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Comparison of rust infection with area on different varieties of wheat in district Sialkot

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Pest Warning and Quality Control of Pesticides, [1]Gujranwala, [2]Hafizabad, [3]Gujrat, [4]Narowal
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Keywords

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Abstract

The pest survey was conducted to evaluate comparison of cultivated area of different varieties of wheat crop i.e. Inqulab-91; Sehar-2006; Lasani-2008; Faisalabad-2008; Punjab-2011; AAS-2011 and AARI-2011 with disease infection (%) at Tehsil level of District Silkot during Rabi 2011-12; 2012-13; 2013-14. Maximum 42.91% area of Sehar-2006 was cultivated however disease infection (25.38%) was recorded during 2012- 13 followed by 39.81% with 5.39% infection and 29.88% with 9.09% infection respectively during 2011-12 and 2013-14. The cultivated area of Lasani-2008 was 7.70%; 4.13% and 3.59% with disease infection recorded 0.63%; 0.00% and 12.12%. In Faisalabad-2008 cultivated area was 12.18%; 25.30% and 25.43% recorded disease infection 2.00%; 1.03% and 5.30% on it. In Punjab-2011, the area was cultivated 1.95%; 3.50% and 7.51% with disease infection was 0.00%; 0.00% and 2.16% respectively. In AAS-2011 total area was cultivated 1.41%; 7.37% and 8.09% with disease infection was recorded 0.00%; 0.00% and 1.57% respectively. The area of AARI-2011 was cultivated 6.92%; 3.60% and 3.49% with nil disease infection was recorded in all Tehsils of Sialkot. In Wheat variety Inqulab-91 the area was cultivated 19.78%; 7.74% and 3.49% with attack of disease was 4.81%; 11.35% and 19.83% during these three seasons. At the end it was concluded that the use of fungicides adds a huge cost to wheat production, which is a burden for many growers, especially in developing countries. The use of fungicides may also create health hazards to the human beings and naturally growing populations.

Introduction

Food scenario in world

Wheat (*Triticum aestivum*) is the most important widely cultivated cereal crop and leading source of food in Pakistan due to its properties, uses of grains and straw. Its grains provide 30% dry matter and 60% calories intake to the population of developing regions of the world. The rising global population and decreasing arable land, wheat production and yield improvement became crucial (Ruttan, 1993; Rajaram, 2002). Therefore, to fulfill the food demands the food produced in developing countries may be enhanced 70% upto 2050 (Semenov *et. al*., 2014). Stripe rust was a dominant disease in Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) in the late 1990s and early 2000s, accounting for yield losses of 20%-40% in 1999 and 2000 (Morgounov, *et. al*., 2004).

Food scenario in Pakistan

In Pakistan wheat was cultivated on an area of 8693 thousand hectares with production 24.2 million tons (Anonymous, 2012). Wheat is cultivated on an area of 1051 thousand hectares in Gujranwala division (Anonymous, 2013). Like other crops wheat has major threat to diseases infection which hindered its quality and decreasing yield. Food insecurity is increasing day by day subject to the prevailing climatic conditions (Sanchez, 2000; Siwar, *et. al*., 2013). These changes attributed to raise the temperatures, fluctuations in rainfall, consequently catalyses the severity of diseases that damage the crops.

Rust of wheat

Plant diseases are the major threat to the global food security, and have an ancient history resulting destruction of economies. Rusts are plant diseases caused by pathogenic fungi of order Pucciniales (previously known as Uredinales). An estimated 168 rust genera and approximately 7000 species, more than half of which belong to the genus *Puccinia*, are currently available. Rust fungi are highly specialized parasites with several unique features, rust usually affects healthy. Rust can attack diverse grass species resulting upto 60% loss of leaf, 30% for stripe and 100% for stem rust (Park, *et. al*., 2007; Hailu *et. al*., 2015) and 10% losses annually (Agrios, 2005). In Canada and USA, stem rust epidemic caused great wheat losses of approximately 4.5 million tons (USDA, 2009; Eversmeyer and Kramer, 2000).

Types of Rust

Wheat crop is affected by three types of rust namely stripe (yellow,) leaf (brown) and stem (black) rust. The most visible attributes of life cycle of rust is the formation of uredinia and telia.

Stem or black rust (*Puccinia graminis* tritici)

It is identified by the appearance of telia in black due to the black teliospores. Stem rusts distinguished by other types of rust as it form reddish brown to black spores that occur in oval or elongated postules have torn margin occurs on both side of leaves, stem and glumes.

Leaf or brown rust (*Puccinia triticina* or *Puccinia recondita*)

It is identified by the brown uredinia and stem rust appears yellow because of the yellow urediniospores on various plant parts (Marasas *et. al*., 2004). It can cause heavy loss upto 50% in susceptible genotype because of its occurrence and however its effect on total annual loss is more severe than stem and stripe rust in the world (Espino *et. al*., 2011). Leaf rust has appeared in epidemic form several times in Pakistan during 1978 a national loss of 86 million USD was estimated (Hassan *et. al*.1979).

