FINAL REPORT ON OFF-SEASON TEF PRODUCTIVITY-INCREASING TRIALS USING DRIP IRRIGATION, JULY 2010

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INTRODUCTION

This exploratory research was conducted for the off-season 2010 under the sponsorship of Oxfam America. The research activity was implemented at Debre Zeit Agricultural Research Center. A similar experiment was conducted at Mekelle University during the off-season using drip irrigation, and also adding compost as a fertilizer treatment. These were a field experiments with plot sizes of 18.5 square meters (4.5 meters x 4 meters). Tef seedlings were grown in pots for two weeks and then transplanted in rows, 20 cm apart and 15 cm between hills. One to three seedlings/hill were used in transplanting. We hope that this report will be of valuable information for future tef research and development.

NEW APPROACHES TESTED IN THE EXPLORATORY EXPERIMENTS

- Regularly spaced transplanting of tef seedlings – planted tef at 20 cm x 15 cm
- Application of granular complete fertilizers (DAP = Di-ammonium phosphate (18N:46P); Urea = (46N), and Sucube-Sucube = (granular fertilizer in West Africa composed of NPK+S+Zn)

- Application of compost, at a rate of 6 ton/ha
- Supplementary irrigation, using drip system

Results of the Experiment

The experiment was conducted in the field to test if tef yields could be improved by transplanting with changes in timing and methods of transplanting, and different fertilizer type applications. Tef seedlings were grown on a wooden flat for two weeks and were then transplanted into the field (at the 2-3 leaf stage). Spacing of the trials was 20 cm x 15 cm to plant one, two or three seedling per hill. In addition to these cultural practices, seed drilling at a seed rate of 2.5 kg/ha with a spacing of 20 cm between rows was the other treatment. Plot size for all treatments was 4.5 meters x 4 meters. As a check, broadcasting method was used at a seed rate of 25 kg/ha.

The difference between broadcasting and transplanting was huge. Plot yields for the broadcasted plots were 463–577 kg/ha while for the transplanted ones was 440–1,097 kg/ha. The main effect of transplanting as indicated in the following figure was in (a) increasing tiller number, (b) producing strong and fertile tiller culms, and (c) increasing the number of productive tillers, which (d) increased number of seeds/panicle. Best results came from (i) wider spacing, giving individual plants wider space to show their potential, and (ii) the use of complete fertilizers.

Figure 1. Photo showing tillering potential of transplanted tef

It was concluded that the tef crop responds well to reduced plant density and to fertilizers, particularly those that contain micronutrients, such as sucube-sucube (Zn, Cu, Mg, and S). There was some plant disease problem due to leaf rust (as indicated in the following figure) that affected the yield performance of the trial observed in contrast to the main cropping season.

