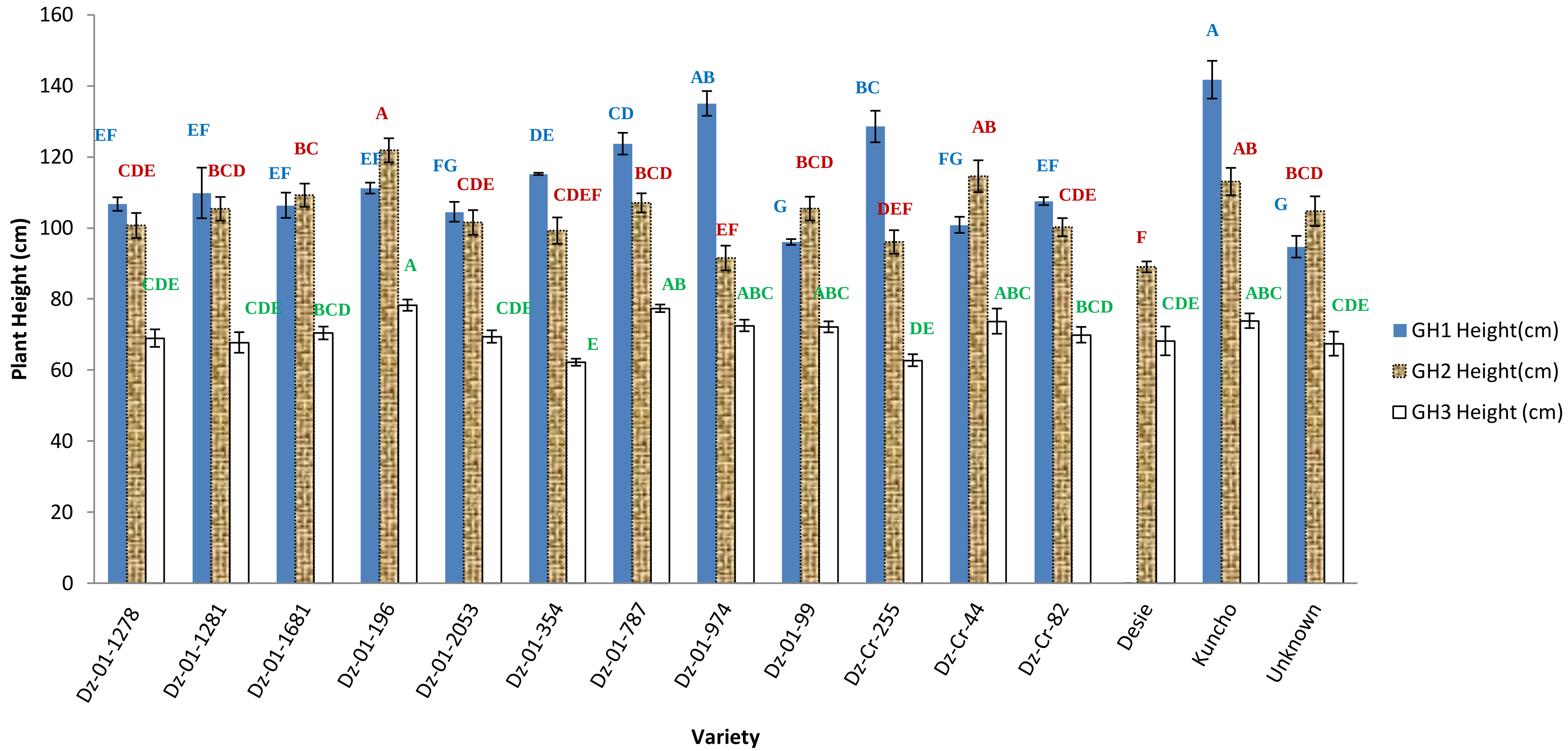
FIGURES



*No data for Desie; fall 2010

Figure 1. Plant height (cm) of all growing seasons (fall 2010, spring 2011, and fall 2011) in the greenhouses located at the Stillwater Agronomy Research Station. Within each GH, variety means followed by the same letter are not statistically different at p<0.05 level using Duncan. Multiple Range Test.

