Engineering and Technology Quarterly Reviews

Mosavi, Mohammad Haidar, Hashami, Sayed Ziauddin, Hussaini, Sayed Najibullah, Jafari, Jamila, and Karimi, Hassan. (2019), Evaluation of Growth and Yield of Genetically Modified Wheat (Triticum sp.) Seed and Farmer Sourced Unmodified Seed Under Mechanized and Traditional Methods of Land Preparation. In: *Engineering and Technology Quarterly Reviews*, Vol.2, No.2, 126-131.

ISSN 2622-9374

The online version of this article can be found at:
https://www.asianinstituteofresearch.org/

Published by:
The Asian Institute of Research

The Asian Institute of Research *Engineering and Technology Quarterly Reviews* is a peer-reviewed International Journal. The journal covers scholarly articles in the fields of Engineering and Technology, including (but not limited to) Civil Engineering, Informatics Engineering, Environmental Engineering, Mechanical Engineering, Industrial Engineering, Marine Engineering, Electrical Engineering, Architectural Engineering, Geological Engineering, Mining Engineering, Bioelectronics, Robotics and Automation, Software Engineering, and Technology. As the journal is Open Access, it ensures high visibility and the increase of citations for all research articles published. The *Engineering and Technology Quarterly Reviews* aims to facilitate scholarly work on recent theoretical and practical aspects of Education.

ASIAN INSTITUTE OF RESEARCH
Connecting Scholars Worldwide

ASIAN INSTITUTE OF RESEARCH
Connecting Scholars Worldwide

The Asian Institute of Research
Engineering and Technology Quarterly Reviews
Vol.2, No.2, 2019: 126-131
ISSN 2622-9374

Evaluation of Growth and Yield of Genetically Modified Wheat (Triticum sp.) Seed and Farmer Sourced Unmodified Seed Under Mechanized and Traditional Methods of Land Preparation

Mohammad Haidar Mosavi[1], Sayed Ziauddin Hashami[2], Sayed Najibullah Hussaini[3], Jamila Jafari[4], Hassan Karimi[5]

[1,3,4,5] Bamyan University, Faculty of Natural Sciences, Department of Biology, Bamyan, Afghanistan
[2] Bamyan University, Faculty of Agriculture, Department of Soil Science, Bamyan, Afghanistan

Correspondence: Mohammad Haidar Mosavi. Bamyan University, Department of Biology, Faculty of Natural Sciences, Bamyan, Afghanistan. Phone: + 98 (0) 799-467-365. Email: yosofi88@gmail.com

Abstract
Mechanized cultivation produced slightly higher crop yields (average 7.97 metric tonnes/hectare) than traditional cultivation (average 7.65 metric tonnes/hectare). However this difference was not statistically significant. A confounding factor may have been the fact that the mechanized treatments had less fertilizer applied than the traditional treatments. Approximately 20% less fertilizer was used on the trial plots that were cultivated by the mechanized method. The seed sowing rate on the mechanized plots was also lower (125kg/ hectare) compared with the traditional plots (150-175kg/hectare). There was very little difference in yield between the farmer sourced seed genetics and the Private Seed Company Enterprise (PSE) sourced certified seed genetics, where both lines of seed had been cleaned and dressed by the PSE. Both these lines of seed produced very high yields (averages 8.9 and 8.5 tonnes/hectare respectively).The significant finding from this trial was the large difference in yield between the seed that was cleaned and dressed by the PSE (average yield 8.6 metric tonnes/hectare) and the crops produced from unprocessed farmer seed (average yield 6.23 tonnes/hectare). This difference was highly statistically significant (P>0.99).[1]

Keywords: Mechanized Cultivation, Private Seed Company Enterprise, Wheat, Traditional Cultivation, Thyram Fungicide

Introduction

In Afghanistan, wheat occupies around 70% of the total cropped area (rain-fed and irrigated) and comprises 70% of the country's total cereal production (Hampton, 2013). However, mean yields are low, ranging from 0.35mt/ha

[1] Paired t-test

(local variety, no fertiliser, rain-fed) to 2.9mt/ha (improved variety, fertiliser, irrigation). In Bamyan, low yields occur because:

(i) the land is usually mono-cropped (i.e. wheat after wheat after wheat);
(ii) access to improved varieties and quality seed is limited;
(iii) access to fertiliser, herbicides and pesticides is limited;
(iv) very few farmers have access to machinery for cultivation/harvesting; and
(v) the rural infrastructure has been damaged.

Overcoming all of these constraints will require significant resources and time, but within the present production environment some initial change is possible and can be achieved by demonstrating to farmers the yield benefits accruing from the use of certified (i.e. quality) seed, mechanised seed bed preparation, chemical fertilisers and irrigation. This was the purpose of the winter wheat demonstration plot in the Waras District of Bamyan Province.

The aims of this study were: (1) to confirm the effect of mechanization and traditional methods of land preparation under high and low soil biological activity on growth and yield of wheat, (2) to evaluate the yield components of traditional Private Seed Company Enterprise (PSE) certified sourced seed and traditional farmer sourced seed in response to different fertilizers application rates, and (3) to evaluate the yield components of mechanized and traditional farmer sourced seed in response to different fertilizers application rates.

