

# Varieties Reaction for Wheat Rust Diseases in Hadiya Zone, Ethiopia

Yilma Dessalegn<sup>1\*</sup> Alemayehu Ayele<sup>2</sup> Selamawit Tesfaye<sup>2</sup>

1. Wachemo University, Collage of Agricultural Science, Department of Plant Science, Ethiopia

## Abstract

Wheat is an important cereal crop in Ethiopia that is widely cultivated in a wide range of altitude. It ranks fourth in area coverage and total production after teff, maize and sorghum. Hadiya Zone is one of the major wheat producing areas in Ethiopia and it is recognized as one of the wheat belts in the country. But wheat production is threatened by abiotic and biotic constraints. Among the biotic, wheat rust (stem rust, yellow rust and stripe rust) is one of the major limitations of wheat production. Even though, Hadiya zone is known in wheat production, there is no detailed information regarding the distribution, incidence and severity of wheat rust. Therefore, this study was conducted with the following objective: to assess the reaction of varieties against wheat rust. The survey was conducted in 2017 main cropping season from mid September to mid October in three districts of Hadiya zone (Misha, Lemo and Duna). A total of 72 fields were surveyed at every 5 to 10 km using vehicle odometer along the main and accessible road sides. The plant samples within a selected field were taken in X-fashion using 0.5m X 0.5m (0.25m<sup>2</sup>) quadrates. Reaction of wheat varieties to stem rust ranges from 5.5% - 16%. The lowest severity of stem rust was recorded on variety Digalu (5.5%) where as the highest was from local variety (16%). In general, disease severity was classified under low class. The survey work showed that if susceptible improved and local cultivars continue to grow as mono-cropping system (due to strategy of cluster farming) serious wheat rust epidemics may occur in the zones and may cause high economic loss. Therefore, it is advised to device other farming system instead of cluster farming and replacing of susceptible varieties with new resistant varieties.

DOI: 10.7176/JBAH/10-6-02

Publication date: March 31<sup>st</sup> 2020

## 1. INTRODUCTION

About 13,352 hectares of land were devoted to wheat production by subsistence farmers in Hadiya zone and the average production per hectare was 26.43 quintal which is far below the average African and world yield productivity (USDA, 2015; CSA, 2015). Multifaceted biotic and abiotic factors are responsible for the low yield of the crop. Cultivation of unimproved low yielding varieties, insufficient and erratic rainfall, poor agronomic practices, diseases and insect pests are among the most important constraints to wheat production in Ethiopia (Hailu, 1991; Dereje and Yaynu, 2000). Among these factors, diseases play a significant role in yield reduction worldwide.

Wheat is susceptible to many diseases including the highly destructive ones like rusts (*Puccinia spp.*), *Septoria* leaf blotches (*Septoria tritici*), *Fusarium* head blight (*Fusarium graminearum*), tan spot (*Pyrenophora tritici-repentis*), smut (*Ustilago tritici*) and powdery mildew (*Erysiphe graminis f. sp. tritici*). Of these, fungal diseases like rusts (stem, stripe and leaf rust), *Fusarium* head blight (FHB), *Septoria* blotch, *Helminthosporium spp.*, and tan spot are the dominant ones that were reported over time (CIMMYT, 2005; Badebo, 2002). Among these cereal rusts are the most destructive diseases of wheat worldwide, in spite of great progress made in their control in many countries and considered the major diseases of wheat since no other wheat disease could result in greater loss over large area in a given year ((Saari and Prescott, 1985; Haldoreet *et al.*, 1982; Stakman *et al.*, 1962).

Ethiopia is one of the hot spot areas for the development of the present wheat rust complex (Leppik, 1970). The occurrence of cereal rusts in Ethiopia has been recognized as early as the 1930s (Mengistuet *et al.*, 1991). Dagnachew (1967) reported cereal rusts to be the most important diseases of wheat. Rusts can cause up to 60 percent of yield loss for leaf or stripe (yellow) rust and 100 percent loss for stem rust depending on the susceptibility of the variety and environmental conditions (Parket *et al.*, 2007). In Hadiya zone, information on the effect of rust on wheat yield is scanty. Before designing any plant disease management or after application of management activities, it is important to assess diseases to quantify the distribution and severity of the disease in the area. In this regard, disease surveying is basic to all effective control and research programs.