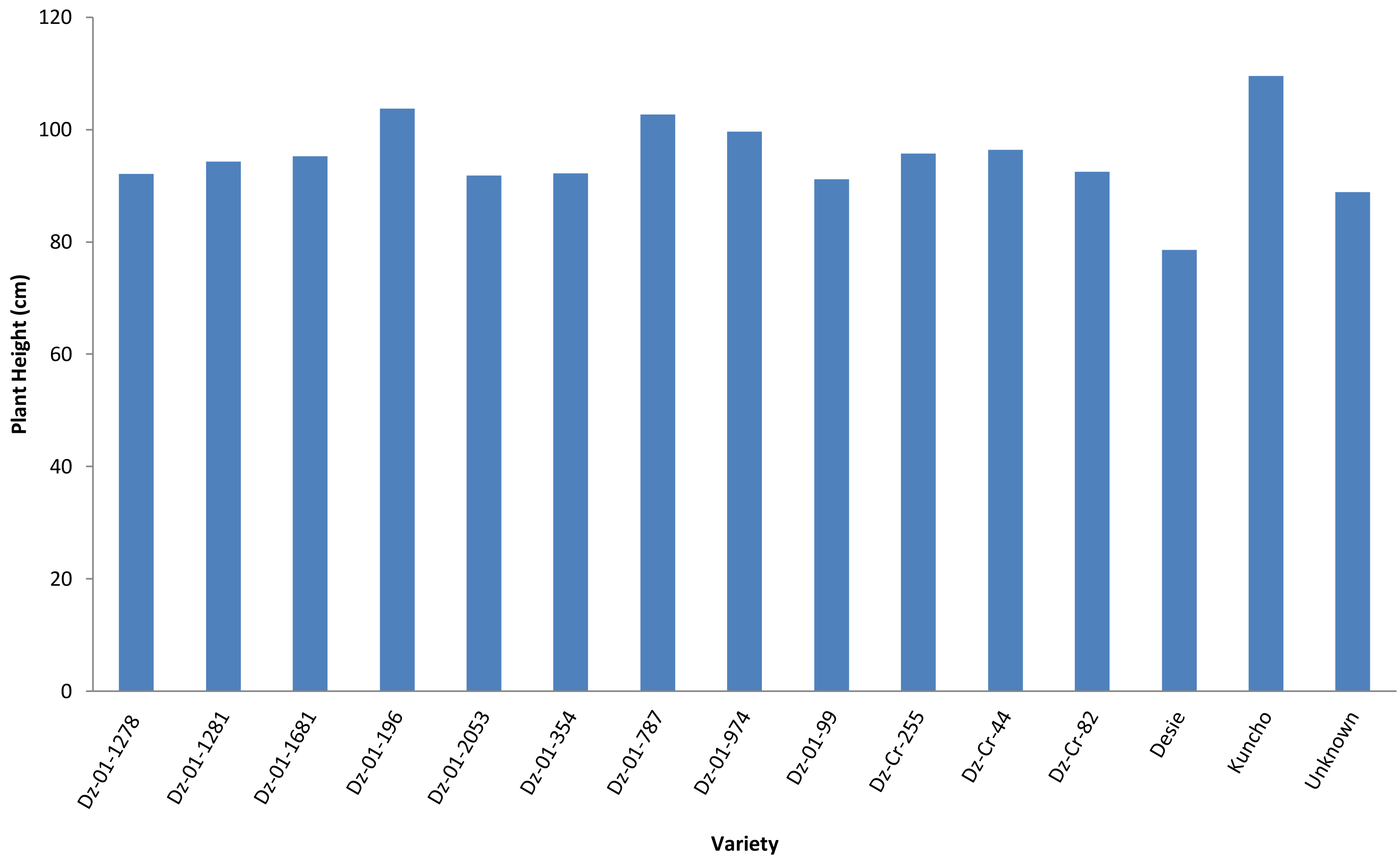
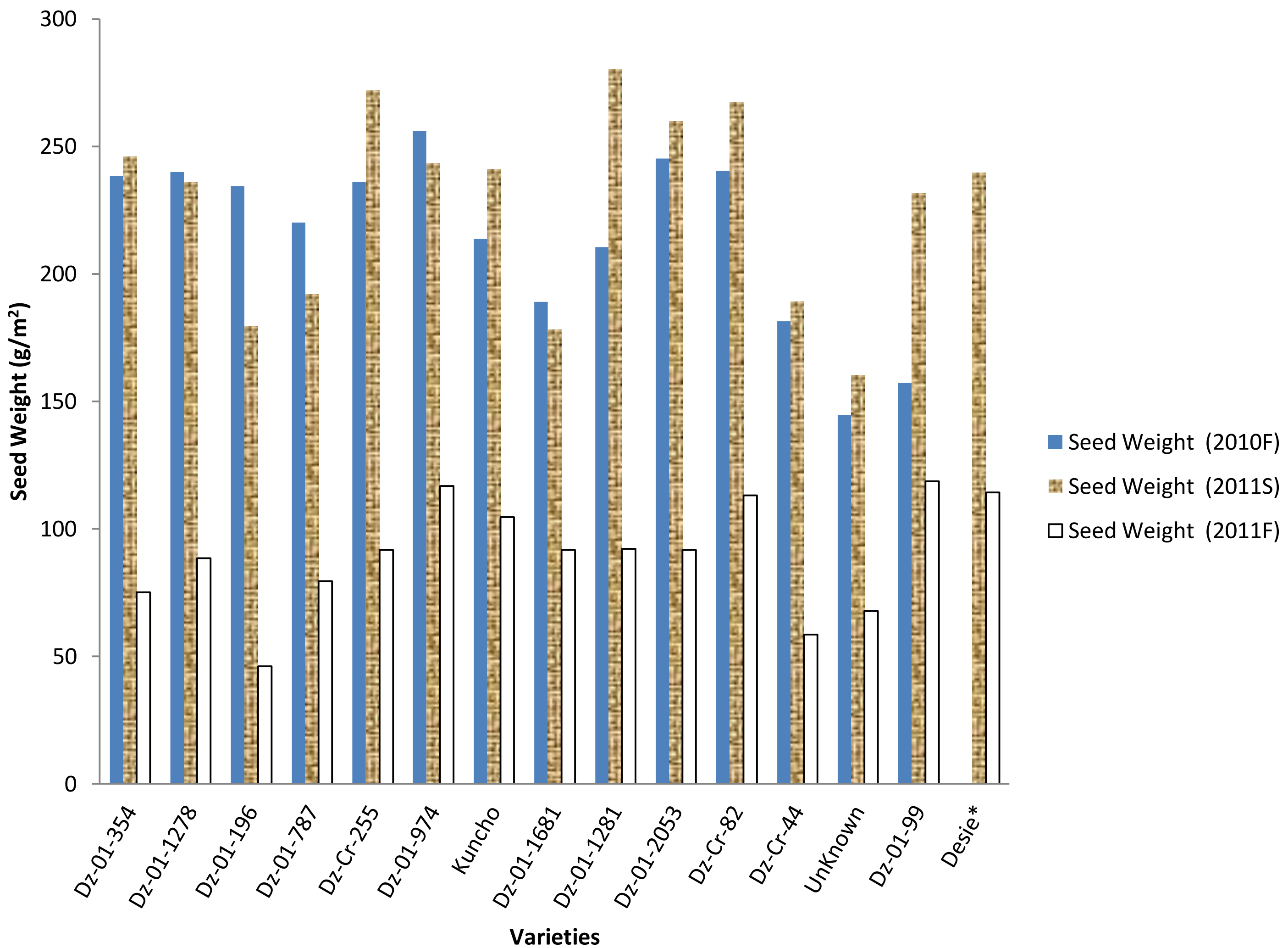


Figure 2. Average plant heights (cm) of the 15 varieties grown in the greenhouse for three growing seasons (2010-2011).



*No Data for Desie ; fall 2010

Figure 3. The total seed weight (g/ m^2) of each variety for the growing seasons (fall 2010, spring 2011, and fall 2011) in the greenhouse.