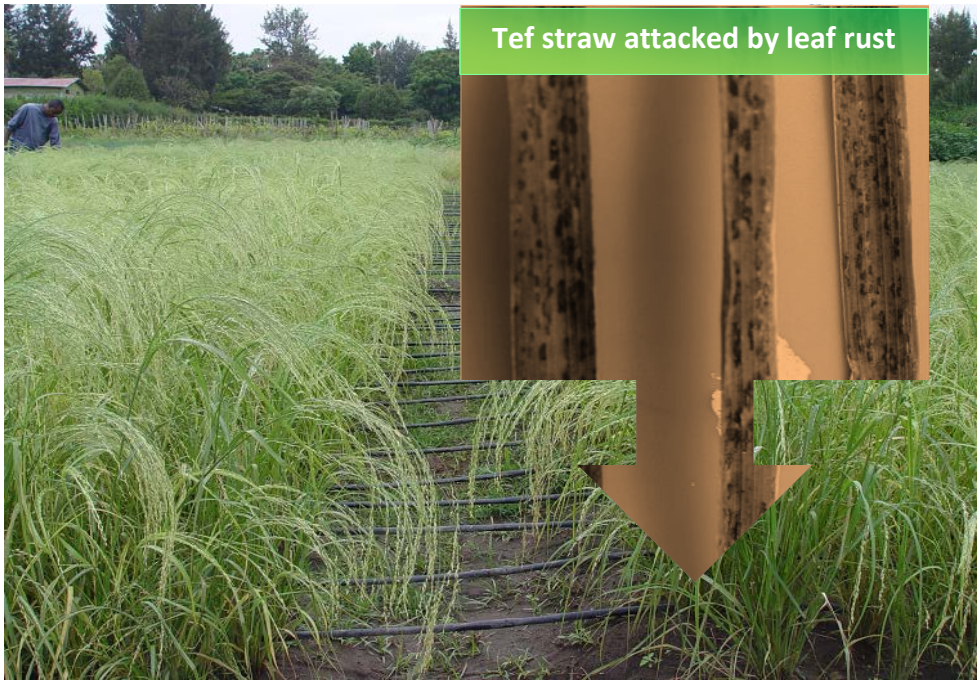


Figure 2. Tef crop affected by leaf rust disease

The results of the experiment are shown in the following tables

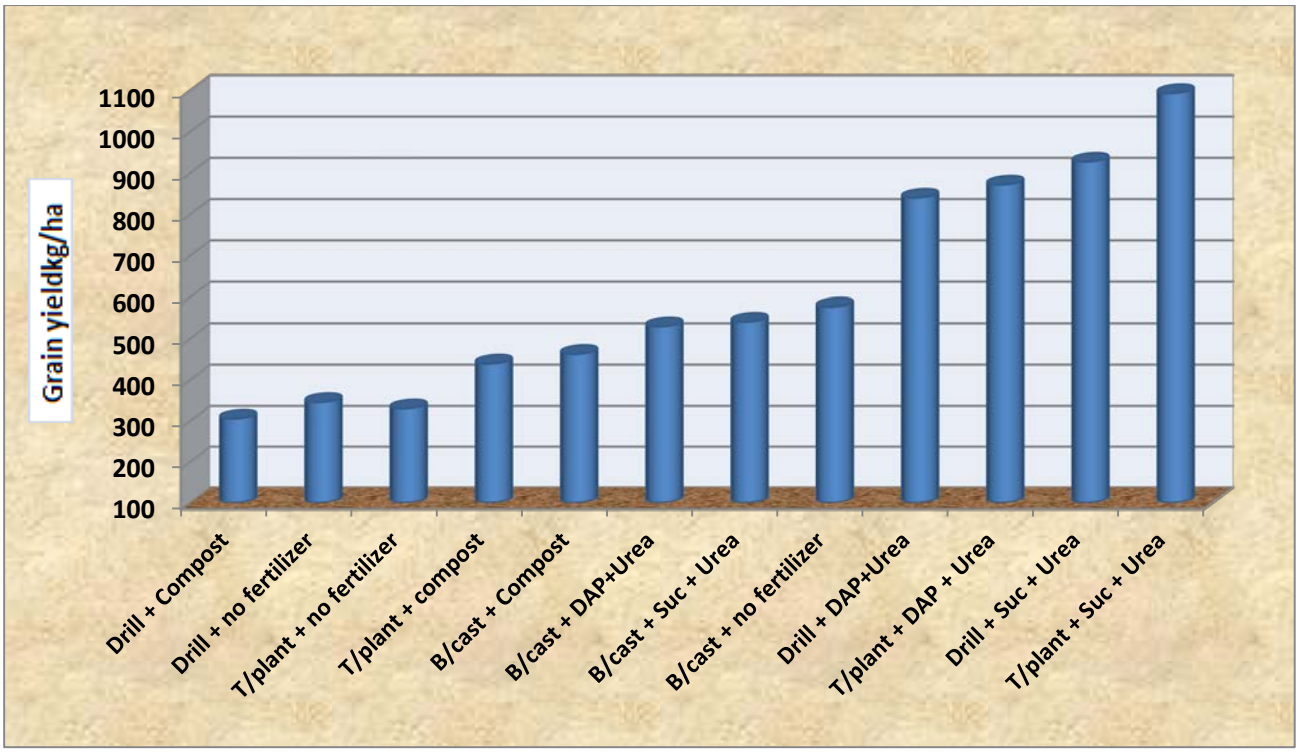
Table 1. Comparison among Fertilizer Types