Stripe or yellow rust (*Puccinia striiformis*)

This type of rust is caused by *Puccinia striiformis* f. sp. tritici, is one of the most important disease of wheat worldwide (Chen, 2005). The first reports of stripe rust and its distribution around the world were recorded by Hassebrauk (1965; Stubbs (1985); Line (2002); Li and Zeng (2003). The pathogen infects the green tissues of plants of cereal crops and grasses. Infection can occur anytime from the one-leaf stage to plant maturity depending upon the chlorophyll contents.

Symptoms

The area of attack of pathogen is small, orange pustules on upper surface of leaf which is circular and oval in shape randomly scattered over leaves of wheat crops. Initially it is easy to see a yellowing of leaf around the rust pustules. Yellow rust pustules are arranged in stripes however in later stages yellow rust can become very severe resulting leaf death. Initial signs are reddish-orange spore masses (pustules) that hit the roof through leaf surfaces under warm, humid conditions. Losses can be heavy, especially if drought conditions occur (Melvin and Newman, 1914).



Development of Pathogen

Mild winters and cool moist spring's favors disease development, subsequent inoculums that can be windblown to adjacent fields of wheat. Uredinio-spores can be blown freely over very long distances so infections in one area can be shifted to other fields. Free water on leaves and temperatures ranging from 0-25^{o}C favored for spore germination (Rapilly, 1979; Evans, *et. al*., 2008).

Environmental factors affecting rust

Hot summer temperatures and dry weather conditions are least conducive for the pathogen emergence. Above 25^{o}C the fungus becomes unable to produce spores and high temperature above 29^{o}C the pathogen died. Moist regions with frequent dew formation during the growing season provide conditions conducive for stripe rust, because high moisture promotes infection. However plant resistance is the main method to avoid epidemics and yield losses, changes in Pathogen virulence and the lack of effective durable resistance support the need for forecasting methods (Moschini and Perez, 1999). Wheat rust epidemics have been successfully predicted using mechanistic (Benizri and Projetti, 1992) and empirical approaches (Burleigh *et. al*., 1972; Evers meyer and Burleigh, 1970). The objective of this study was to find appropriate relationship of cultivated area with disease infection percentage of rust on different varieties of wheat in agro ecological condition of four tehsils of Sialkot during Rabi 2011-12; 2012-13; 2013-14.

Materials and Methods

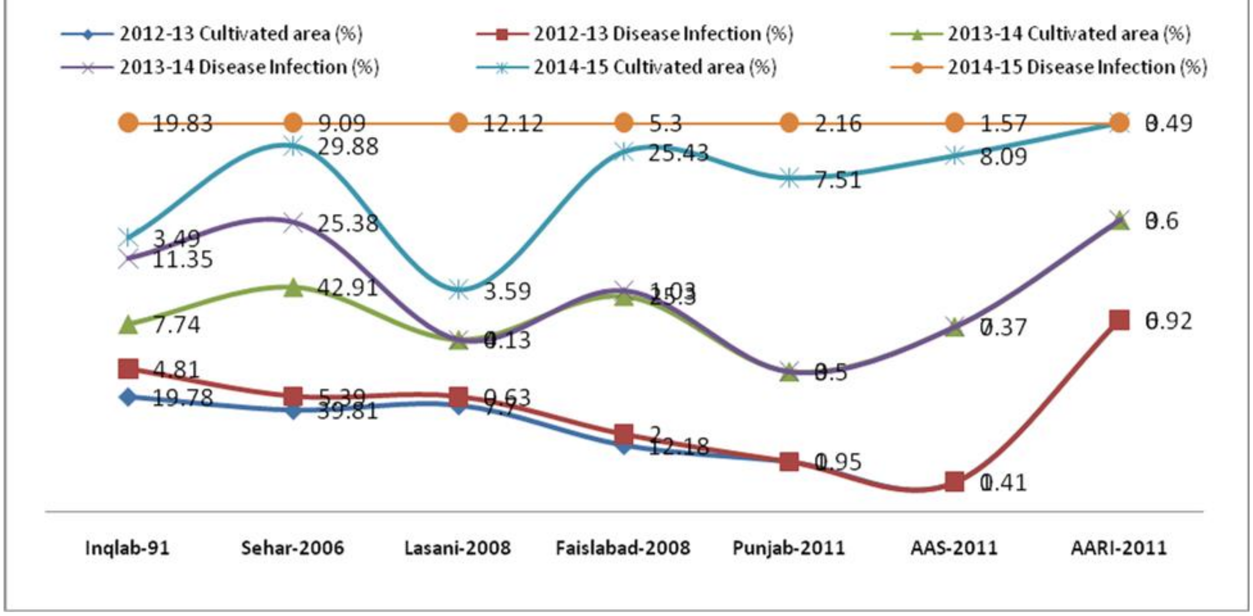
The pest survey was conducted to evaluate comparison of cultivated area of different varieties of wheat crop i.e. Inqulab-91; Sehar-2006; Lasani-2008; Faisalabad-2008; Punjab-2011; AAS-2011 and AARI-2011 with disease infection (%) at Tehsil level of District Silkot during Rabi 2011-12; 2012-13; 2013-14. The farmers were interviewed according to well designed pre-tested and approved questionnaire. Four tehsils from district Sialkot were selected randomly. Then from each tehsil four villages were randomly selected and from each village five farmers were interviewed thus making a total sample of 120 (Sher, *et. al*., 2015). The percentage area was calculated and disease infection (%) was recorded according to above mentioned varieties of wheat crop. Data on disease intensity was recorded from each location according to parameter given by Arain, *et. al*., (2017) and Iqbal, *et. al*., (2015).