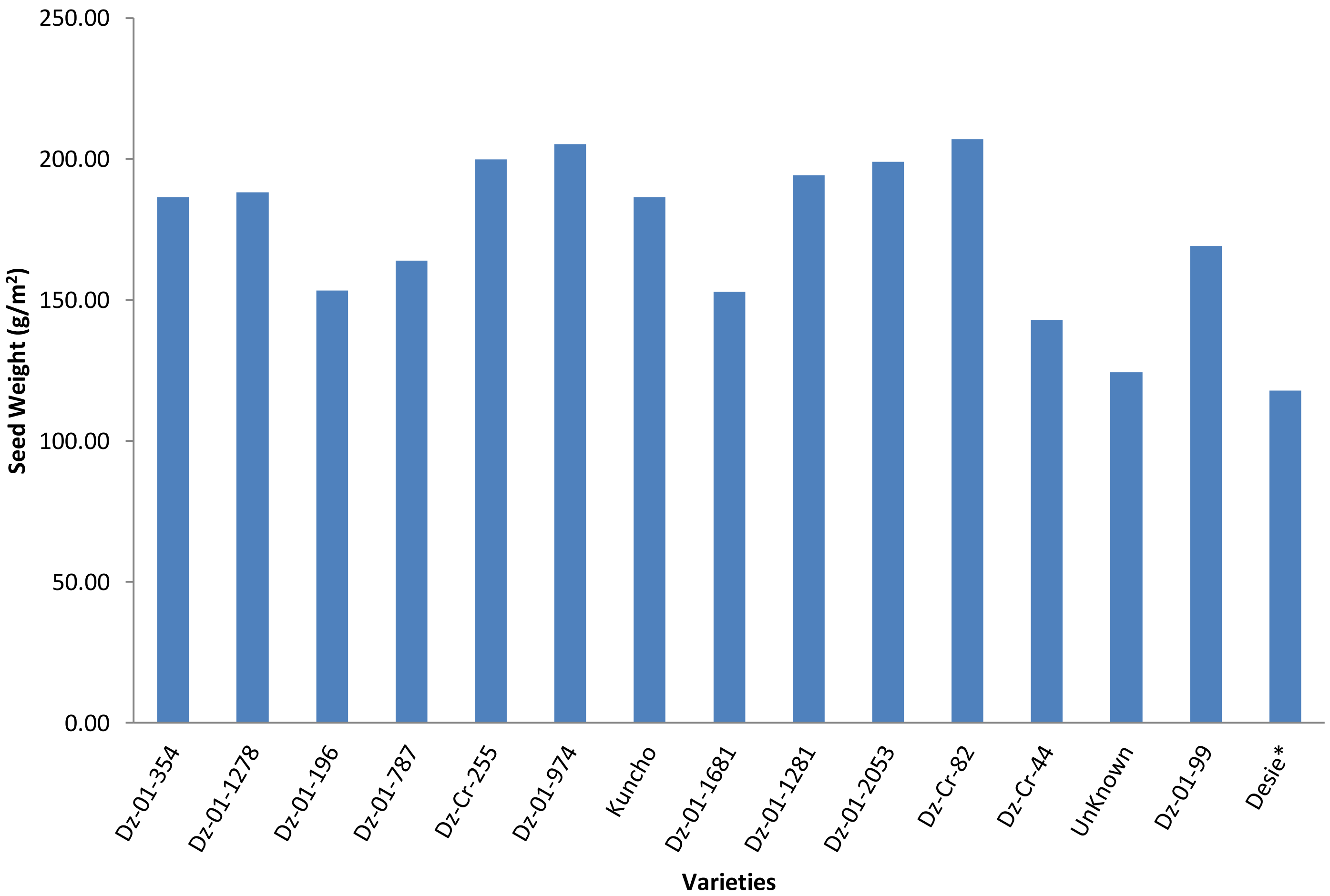
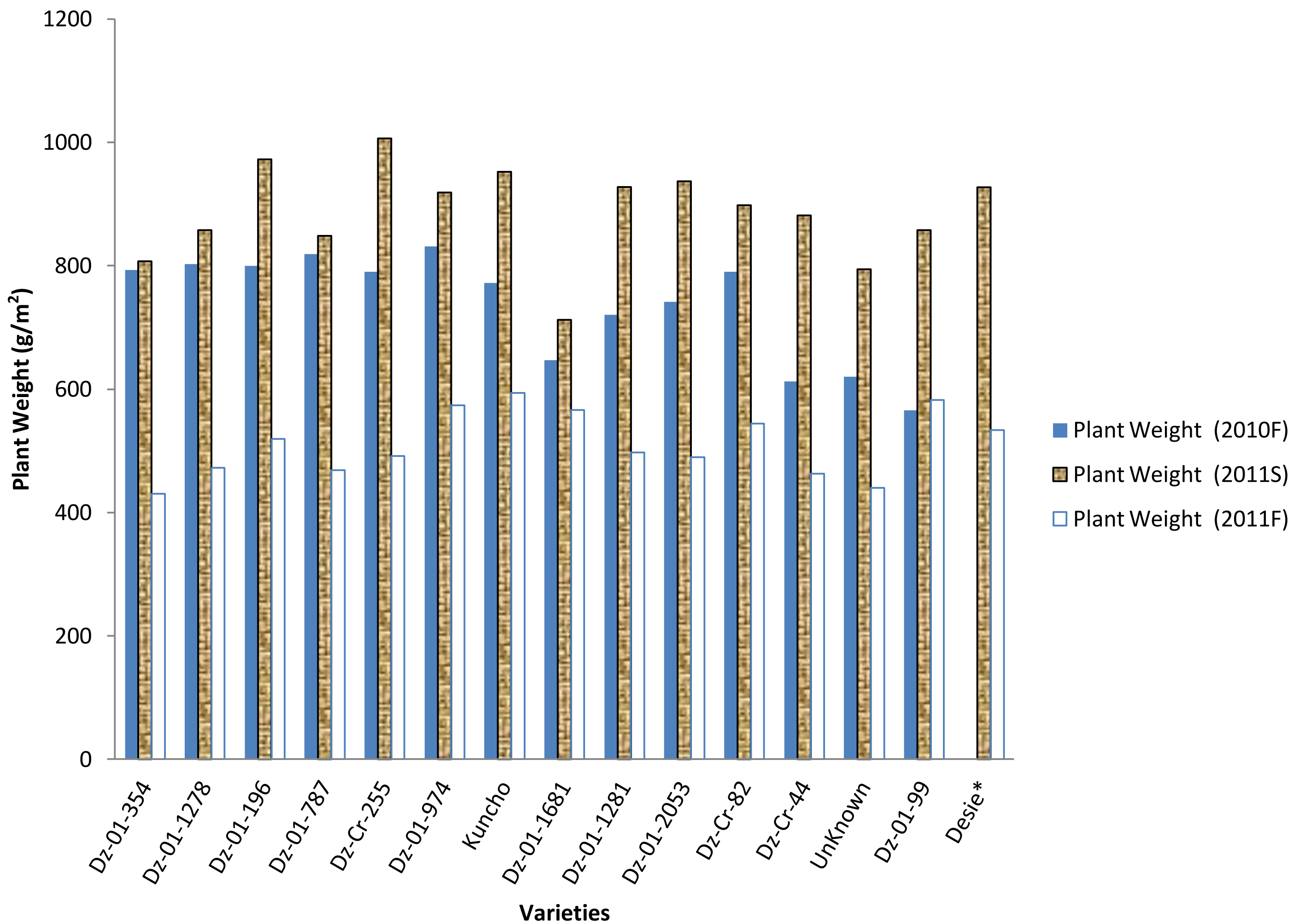


Figure 4. The average seed production (g/m^2) of the 15 varieties for the three growing seasons in the greenhouse.



*No Data for Desie; fall 2010

Figure 5. Total plant weight (g/m^2) of each variety for the growing seasons (fall 2010, spring 2011, and fall 2011) in the greenhouse.