Materials and Methods

Land Preparation

The land used belonged to one of the co-operative members in Waras district of Bamyan Province. The soil type was a silty clay loam. Half of the land (comprising Site B1, B2 and C1) (Mechanised Cultivation) was prepared mechanically by tractor using a two-bladed mouldboard plough and nine tine harrow. The other half of the land (comprising Sites A1, A2 and C2) (Traditional Cultivation) was prepared by a local farmer who used a bullock and wooden plough.

Three types of seed were planted on each half of the trial area:

- Certified seed from the PSE (variety Solh-2002) (Sites A2 and B1);
- Farmer bred seed that was cleaned and dressed by the PSE (Sites A1 and B2); and
- Farmer bred seed that was unprocessed (Sites C1 and C2).

Farm Yard Manure (FYM) and Ash Application

Seven and half tonnes of farm yard manure (sheep manure) (FYM), including 1.5 tonnes of wood ash, was applied to site B, Site A and Site C on 10 October 2012, 20 days ahead of cultivation. Potassium (K) deficiency is common in Afghanistan calcareous soils. About 90-98% of K is bound to mica and feldspar clay minerals for example, potassium aluminium silicate ($KAlSi_3O_5$) and is unavailable for plants to be taken up. This means that only less than 1% of exchangeable K^+ is available in soil solution (Hashami, 2011). Farmers are unable to purchase this important soil nutrient in Afghanistan, because of its possible use in bomb making, the only option was to use wood ash to overcome some of the potassium deficiency in the soil. The land was irrigated before FYM application and sowing in order to let the FYM to fully penetrate the soil.

Sowing Rate and Cultivation Method

The sowing rates for site B, A, and C respectively were 25, 30 and 35 kg/jerib. These rates equate to approximately 125, 150 and 175 kg/hectare respectively. The seed was treated with Thyram fungicide prior to sowing.

Irrigation and Fertiliser Application

For Site B, the Float Method (Q= A x V) where Q is the volume of water in cubic meter per second, V is velocity of water in meter per second and A is the water follow section was used then the total time to irrigate Site B was recorded and the total volume of water applied determined. The volume of water applied to Site A was not recorded but rather left to the discretion of the farmer, which is common practice in Bamyan. All the three sites were irrigated 6 times before harvesting using the float method of measuring water (refer Appendix II). The application of water 6 times was less than typical Bamyan farmer would do, which is usually 8 to 10 times.

Two kinds of chemical fertilisers, nitrogen in the form of Urea and phosphorus in the form of DAP were applied to all the three Sites. For Site B, urea was applied at the rate of 205kg N/ha and for Sites A and C 250 kg N/ha. For Site B, DAP was applied at the rate of 105 kg P/ha and for Sites A and C 125 kg P/ha. All the DAP fertiliser was applied during the cultivation and sowing and urea fertiliser was divided into three parts and applied on three separate occasions.

The first portion was applied when the germination percentage reached 100 %, the second portion was applied during the tillering stage and finally, the third portion was applied during the early ear emergence.

After each urea application the trial was irrigated in order to reduce the urea volatilization into the atmosphere.

Observations Recorded before Harvesting

Two separate observations were recorded throughout the trial; germination and plant height. When the first observation was taken on 19 March 2013, the germination percentage was 3% and a final germination percentage of 100% was recorded on 4 April 2013 (refer Figure 1). For Site B the average plant height was 63.7 cm, for Site A and C the average plant height was 57 cm and 53.5 cm respectively.

Figure 1: Study Trial when the germination reached 100%.

Harvesting Method

The trial was harvested on 16 August 2013. Using a 1 meter square (quadrat), within each plot three randomly samples were taken and the average yield recorded. Maximum effort was undertaken to make sure that no single seed remained attached to the ear and a standard balance was used for weighing the wheat samples harvested from each plot. Figures 2 and 3 below show the wheat being sampled by using 1 meter quadrat and how the wheat was collected from the ground and waiting for the threshing.

Figure 2. Using 1 meter quadrat for taking the wheat samples.

Figure 3: Collected wheat waiting for the threshing.

Results

Yield results from the various plots are shown below in Table 1.

Table 1: Waras Winter Wheat Trial Yield Results

Treamtments	AverageYield (kg)/m^2	Average Yield (kg)/jerib	Average Yield (MT/jerib)	Average Yield (MT/ha)
B1- Mechanized PSEs	1.10	1800	1.80	9.00
B2-Mechanized Farmer seed	1.11	1780	1.78	8.90
A1-Traditional Farmer seed	1.10	1700	1.70	8.50
A2-Traditional PSEs	1.07	1600	1.60	8.00
C1-Mechanized farmer unprocessed seed	0.74	1200	1.20	6.00
C2- Tradtional farmer unprocessed seed	0.65	1290.24	1.29	6.45

A statistical analysis was also undertaken comparing processed seed with unprocessed seed, PSE seed genetics with farmer seed genetics and mechanized cultivation with traditional cultivation. The results of this analysis are summarized below.