TREATMENT	Grain yield kg/ha	Straw yield kg/ha
Drill + Compost	306	1,944
Drill + No Fertilizer	347	1,833
T/Plant + No Fertilizer	331	1,352
T/Plant + Compost	440	1,963
B/Cast + Compost	463	2,444
B/Cast + DAP+Urea	530	3,469
B/Cast + Suc + Urea	541	3,611
B/Cast + No Fertilizer	577	3,333
Drill + Dap+Urea	841	3,389
T/Plant + DAP + Urea	872	3,815
Drill + Suc + Urea	928	3,222
T/Plant + Suc + Urea	1,094	4,074

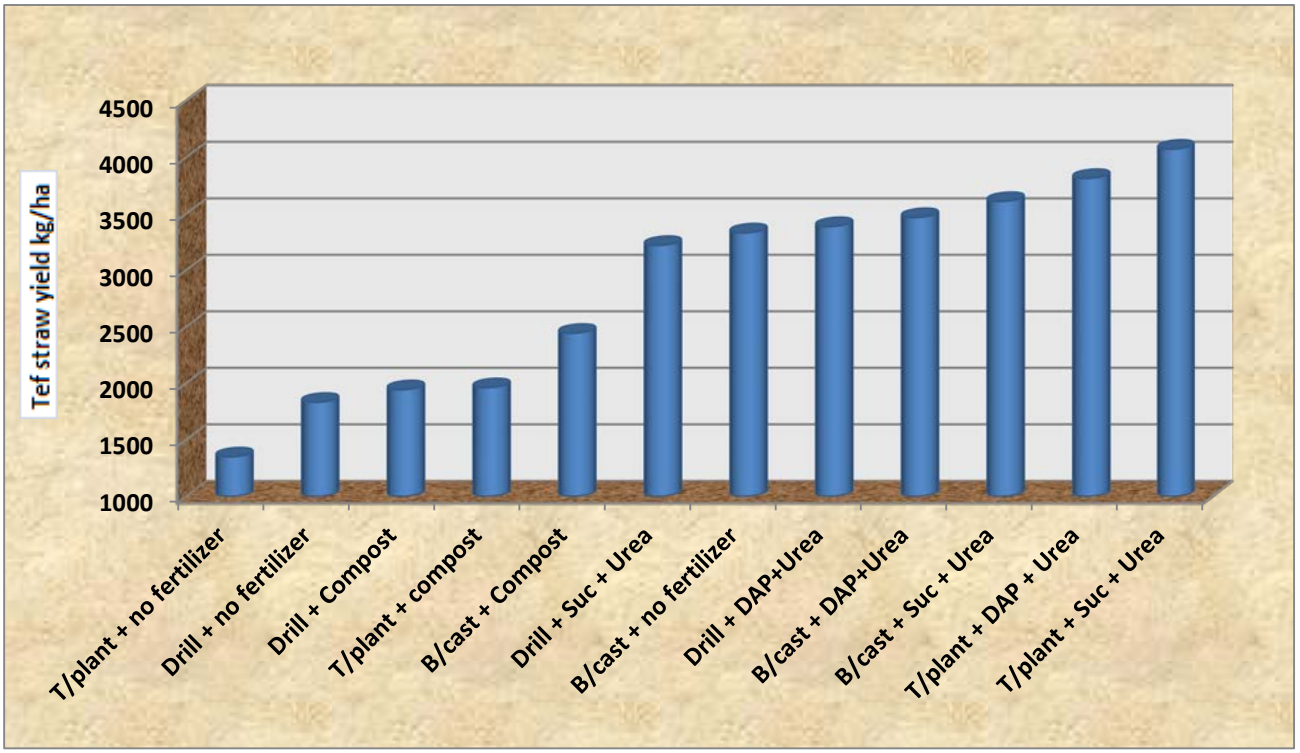
Table 2. Comparison among Planting Methods

TREATMENT	Grain yield kg/ha	Straw yield kg/ha
Transplanting	691	2,898
Drilling	605	2,597
Broadcasting	528	3,214

Figure 3. DZ-01-974 TEF GRAIN YIELD IN KG/HA (D/ZEIT ARC)



Figuer 4. DZ-01-974 TEF STRAW YIELD KG/HA (D/ZEIT ARC)



Summary of System of Tef Intensification Trial at Mekelle University during 2010 Off–Season

This experiment was initiated to improve the productivity of tef through intensive agronomic management, such as provision of appropriate inputs and plant staggering in the field. The experiment was initiated at Debre Zeit and expanded to Tigray for multi-location trials. The first test was conducted during the off – season of 2010 at Mekelle University research site.