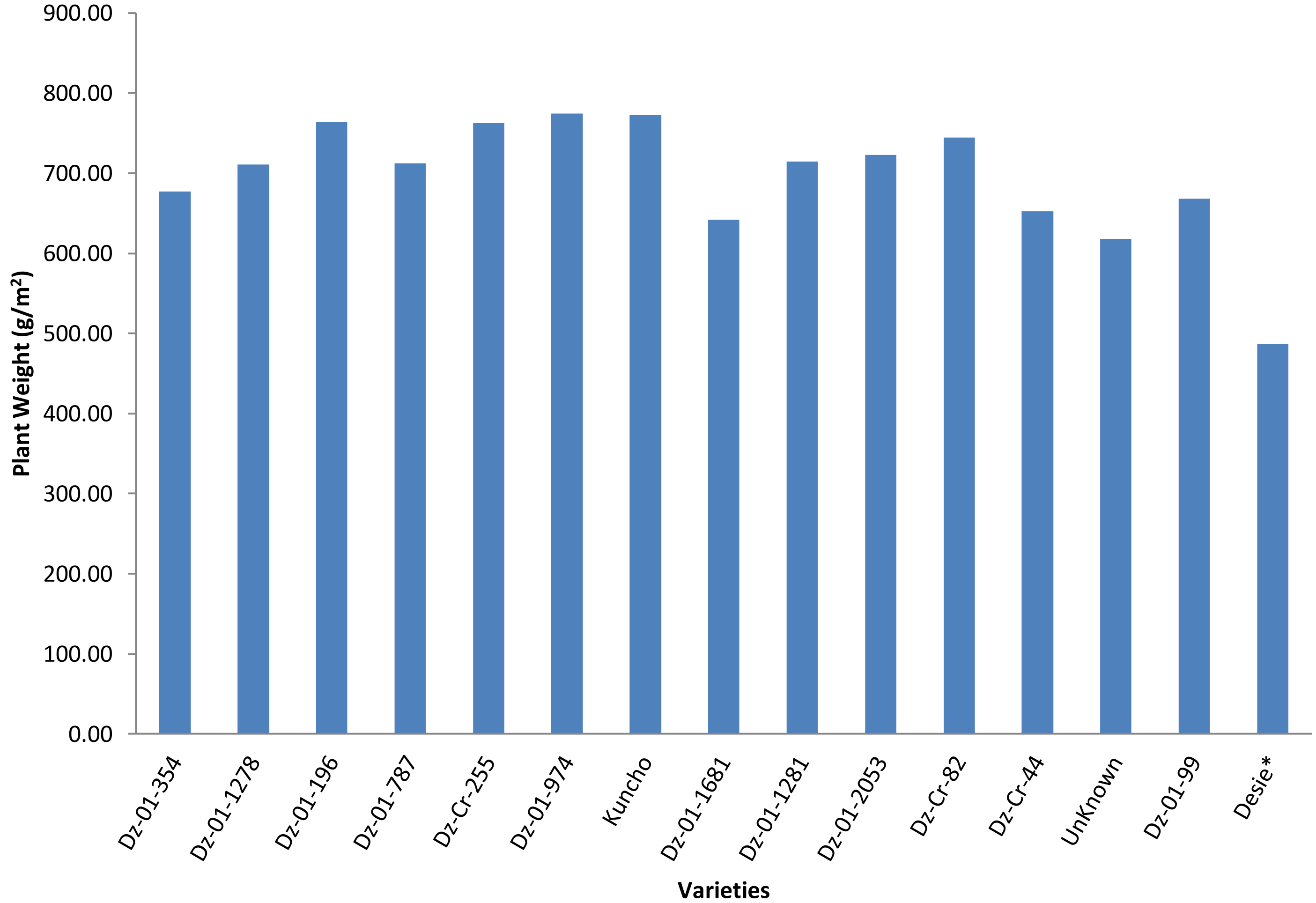


Figure 6. The average plant weight (g/m^2) produced by each variety over the three growing seasons in the greenhouse.

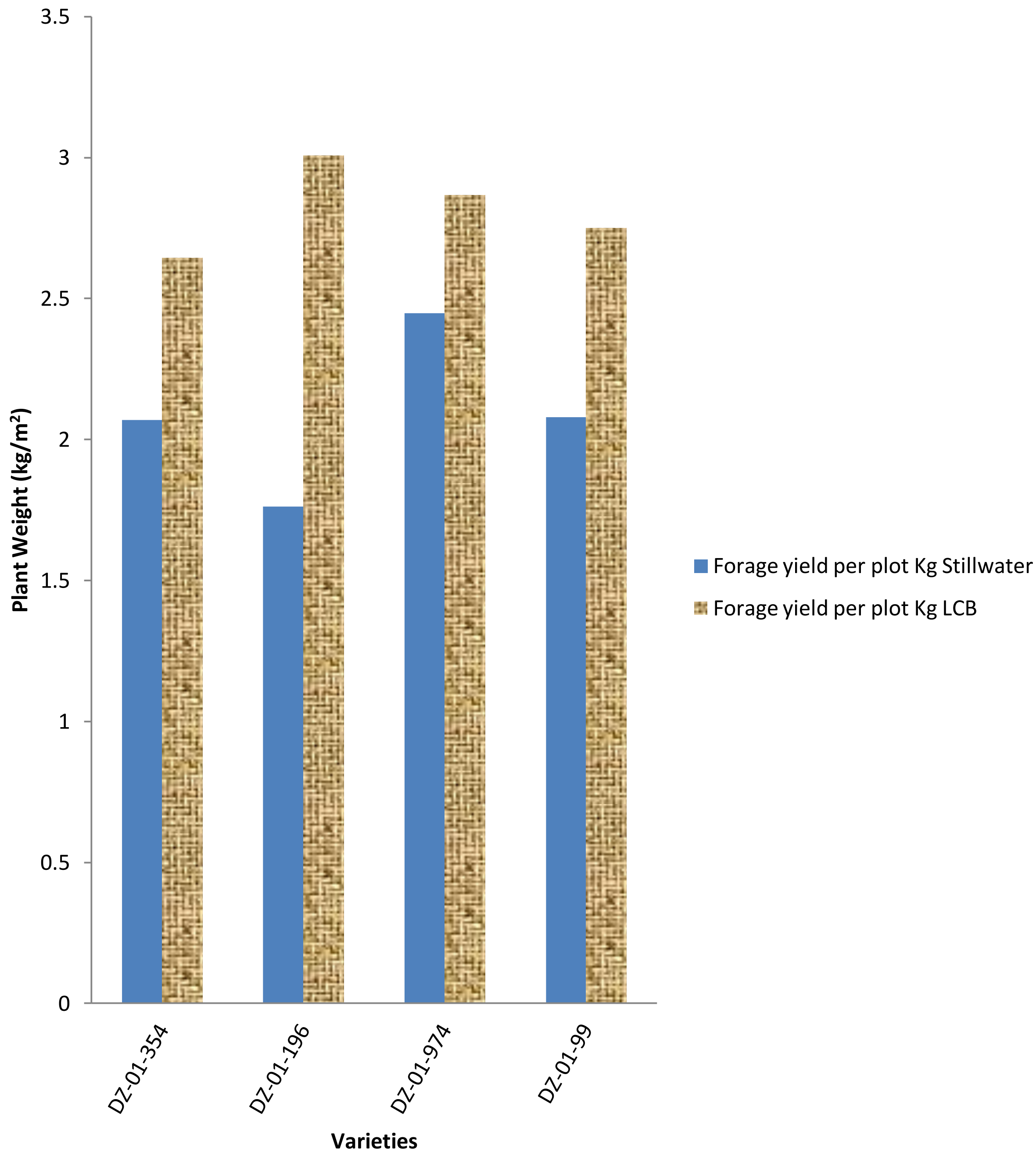


Figure 7. Plant weight (kg/m^2) for teff varieties, Lake Carl Blackwell (LCB) and Stillwater, Oklahoma, field trials, 2010. Plant weight did not differ among varieties at $p<0.05$.