Results and Discussion

Figure-1 maximum 42.91% area of Sehar-2006 was cultivated however disease infection (25.38%) was recorded during 2012-13 followed by 39.81% with 5.39% infection and 29.88% with 9.09% infection respectively during 2011-12 and 2013-14. The cultivated area of Lasani-2008 was 7.70%; 4.13% and 3.59% with disease infection recorded 0.63%; 0.00% and 12.12%. In Faisalabad-2008 cultivated area was 12.18%; 25.30% and 25.43% recorded disease infection 2.00%; 1.03% and 5.30% on it. In Punjab-2011, the area was cultivated 1.95%; 3.50% and 7.51% with disease infection was 0.00%; 0.00% and 2.16% respectively. In AAS-2011 total area was cultivated 1.41%; 7.37% and 8.09% with disease infection was recorded 0.00%; 0.00% and 1.57% respectively. The area of AARI-2011 was cultivated 6.92%; 3.60% and 3.49% with nil disease infection was recorded in all Tehsils of Sialkot. In Wheat variety Inqulab-91 the area was cultivated 19.78%; 7.74% and 3.49% with attack of disease was 4.81%; 11.35% and 19.83% during these three seasons. These results are in line with Afzal, *et. al*., (2008) who reported maximum disease in wheat crop. Developing resistant genotypes is one of the strategies to combat losses due to rust diseases in wheat producing regions of the world.

Yellow rust (*Puccinia striiformis* f. sp. tritici) is important biotic factor limiting wheat (Singh *et. al*., 2004; Wellings, 2011). Severe impact imposed by this foliar disease in terms of yield reduction ranging from 10 to 70% has mold research into its vigorous virulence as indispensable for sustainable control (Chen, 2005; Chen, 2007). The screened material would be incorporated further in hybridization programs to create genetic variability against rusts (Kolmer, 2013; Dubin and John, 2009). High humidity leads to stronger adhesion of urediniospores to the leaves (Rapilly, 1979). The disease can start very early in the crop season and, therefore, can cause severe damage in some areas than leaf rust. The effects of temperature on development of stripe rust, night temperatures play a more critical role than daytime temperatures (Stubbs, 1985).

Figure-1 showing comparison of area with disease infection (%) in different varieties of Wheat crop



Both dew formation and low temperatures occur together most frequently at night, and therefore, infections are more likely to occur at night. The cool weather at night allows stripe rust to develop and the pathogen to survive. Cold-weather conditions reduced the pathogen winter survival by winter killing the pathogen in the infected leaves. Therefore, temperature is one of the major weather factors used to predict occurrence of stripe rust (Chen, 2005). Although the disease was recorded for the first time in South Africa in 1996, it caused a widespread epidemic in spring wheat that year because of cultivar susceptibility and favorable weather conditions (Pretorius, 2004). An epidemic of stripe rust occurred in China in 2002 and affected about 6.6 × 106 ha of wheat in 11 provinces and caused a yield loss of 1.3 × 106 t (Wan, *et. al*., 2004). However other airborne fungal pathogens, long distance dispersal in the air and occasionally by human activities enables pathogens of stripe rust to spread to new geographic areas.

Management of rust

- To overcome rust associated problems resistance varieties should be the best option (Chen, 2005; Röbbelen and Sharp 1978; Line and Chen 1995).
- The foliar fungicides such as Difenaconazole @ 375mlha^{-1}; Propiconazole @ 625mlha^{-1}; Sulpher @ 2500gha^{-1} and Metiram @ 625gha^{-1} sprayed against rust (Iqbal *et. al*., 2015).

Conclusion

At the end it was concluded that the use of fungicides adds a huge cost to wheat production, which is a burden for many growers, especially in developing countries. The use of fungicides may also create health hazards to the human beings and naturally growing populations.

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