Despite the frequent occurrence of severe epidemics of the rust disease and wheat production in Hadiya zone is the leading in area coverage and production, there is no detailed information with regard to the development and temporal dynamics of wheat rust and their relative importance on yield loss rather a 'fire extinguishing' style of crop protection which try to utilize control strategies where disease outbreak occurred. So, it was rationale to assess diseases in order to make decision on selection or designing of sustainable control or management strategies or to assess the effectiveness of the management activities applied in a given area. This

research was conducted with following objectives:

- ☞ To determine the reaction of cultivars grown to wheat rust

## 2. Description of the Study area

The field study was conducted in major wheat producing areas of Hadiya Zone of the Southern Nations Nationalities and Peoples Regional State (SNNPRS). It is located between 7°7'-7°92'N and 37°29'-38°13'E at altitude ranges from 501 to 3000 meters above sea level (m.a.s.l) and 230 km far from the capital city of Ethiopia. The Zone has 10 districts and one city administration as administrative political unit of the zone. It receives an average rainfall ranges from 801mm to 1400mm. The averages of minimum and maximum temperatures are 10.54°C and 22.54°C, respectively.

## 3. Survey of Wheat Rust

The plant samples within a selected field were taken in X-fashion using 0.5m X 0.5m (0.25m<sup>2</sup>) quadrats. Rusts incidence and severity were recorded from six quadrats along the two diagonals of the X axis in the field and used to calculate average values. The prevalence of the disease was computed using the number of fields affected divided by total number of fields assessed and was expressed in percentage. The incidence of rusts was calculated by using the number of infected plants and expressed as a percentage of the total number of plants assessed for the three wheat rusts. Similarly, Disease severity were assessed by following the modified Cobb scale (Peterson, *et al.* 1948) for the three rust based upon percentage of the plant infected and type of disease reaction. According to this scale, at 100 % disease severity, the actual leaf area covered by rust pustules is 37 %. Disease severity was assessed by selecting 10 plants from a single quadrat and six quadrats were used for the estimation of disease severity from a single wheat field, finally the average severity was taken for the analysis. Percentage of severity index (PSI) was calculated by following Wheelers formula (1969).

## 4. Data Analysis

Percentage data were arc sine transformed before analysis. All the parameters measured/recorded were subjected to ANOVA using SAS software (Version 9.2). The data were also analyzed by using descriptive statistical analysis over variety grown, peasant associations and districts.

## 5. SUMMER AND CONCLUSION

### A. Reaction of wheat varieties to rust diseases

Wheat varieties Digalu, Hidasse, Danda'a Ogolcho and local varieties were cultivated in the surveyed area. Among the wheat varieties, Digalu was the most popular and widely grown variety in Hadiya zone followed by Hidasse and Local varieties (Table 1). Reaction of wheat varieties to stem rust ranges from 5.5% - 16 %. The lowest severity of stem rust was recorded on variety Digalu (5.5%) where as the lowest was from local variety (16%). As compared to others variety Digalu is more resistant than the other followed by Hidasse even though all varieties are classified under low disease severity class. In general, disease severity was classified under low class except that of local variety in Duna district was classified under medium disease class (>20%). From the current work all of the varieties are moderately resistant to yellow rust and leaf rust but Hidasse, digalu and danda'a were more resistant than Ogolcho and local, nevertheless the disease severity class was under low disease class (Table 1 and 2). The maximum leaf rust was recorded at Duna district on local variety (10%). The study showed that different levels of wheat rust incidence and severity was observed on different cultivars grown indicating that some cultivars were less affected by the disease than others; this may be due to the genetic makeup of cultivars which confer difference in resistance under different environmental condition.

**Table 1: Reaction of wheat varieties to rust diseases**

Cultivars	No of fields assessed	Stem rust		Yellow rust		Leaf rust	
		Incidence (%)	Severity (%)	Incidence (%)	Severity (%)	Incidence (%)	Severity (%)
Digalu	21	62.16	5.55	3.33	0.5	3	0.66
Hidasse	14	62.81	6.86	1.67	0.33	1.67	1.67
Danda'a	11	70.24	8.02	2.3	0.33	5.67	2.2
Ogolcho	12	64	10	7	2	11.67	5
Local	14	79	16	8.3	2	10	3.33

L=low disease class designated 0-20% (Incidence and Severity), M =medium disease class designated from 21-40% (Incidence and Severity), H=high disease class is greater than 41% (Incidence and Severity).