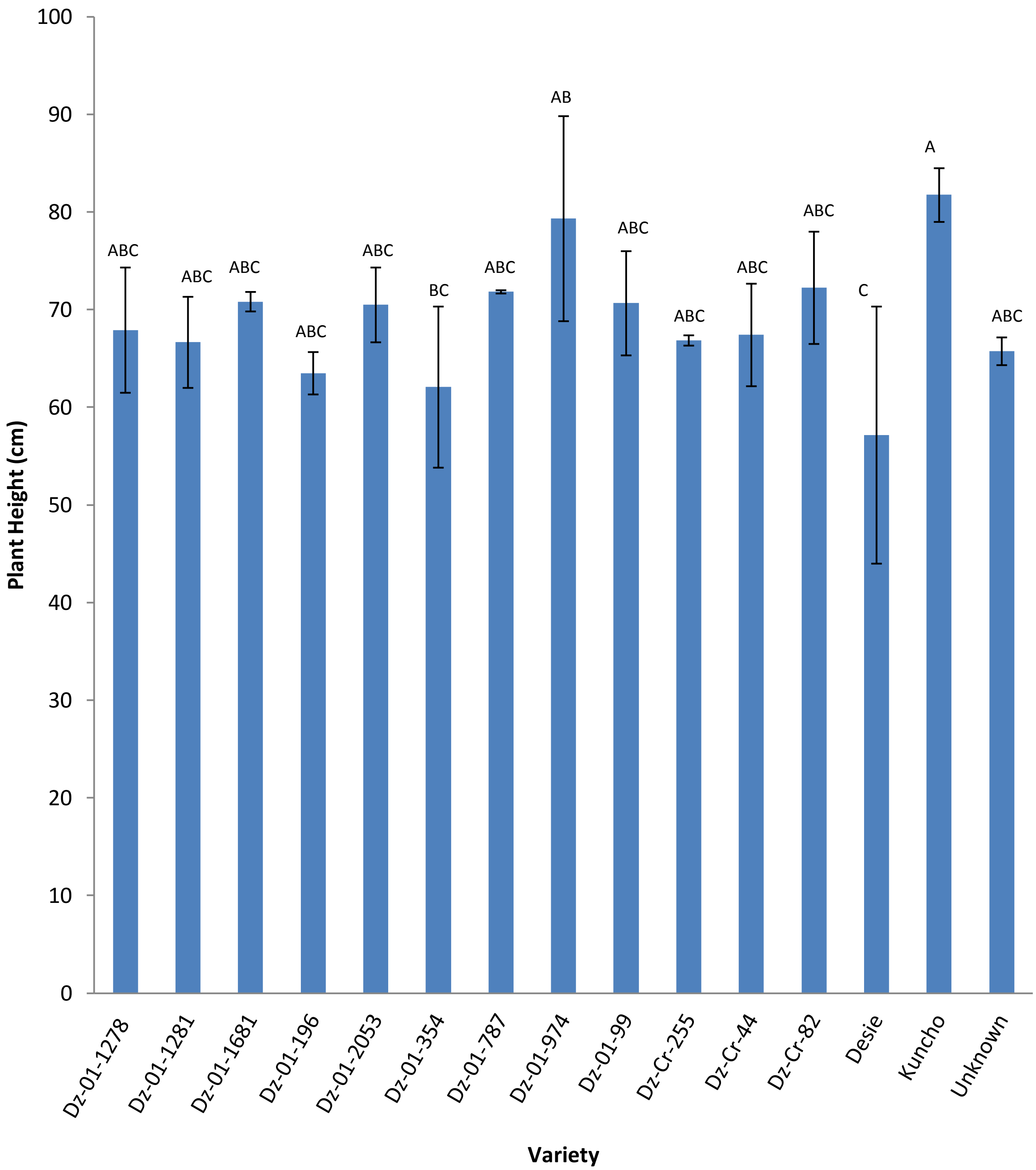


Figure 8. Average plant height (cm) for 15 teff varieties grown at the Agronomy Research Station, Stillwater, Oklahoma in 2011. Varieties with same letter are not significantly different at p<0.05 level using Duncans. Multiple Range Test.

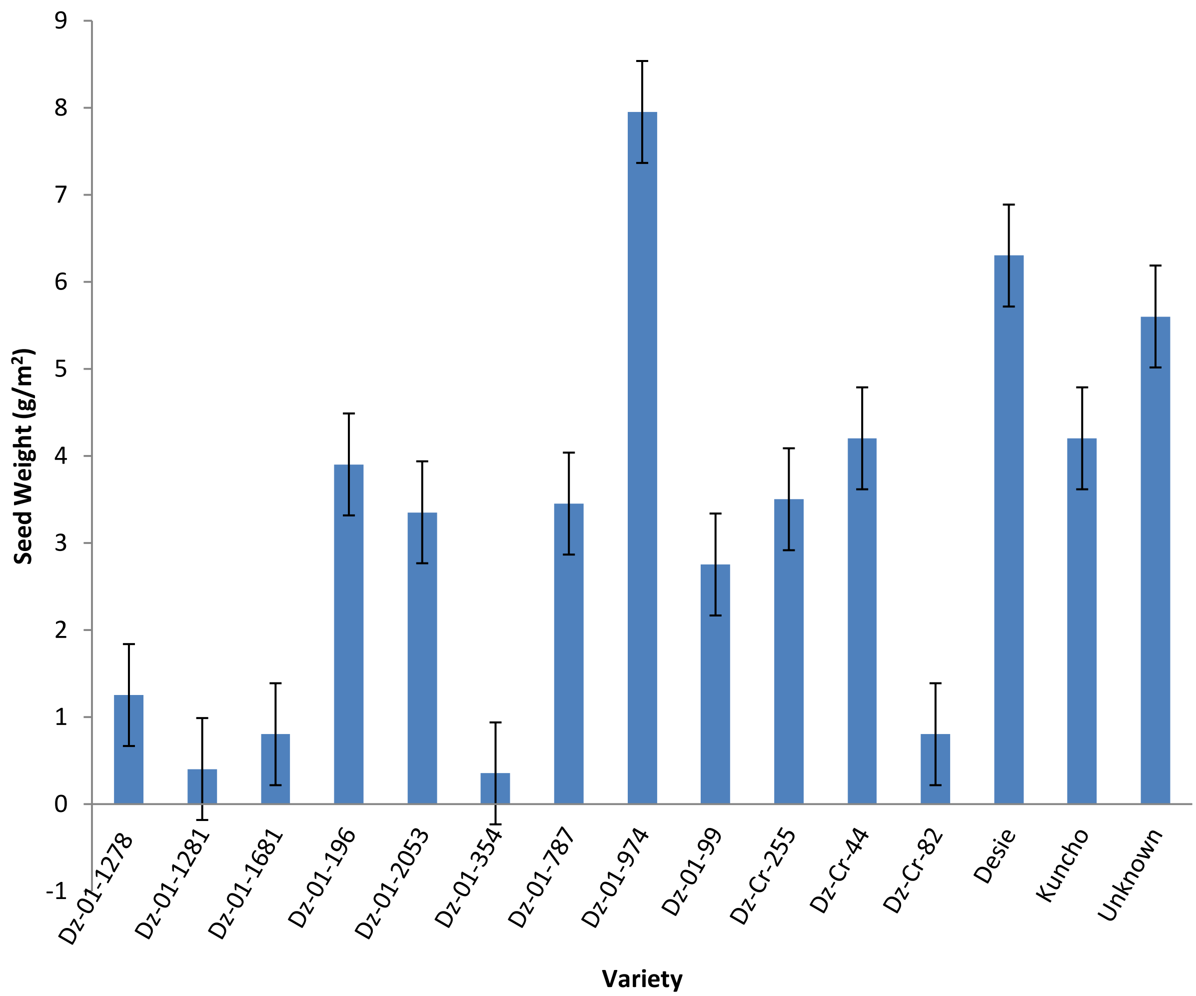


Figure 9. Average seed weight (g/m^2) for teff varieties grown at the Agronomy Research Station Stillwater, Oklahoma in 2011. Seed weight did not differ among varieties at $p<0.05$.