Table 3. Row data from off–season System of Tef Intensification at Mekelle University

No.	Treatment	Productive tiller number	Plant height (cm)	Panicle length (cm)	50% days to flowering	90% days to maturity	Lodging (%)	Grain yield (g/plot)	Biomass yield (g/plot)
1	SB	4	90.25	40.25	55	95	15	66.5	837.26
2	SR	19.5	98	36.75	59	105	0	92.8	446.11
3	DUB	3	93.5	36.5	58	99	10	52.5	534.4
4	DUR	9	95	34.5	60	102	0	no	no
5	ComB	5	79	30	61	101	0	46.4	304.32
6	ConB	2.5	65.75	23.25	65	102	0	23.7	244.16
7	SB1ph	20	60	31.25	Data not taken for these treatments on these parameters because the plants rejuvenate back because of rain.				
8	SB2Ph	11.25	68.75	29.5					
9	SR3Ph	17.25	67.75	38.5					

Key: *SB = Succube broadcast, SR = Succube row, DUB = DAP/Urea broadcast, DUR = DAP/Urea row, ComB = Compost broadcast, ConB = Control broadcast, SB1ph = Succube broadcast 1 plant per hill, SB2ph = Succube broadcast 2 plants per hill, SB3ph = Succube broadcast 3 plants per hill*

The performance of the crop was far lower than its performance at Debre Zeit under the same treatment conditions except for prevailing environmental conditions. The major possible reasons for the poorer performance would be:

1. **Salinity of the soil: T**he soil of the experimental site was salty because of repeated irrigation treatments with saline water in the area. Tef was reported to be susceptible to salinity especially at an early stage. Row-planted treatments and transplants are highly affected (as indicated in the figure below). Soil samples were taken and are under analysis to know the salinity level of the soil.

Figure 5. Salt-affected tef trial plots

2. The poor performance of transplants might also be related to the fertility of the field soil put into nursery trays during sowing. The soil used to raise the seedlings could be poor in fertility.
3. As there was not any other crop nearby during the experimental period, bird attacks (damage) were very significant.
4. As this is a new innovative approach, a lack of experience on transplanting of the crop might contribute to its weak performance.

Generally, the results of the current research cannot be used to draw any conclusion that the system will not work in Tigray because of the above reasons. It would be good if the experiment is repeated during the main season (*kiremt*) under natural conditions and with experience gained for drawing a firm conclusion. The performance of the crop was by far lower than its performance at Debre Zeit under the same treatment conditions.

LESSONS LEARNED AND RECOMENDATIONS

The trial conducted at Debre Zeit Agricultural Research Centre during the off-season passed with an excellent awareness creation among farmers, agricultural extension workers, researchers, members of Administrative Council, and other invited guests who attended the field day prepared by the organizers. The occasion was transmitted to a wide range of the farming and development community through media.

Contrary to common belief that tef yields have reached a ceiling, the crop responds well to intensification or precision agriculture. Recent exploratory agronomic experiments have shown that tef grain and straw yields can be improved considerably over the existing farmers' practice (Figures 1 & 2) by: (a) drastically reducing plant population, and (b) applying fertilizers that contain micronutrients such as zinc and copper. The increases in productivity were both for grain and straw. Straw yield is also an important cash crop to Ethiopian smallholder farmers since it can be sold for fodder or for construction.

Since teff has shown a positive response to new and innovative approaches, it is recommended that:

- Agronomic practices that reduce the planting density be promoted
- Complete fertilizers (NPK + micronutrients) be used for teff production
- Row-planting techniques be developed with low plant densities