

Sources of resistance to stem, and yellow rust diseases in CIMMYT durum wheat lines, Ethiopian durum wheat landraces, and commercial cultivars

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Abstract

Fungal diseases such as, stem rust (*Puccinia graminis f.sp tritici*) and yellow rust (*P. striiformis f.sp tritici*) cause serious challenges to wheat production in Ethiopia. In the past decades, many wheat varieties became out of production due to the frequent occurrence of new virulent races. Most of the major rust resistance genes deployed in commercial wheat cultivars succumb to emerging races of the pathogens. The objective of this study was to identify stem and yellow rust resistance in the Ethiopian durum wheat landraces, cultivars and CIMMYT advanced durum wheat lines. During 2020- 2021 main cropping season, a total of 854 (306 land races, 40 cultivars and 507 CIMMYT durum wheat lines) germplasm were evaluated against stem and yellow rust at Debre Zeit and Meraro, respectively. Nineteen percent (n=507), 7.5% (n=40) and 4.9% (n=306) of the tested CIMMYT advanced durum wheat lines, commercial cultivars and landraces exhibited resistance to moderately resistance reaction to stem rust at Debre Zeit whereas only 13.8%, 10% and 2.3% of the entries showed RMR to yellow rust at Meraro. From the total tested materials 853 (18 lines) exhibited combined resistance to the prevailing races of stem and yellow rust diseases. Fourteen of these are from CIMMYT advanced lines while the remaining, four accessions are landraces. In general, CIMMYT durum wheat lines showed better resistance to moderately resistance as compared to the Ethiopian landraces and commercial cultivars. The newly identified sources of resistance will be exploited in the durum breeding program whereas; the CIMMYT advanced lines with good agronomic traits will be promoted to yield trials.

Introduction

Breeding durum wheat varieties with durable resistance to rust diseases are priority in several wheat breeding programs worldwide including Ethiopia. Most of the major rust resistance genes deployed in commercial wheat cultivars succumb to emerging races of the pathogens in Ethiopia. Identifying and utilization of new sources of resistance to stem, and yellow rust diseases in advanced durum wheat breeding lines minimize losses and sustain durum wheat production. This study was initiated to identify stem and yellow rust resistance in the Ethiopian durum wheat landraces, cultivars and CIMMYT advanced durum wheat lines.

Materials and Methods

A total of 853 germplasm consisting of 507 CIMMYT advanced durum wheat lines, 40 released varieties and 306 Ethiopian durum wheat land races were evaluated against stem and yellow rust at Debre Zeit and Meraro during 2020 and 2021 main seasons.

The testing sites are known to be hot spots for the respective diseases in Ethiopia. The lines were sown in double rows of 1 m length with 0.2 m inter-row spacing. Augmented design was used with three checks (*Mangudo*, *Malefia* and *LD-357*) replicated after fifty entries. A total of three wheat cultivars (*Digalu*, *Malefia* and *Leeds*) were used as spreader rows in the field nursery for stem rust. Spreader rows for stem rust nursery was inoculated with the bulk of stem rust spores three times starting from stem elongation growth stage using syringe and spray methods at booting (Fig 1).

The test materials were exposed to yellow rust under natural conditions at Meraro. The rust diseases were scored according to the modified Cobb's scale (Roelfs et al., 1992). The diseases notes were taken three times for both diseases while the terminal severities and disease reactions were used for comparison.



Figure 1. Field showing the international wheat stem rust screening nursery at Debre Zeit (different methods of inoculation and final view)

Results and Discussion

Of the 853 germplasm, 97(19.1%), 3(7.5%), and 15(4.9%) of CIMMYT advanced lines, cultivars and landraces were resistant/moderately resistant to stem rust, respectively. Whereas, 197(38.9%), 3(7.5%), and 188(61.4%) of CIMMYT advanced lines, cultivars and landraces exhibited intermediate reaction to stem rust, respectively (Figure 1 and table 1). However, 18(2.1%) entries exhibited resistance to the two diseases. Based on the disease data of the evaluated CIMMYT advanced entries 176(34.6%) and 44(8.7%) of the entries were showed intermediated reaction to stem and yellow rust, respectively (Table 1 & 2). Of the tested land races 209 (67%) and 35(11.2%) showed intermediate reaction against stem and yellow rust, respectively (Table 1&2). Of the tested germplasm, 70(13.8%) showed the coefficient of infection 1-4 and exhibited R/MR reaction to yellow rust Table 2 and Fig 2). As compared to landraces and cultivars, CIMMYT advanced lines were more resistant to yellow rust. However, durum wheat landraces were susceptible to moderately susceptible to yellow rust (52%) (Table 2).