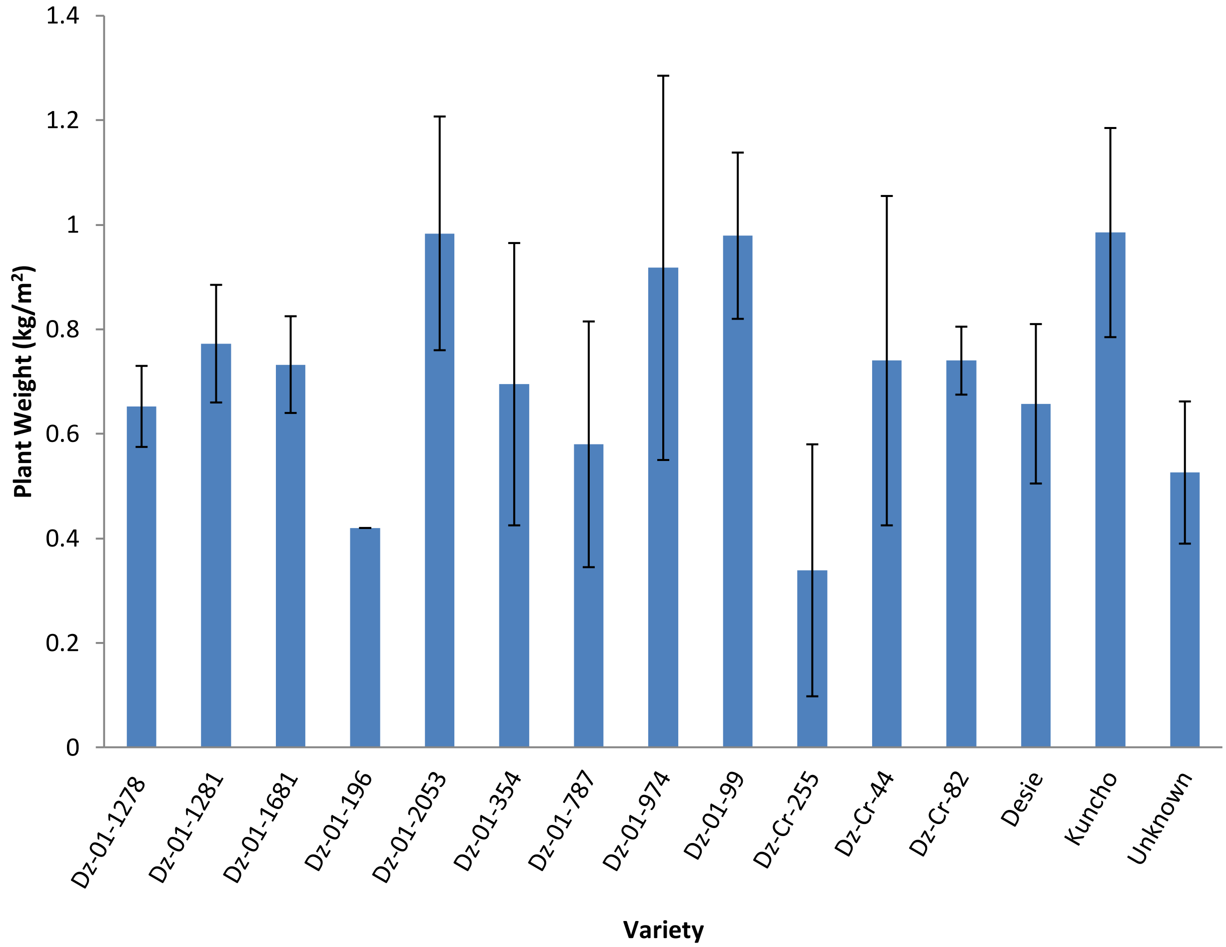


Figure 10. Average plant weight (kg/m^2) for teff varieties grown at the Agronomy Research Station Stillwater, Oklahoma in 2011. Plant weight did not differ among varieties at $p<0.05$.

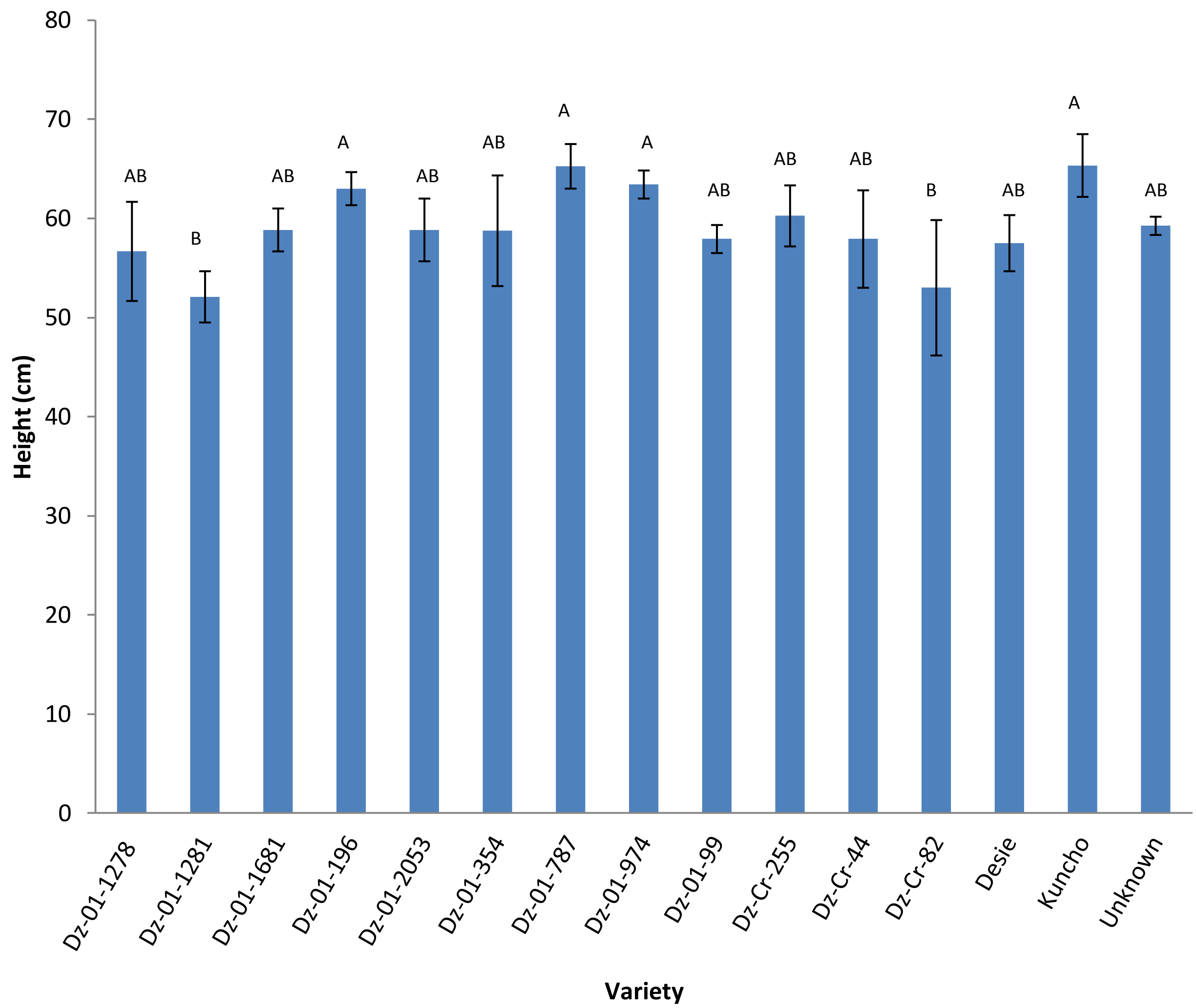


Figure 11. Average plant height in (cm) for 15 teff varieties grown at Lake Carl Blackwell, Oklahoma in 2011. Varieties with same letter are not significantly different at P<0.05 using Duncans. Multiple Range Test.