Mechanized cultivation produced slightly higher crop yields (average 7.97 metric tonnes/hectare) than traditional cultivation (average 7.65 metric tonnes/hectare). However this difference was not statistically significant. A confounding factor may have been the fact that the mechanized treatments had less fertilizer applied than the traditional treatments. Approximately 20% less fertilizer was used on the trial plots that were cultivated by the mechanised method. The seed sowing rate on the mechanized plots was also lower (125kg/ hectare) compared with the traditional plots (150-175kg/hectare).

There was very little difference in yield between the farmer sourced seed genetics and the PSE sourced certified seed genetics, where both lines of seed had been cleaned and dressed by the PSE. Both these lines of seed produced very high yields (averages 8.9 and 8.5 tonnes/hectare respectively).

The significant finding from this trial was the large difference in yield between the seed that was cleaned and dressed by the PSE (average yield 8.6 metric tonnes/hectare) and the crops produced from unprocessed farmer seed (average yield 6.23 tonnes/hectare). This difference was highly statistically significant ($P>0.99$)[2].

Discussion and Conclusions

The wheat yields obtained from the processed seed lines in this trial are similar to those obtained internationally from higher yielding wheat crops.
For example, UK producers, who have the highest wheat yields in the world, had average production of 7.7 tonnes per hectare in 2011. By comparison the national average in Pakistan was 2.6 tonnes/hectare.[3]

This shows that there is potential to produce similar yields to those of the UK using locally available seed. These yields are more than 400% higher than current average production by Bamyan farmers.
However, in order to produce these high yields:

1. The seed must be correctly cleaned, dressed and stored; and
2. Correct husbandry guidelines must be followed.

Evaluation of the use of mechanised cultivation in this trial was confounded by the use of different fertiliser rates for mechanised and non-mechanized treatments.

[2] Paired t-test
[3] http://www.thenews.com.pk/Todays-News-3-99616-Pakistan-lags-behind-in-per-hectare-crop-yield

The treatments where the traditional cultivation method was used had higher fertiliser rates applied, similar to those currently in use by farmers in the area. By comparison, the fertiliser rates for the mechanised treatments were calculated based on a scientific assessment of crop demand, the soil profile and recommendations from DAIL and FAO. These rates were lower. The fact that the mechanized treatments using PSE processed seed produced similar crop yields to the traditional treatments, but with lower fertiliser rates, suggests that the value of mechanised cultivation was in reducing fertiliser costs whilst obtaining high crop productivity. Fewer weeds were observed in the mechanised treatments compared with traditional cultivation, suggesting another key benefit of mechanised cultivation is reducing crop completion from weeds. The trial also suggested that the DAP fertiliser should be applied all at sowing and the urea fertilizer should be applied in three separate occasions.

Other good husbandry practices used to obtain these yields were:

- Seed treatment with fungicide prior to planting
- Regular crop inspections
- Controlled application of water according to crop requirements
- Regular hand weeding
- Removal of off-types and defective wheat plants before harvest

Recommendations

The results of this trial support the following recommendations:

1. Wheat seed should be processed cleaned and properly stored ahead of cultivation.
2. Treat the wheat seed with fungicide (Thyram) before planting in order to control or decrease the smut disease which is common in Bamyan winter wheat fields.
3. The correct use of mechanised cultivation will improve wheat productivity. Deeper ploughing of land, which can only be obtained using a tractor and mouldboard plough, allows the wheat root to penetrate deeper into the ground and develop more. Another benefit of mechanised cultivation is to reduce weeds in the crop.
4. Measured application of farmyard manure (FYM) and chemical fertilizers will also increase yields. It is recommended to apply all of the DAP fertilizer at sowing and urea in three separate applications instead of applying it only once.
5. Apply the FYM at least 20 days ahead of cultivation in order to let the manure get the maximum fixation within the soil.
6. The ratio of DAP and urea fertilisers should be correctly calculated.
7. The three separate urea applications should be done at sowing, tillering stage and early ear emergence.
8. After applying urea irrigate the land to reduce losses from volatilisation.

It is important to measure the timing and amount of water going to the field and irrigate the field more, but we recommend light irrigation over heavy watering (i.e. apply water more frequently but less heavily).

References

FAO,. (2011), Statistical Yearbook, cited by The Pakistan News (2013) – refer http://www.thenews.com.pk/Todays-News-3-99616-Pakistan-lags-behind-in-per-hectare-crop-yield; accessed August 2013.

Hampton, J.G. (2013), Director of Seed Research Centre and Professor of Seed Technology, Lincoln University, New Zealand.

Hashami, S.Z.(2011), Phosphorus and Zinc Availability in Selected Calcareous Soil from the Khost Province of Southeastern Afghanistan, graduate thesis, Purdue University, IN, USA.

Pearson, A.B. (2013), Prime Consulting International Ltd. Pers. comm. 27 August