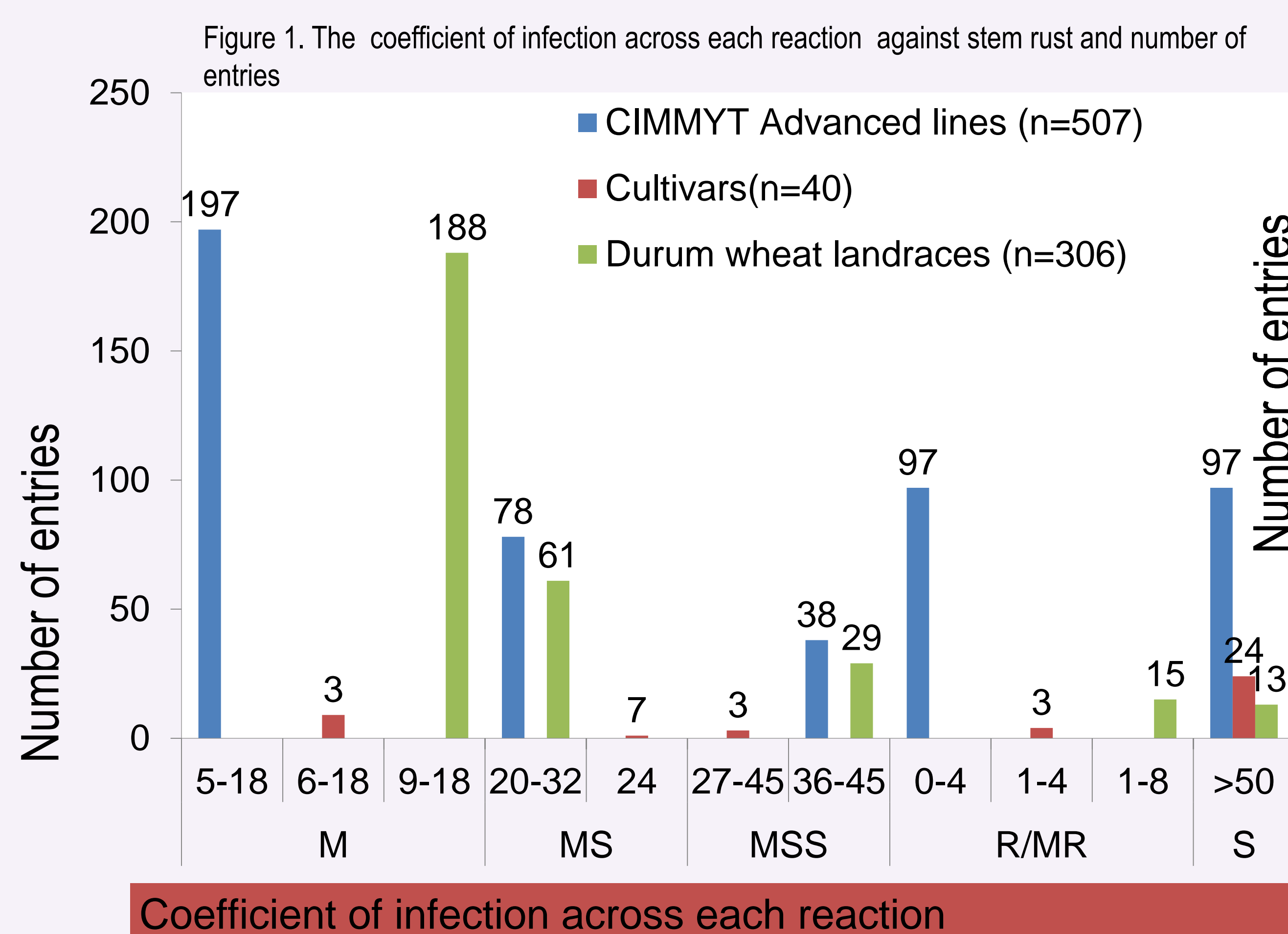


Figure 2. The coefficient of infection across each reaction against yellow rust and number of entries