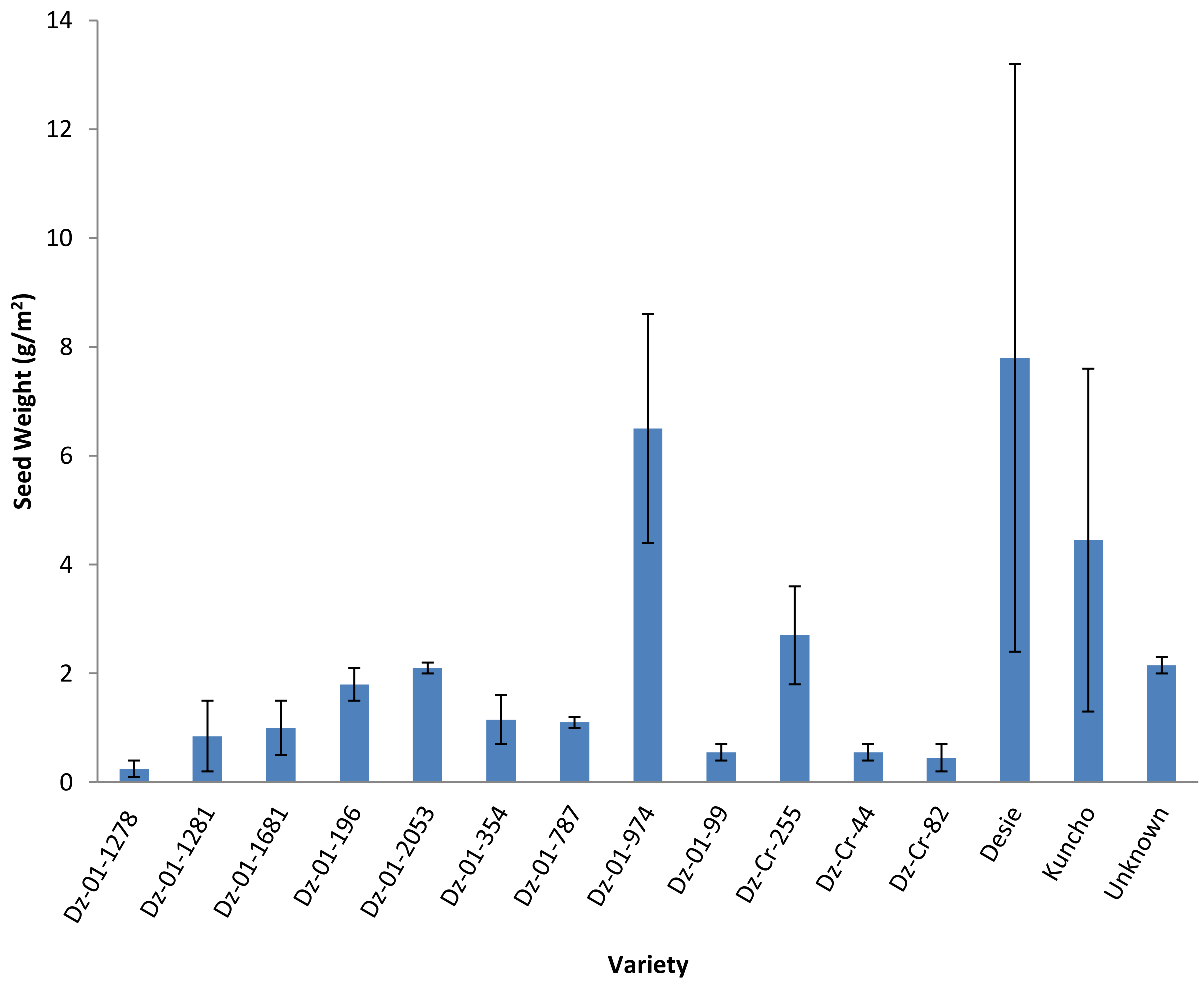


Figure 12. Average seed weight (g/m^2) of 15 teff varieties grown at Lake Carl Blackwell Oklahoma in 2011. Seed weight did not differ among varieties at $p<0.05$.

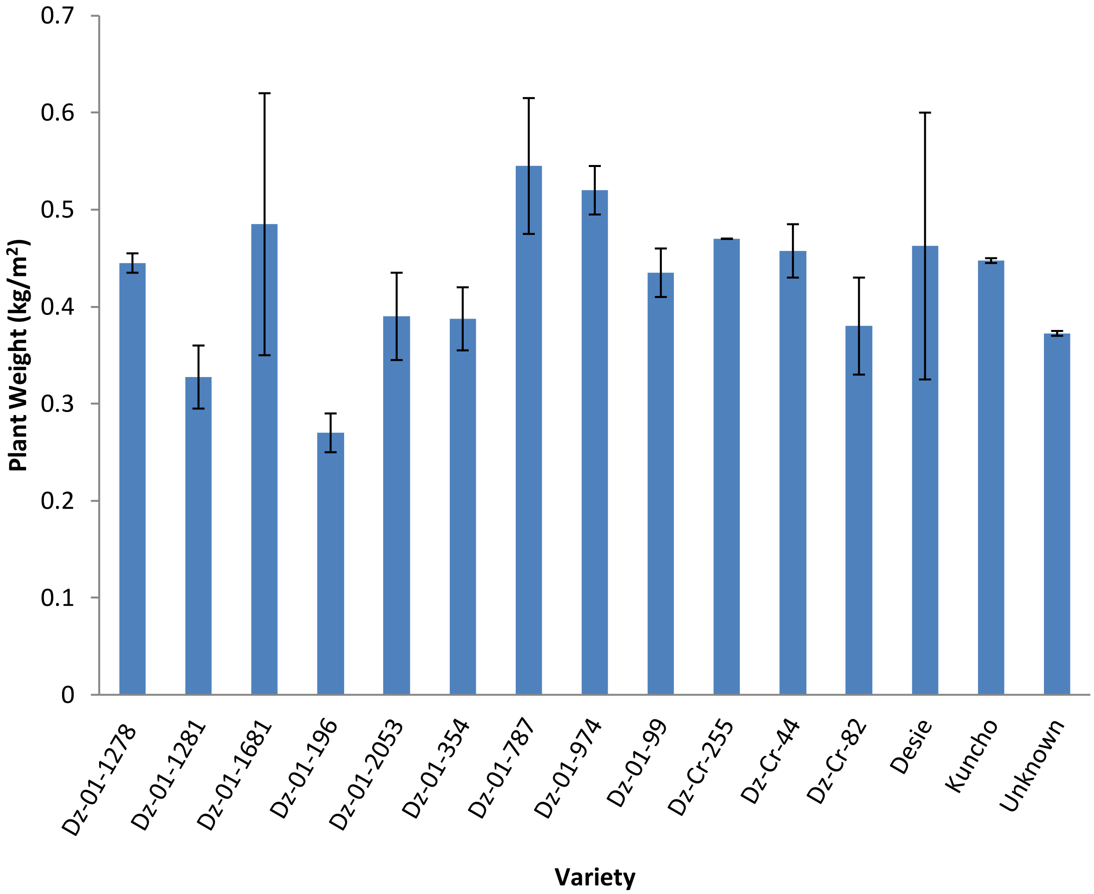


Figure 13. Average plant weight (kg/m^2) for 15 teff varieties grown at Lake Carl Blackwell, Oklahoma in 2011. Plant weight did not differ among varieties at $p<0.05$.