Table 2: Reaction of varieties to rust diseases in different districts of Hadiya Zone

Districts	Cultivars	No of fields assessed	Stem rust		Yellow rust		Leaf rust	
			Incidence (%)	Severity (%)	Incidence (%)	Severity (%)	Incidence(%)	Severity (%)
Lemo	Digalu	9	58.77	3.69	5	1.2	3	1
	Hidasse	5	49.2	4.06	0	0	5	3
	Danda'a	3	57.33	5.83	0	0	10	5
	Ogolcho	5	56.6	5.86	3	1	0	0
	Local	2	74	10.55	5	1	0	0
Misha	Digalu	5	60	5.44	5	0	5	1
	Hidasse	5	64	7.48	5	1	0	0
	Danda'a	5	76.4	8.2	0	0	7	1.6
	Ogolcho	3	65.67	10.03	8	4	10	5
	Local	6	79.67	17.38	10	4	0	0
Duna	Digalu	7	67.71	7.51	0	0	0	0
	Hidasse	4	75.25	8.68	0	0	0	0
	Danda'a	3	77	12.78	7	1	0	0
	Ogolcho	4	69.75	11.83	10	1	25	10
	Local	6	83.3	21	10	1	30	10

The current survey revealed that reaction of different cultivars to rust was varied; this might be due to the genetic makeup of cultivars which confer difference in resistance under different environmental condition. Countries like Ethiopia in which stem and yellow rust severely occur every year and the majority of wheat grown by subsistence farmers, for whom use of chemical fungicide against stem rust is not economical and supply of fungicides is a problem, continuous supply of resistance varieties absolutely needed to avoid wheat rust epidemics. Moreover, diseases like bacterial stripe (*Xantomona stranslucens*) become a serious problem in the surveyed area. In addition, assessment and detection of viral diseases (like *Barley Yellow Dwarf Virus* and *Cereal yellow dwarf virus*) in the survey area is mandatory. Therefore, warranty is required to direct research areas in those emerging and re-emerging pathogens since; nowadays they become one of the national and international stark for food security.

## REFERENCE

- Ayele, Bedada. Eshetu, B., Betelehem, B., Bekele, H., Melaku, D., *et al.*, 2008. Review of two decades of research on diseases of small cereal crops. Increasing crop production through improved plant protection volume I. Proceedings of 14th ann. Con. Addis Ababa, Ethiopia.
- CIMMYT (2005) Sounding the alarm on global stem rust: an assessment of race Ug99 in Kenya and Ethiopia and potential for impact in neighboring countries and beyond. Mexico City, Mexico.
- Central Statistical Agency (CSA), Ministry of Finance and Economic Development Agricultural Sample Survey 2014-2015
- Dagnatchew, Y. 1967. Plant disease of economic importance in Ethiopia. Hialeslassie I University, College of Agriculture, Environmental station bulletin, Addis Ababa, Ethiopia.
- Dereje, G. and Yaynu, H. 2000. Yield losses of crops due to disease in Ethiopia. *Pest management Journal of Ethiopia*. 5:55-67. <http://www.eiar.gov.et/>.
- Hailu G. 1991. Wheat production and research in Ethiopia. In Hailu Gebre-Mariam, D.G. Tanner, and Mengistu Hulluka (eds.), *Wheat Research in Ethiopia: A Historical Perspective*. Addis Ababa, Ethiopia: Institute of Agricultural Research and CIMMYT. Pp. 1-15. <http://www.ejournalofscience.org>
- Haldore, H., Borlang, N.E. and Anderson, R.G. 1982. *Wheat in the Third World*. West View Press. Boulders, Colorado, USA.
- Leppik, E.E. 1970. Gene centers of plants as a source of disease resistance. *Annual Review of Phytopathology* 8:323-344.
- Mengistu, H., Getaneh, W., Yeshe, A., Rebeka, D and Ayele, B. 1991. Wheat Pathology Research in Ethiopia. In: Hailu Gebre-Mariam, Tanner, D. G., and Mengistu Hulluka. (eds.). *Wheat Research in Ethiopia: A historical perspective*. Addis Ababa. IAR/CIMMYT. pp. 173-217.
- Park R.F., 2007. Stem rust of wheat in Australia. *Australia Journal of Agricultural Research* 58:558-566.
- Peterson, RF., Campbell, AB., Hannah, A. 1948. A diagrammatic scale for estimating rust intensity on leaves and stems of cereals. *Canadaian Journal Research* 26: 496-500.
- Saari EE, Prescott JM (1985) A scale for appraising the foliar intensity of wheat disease. *Plant Disease Reporter* 59: 377-380.
- Stakman EC, Stewart DM, Loegering WQ (1962) Identification of physiologic races of *Pucciniagraminis var. tritici*. USDA ARS, E716. United States Government Printing Office: Washington, DC.