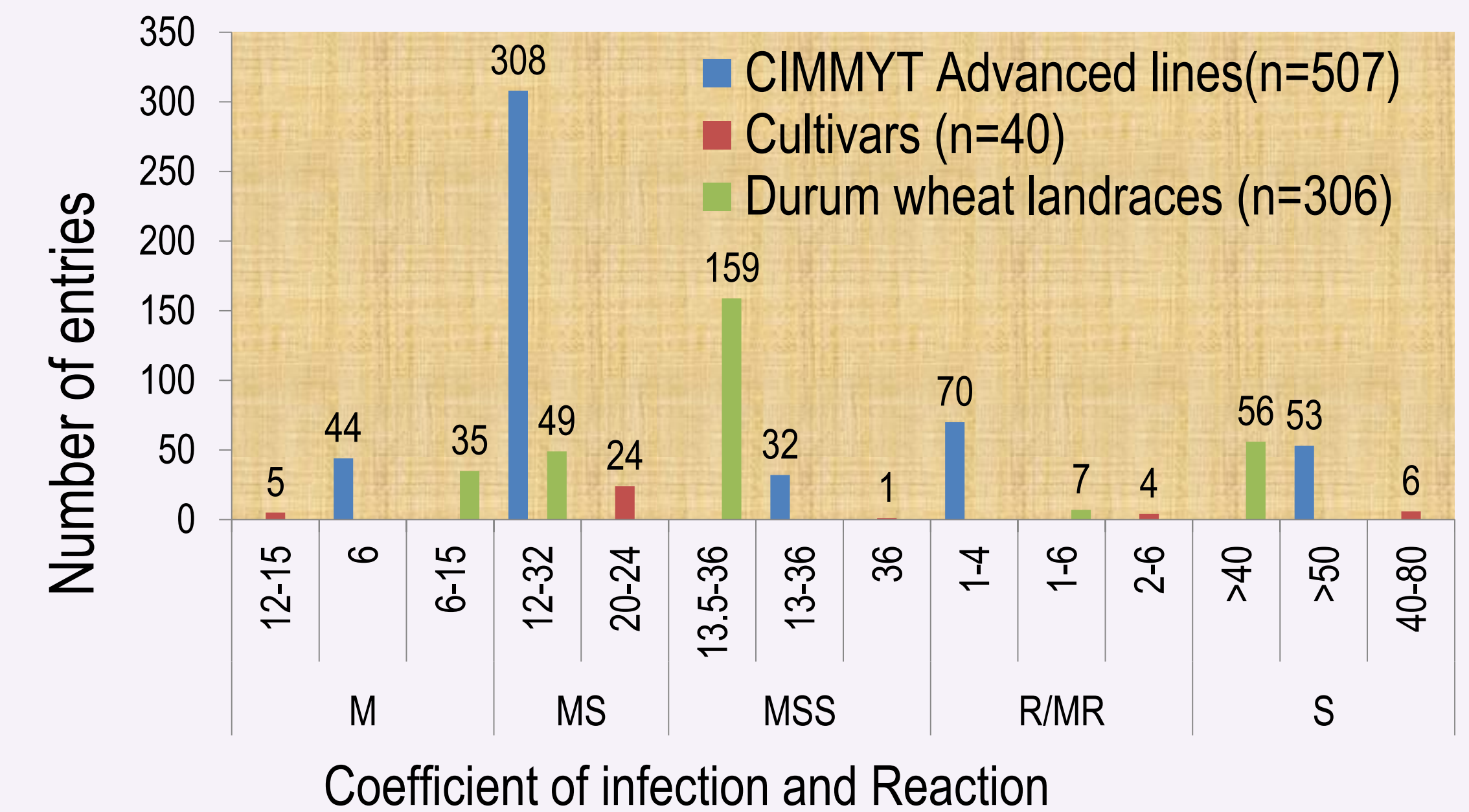


Table 1. The frequency (%) distribution of CIMMYT advanced lines, commercial cultivars and landraces in different reaction type to stem rust

Reaction type to stem rust	CIMMYT Advanced lines (n=507)	Ethiopian Cultivars (n=40)	Ethiopian landraces (n=306)
R/MR	19.1	7.5	4.9
M	38.9	7.5	61.4
MS	15.4	17.5	19.9
MSS	7.5	7.5	9.5
S	19.1	60	4.2

Table 2. The frequency (%) distribution of tested durum wheat lines, commercial cultivars, and landraces in different reaction type to yellow rust at Meraro

Reaction type to yellow rust	CIMMYT Advanced lines (n=507)	Ethiopian Cultivars (n=40)	Ethiopian landraces (n=306)
R/MR	13.8	10	2.3
M	8.7	12.5	11.4
MS	60.7	60	16.0
MSS	6.3	2.5	52
S	10.5	15	18.3

Conclusion

The results of the current study indicated that the CIMMYT advanced durum wheat breeding lines have potential sources of resistance to stem, and yellow rust. Whereas Ethiopian durum wheat landraces showed good resistance to intermediate reaction (M) to stem rust disease. Most of the lines from CIMMYT advanced durum wheat lines are included in multi-location durum wheat variety trial by the breeding program at Debre Zeit. Lines which combined resistance and desirable traits (yield, quality) could be released to farmers for commercial production while others could be exploited in breeding program.

Reference

Roelfs, A.P., R.P. Singh, and E.E. Saari. 1992. Rust Diseases of Wheat: Concepts and methods of disease management. Mexico, D.F.: CIMMYT. 81 pages