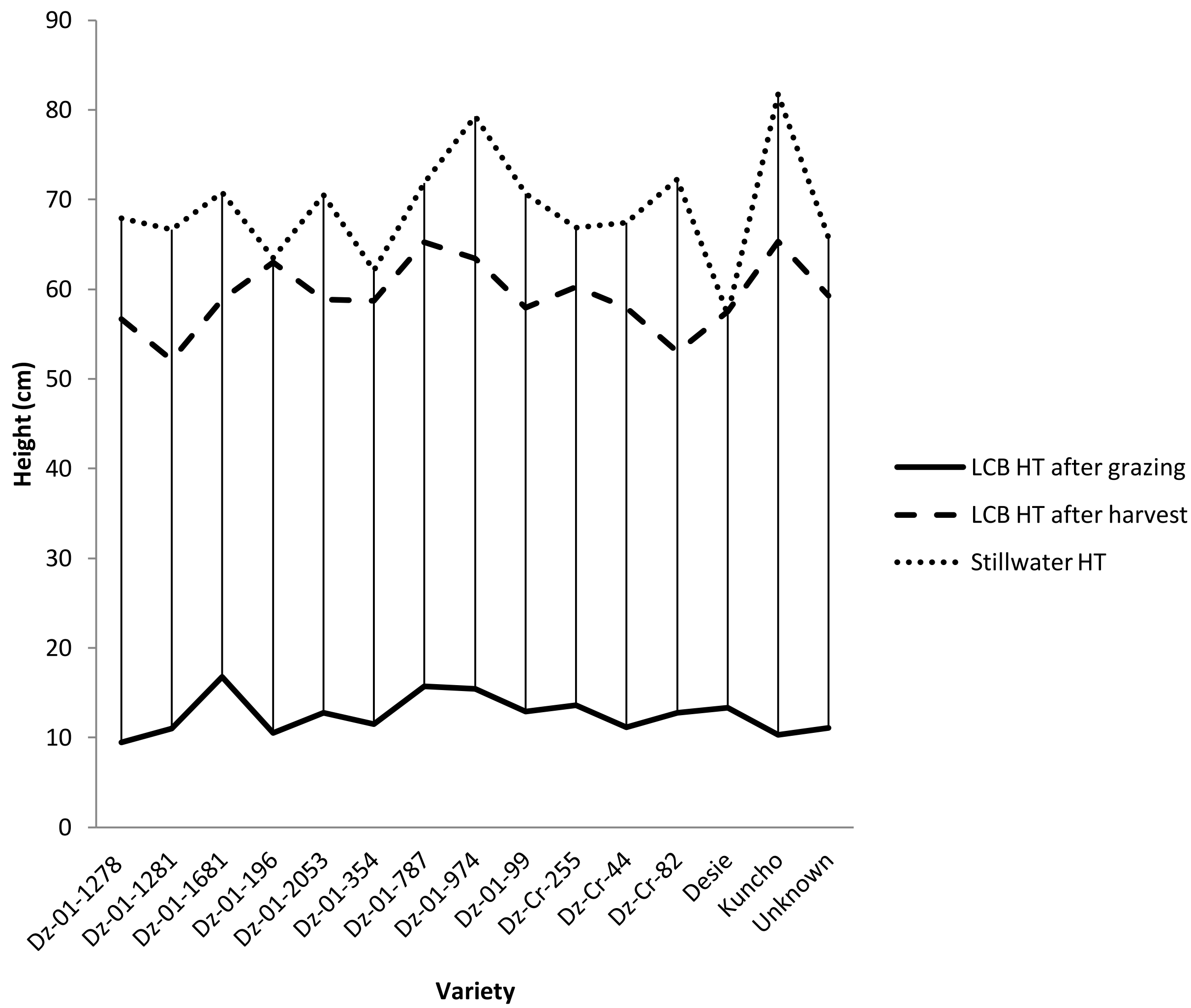


Figure 14. A comparison of the 2011 variety heights.

Note: Lake Carl Blackwell (LCB) was grazed off so the re-growth is recorded in comparison to full season growth in Stillwater.

APPENDICES

Table 1. Plot layout of teff variety study at Agronomy Research Station, Stillwater OK, summer 2010.

Plot Number	Variety Name
1	Dz-Cr-387-Kuncho
2	Dz-Cr-358-Ziquala
3	DZ-01-2675- Chefe
4	DZ-01-354
5	DZ-01-899-Dega teff
6	DZ-01-196-Magna
7	DZ-01-974- Dukem
8	DZ-01-99- Asgori
9	Tiffany
10	Quick-E

1	6	9	7	8	Rep II
4	5	10	2	3	

4	6	9	2	3	Rep I
7	10	1	8	5	

Table 2. Plot layout of teff variety study at Lake Carl Blackwell, OK, summer 2010.

Plot Number	Variety Name
1	Dz-Cr-387-Kuncho
2	Dz-Cr-358 -Ziquala-
3	DZ-01-2675- Chefe
4	DZ-01-354-Enatite
5	DZ-01-899
6	DZ-01-196-Magna
7	DZ-01-974-Dukem
8	DZ-01-99-Asgori
9	Tiffany
10	Quick-E

4	5	10	2	3	1	6	9	7	8	Rep II
7	10	1	8	5	4	6	9	2	3	Rep I

Table 3. Plot layout of teff variety study at Lake Carl Blackwell and Agronomy Research Station, Stillwater OK, summer 2011.

Plot Number	Variety Name Rep 1	Variety Name Rep 2
1	Dz-01-196	Dz-01-196
2	Unknown	Kuncho
3	DZ-01-1278	Unknown
4	Dz-01-1681	Dz-01-1681
5	Desie	Dz-Cr-255
6	Dz-Cr-255	Dz-01-99
7	Dz-01-974	Dz-01-787
8	Dz-Cr-44	Dz-01-354
9	Dz-01-99	Dz-01-1278
10	Dz-01-354	Dz-Cr-82
11	Kuncho	Dz-01-2053
12	Dz-Cr-82	Dz-01-974
13	Dz-01-1281	Dz-Cr-44
14	Dz-01-787	Desie
15	Dz-01-2053	Dz-01-1281

1	2	3	4	5	6	7	Blank	
8	9	10	11	12	13	14	15	Rep I

1	2	3	4	5	6	7	Blank	Rep II
8	9	10	11	12	13	14	15	

VITA

Michael Denis Reinert

Candidate for the Degree of Plant and Soil Science

Master of Science

Thesis: Evaluation of Selected Teff ([*Eragrostis tef (Zucc.)* Trotter]) Varieties in Oklahoma
Major Field: Plant and Soil Science

Biographical:

Education:

Completed the requirements for the Master of Science in Plant and Soil Science at Oklahoma State University, Stillwater, Oklahoma USA in, JULY, 2012.

Completed the requirements for the Bachelor of Science in Plant and Soil Science at Oklahoma State University, Stillwater, Oklahoma/USA in May 2010.

Graduated Pioneer High School, Waukomis, Oklahoma USA in May 2006

Experience: Employed under Dr. Klatt at OSU as an undergrad 2008-2010 Farming personal ground 2009-present, Employed through OSU as a research assistant 2010-present

Name: Michael Denis Reinert Date of Degree: July, 2012

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: EVALUATION OF PERFORMANCE OF SELECTED TEFF ([*ERAGROTIS TEF (ZUCC.)* Trotter]) VARIETIES IN OKLAHOMA

Pages in Study: 41 Candidate for the Degree of Master of Science

Major Field: Plant and Soil Science

Scope and Method of Study:

We evaluated the performance of 15 varieties of teff in the greenhouse and the field in 2010 and 2011. Field studies were conducted at Lake Carl Blackwell and Stillwater Agronomy Research Station, Stillwater, OK, while greenhouse studies were established in a greenhouse facility located at Agronomy Research Station, Stillwater, OK. The variables collected included plant height, plant biomass, and seed weight from each variety. Data were subjected to statistical analysis using ANOVA in SAS.

Findings and Conclusions:

We found two varieties that performed well for both seed and biomass in the greenhouse. Variety Dz-01-974 performed in the top 5 in all aspects in the greenhouse. In the field, variety Dz-01-974 would be recommended for both seed and biomass production and the variety Kuncho would be recommended for biomass production.

ADVISER'S APPROVAL: Dr. ART KLATT