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INTEGRATED DISEASE MANAGEMENT OF BLACK POINT IN WHEAT IN PUNJAB (PAKISTAN)

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ABSTRACT

Black point or Kernel Smudge of wheat caused by a variety of fungi occur on developing kernels that do not exhibit symptoms. The disease causes reduced yield as well as quality affecting the market value of the produce. A project was conducted to suggest a disease management strategy to reduce losses caused by this disease. 46 wheat genotypes were screened for seedling development. Six Entries 7C032, CH 97, 7C037, 7C034, 5C034 and 6C045 showed more than 0.5 mm per hour radical and plumule development that is significantly higher than the rest of genotypes. Effect of four chemicals (Neem Leaf Extract, Neem oil, Thiophanate Methyl and Thiophanate Methyl M) was compared. Maximum germination and rate of plumule development showed Thiophanate Methyl M is the best treatment for black point infected seeds followed by Neem extract. The maximum increase in seminal root number was observed in Neem extract treatment. Disease incidence on wheat advance lines under different environmental conditions was carried at Barani Agricultural Research Institute Chakwal, Agronomic Research Station Karor, Cotton Research Station Multan, Ayub Agricultural Research Institute Faisalabad and Rice Research Institute Kala Shah Kaku showed that environmental conditions of BARI Chakwal and Rice Research Institute Kala Shah Kaku (35% and 40% incidence in susceptible cultivars respectively) are more conducive from rest of the locations.

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INTRODUCTION

Black point disease caused by several common fungi is characterized by a brown to black discoloration of the embryos of the wheat (*Triticum aestivum* L.) kernels. These fungi are most aggressive when the relative humidity exceeds 90% and is more prevalent in the seasons with heavy precipitation (McIntosh and Williamson, 2004). Several fungi were found to be associated with the black-point disease of wheat. *Alternaria, Cochliobolus, Fusarium, Cladosporium, Curvulavia, Penicillium, Aspergillus* and *Stemphylium* were predominant (Abdullah and Atrosh, 2014; Adlaka and Joshi, 1974; Conner, 1987; Conner et al., 1996; El-Khalifeh et al., 2002; Fakir et al., 1989; Fernandez et al., 1994; Ilyas et al., 1998; Kailash et al., 1987; Khanum et al., 1987; Malaker and Mian, 2002; Mishra and Srivastava, 2015).

Alternaria alternate (Fr.) Keissl*, Cochliobolus sativus* (Ito and Kurib.) Drechsler ex Dastur and *Fusarium graminearum* Schwabe had been repeatedly isolated from kernel black-pointed wheat and found to be pathogenic either alone or in combination (Agarwal et al., 1993; Ahmed et al., 1994; Conner and Kuzyk, 1988; Dhruj and Siddiqui, 1994; Fernandez et al., 1994; Huguelet, 1973; Pathak and Zaidi, 2013; Rana and Gupta, 1982; Srivastava et al., 2014; Toklu et al., 2008; Vassileve et al., 1997).

Reports in the past claimed the incidence of black point in reaped grain does not reduce yield but affects quality, the underprivileged look of wheat with black point decrease value of produce in market (CGC, 1983). But the work conducted in current century contradict the report of commission and support pathogens associated with the black-point disease occupies the status of one of the most serious problems of wheat, damaging yield and quality of wheat grains (Bhandari et al., 2003; Draz et al., 2016; Fernandez and Conner, 2011). Grain losses due to the disease ranged from 24 to 27% in susceptible cultivars due to a loss in both number of kernels and in kernel dry weight (Bhandari et al., 2003). In addition, toxin contents were recorded in the infected grains (Amatulli et al., 2013; Fernandez and Conner, 2011).

Black point can occur at detrimental levels in some seasons. The paramount alternative for control is to combine seed treatment with black point resistant cultivars. The objective of this study was to evolve multidimensional disease management strategy. Following studies were conducted to achieve the target:

1- Screening of wheat genotypes against Black point
2- The efficacy of different commercial and botanical fungicides on black point was compared.
3- Incidence of black point under different agro-ecological conditions.

MATERIAL AND METHODS

Evaluation of wheat genotypes against black point infestation: Experiment was conducted to study the influence of black point infestation on wheat seedling development. Experiment was laid out on complete block randomized design to evaluate breeding material from Barani Agricultural Research Institute, Chakwal. Forty-six wheat genotypes infected with black point were tested. Five wheat seeds of each variety/genotype were placed in moist chamber under aseptic conditions under randomized design with three replications. These moist chambers were incubated under 12-hour light/darkness at 15^o C initially. Temperature was raised 21^0 C after germination initiated. Data on plumule, radical and seminal root development was recorded after 96 hours with an interval of 24 h.

Effectiveness of fungicides on black point: A trial was conducted to compare the effectiveness of different commercial and botanical fungicides on black point in vitro. Wheat seeds infected with black point collected from BARI Chakwal were used for this purpose. Seeds were treated with

1) Neem Leaf extract (at concentration of 2 ml/L)
2) Neem oil (Cold Pressed Neem Oil) (3 table spoons in one gallon of water)
3) Thiophanate Methyl (Topsin M) (0.307 fl.oz/ cwt)
4) Thiophanate Methyl M (Mancozeb) (250 ppm)
5) Control

Neem tree, *Azadirachta indica* Juss., a member of the *Meliaceae* family that originates from the Indian subcontinent and is now valued worldwide as an important source of phytochemicals for usage in human fitness and pest control. *Azadirachta* is a fast-growing evergreen tree small-to-medium sized, with extensive and dissemination branches. It can grow in high temperatures as well as poor or degraded soil. The young leaves are reddish to purple, while the mature leaves are bright green, consisting of petiole, lamina, and the base that attaches the leaf to the stem and may bear two small lateral leaf-like structures known as stipules (Forim et al., 2014; Norten and Pütz, 1999).

Preparation of neem extract: Herbal material was desiccated under shade was crushed to a fine powder and extracted (48 h) with absolute ethanol in a soxhlet apparatus (Ndukwe et al., 2006). The solvent was detached by means of rotary evaporator under reduced pressure at temperature below 50^o C. The resulting rough extract was kept at -20^{o}C until assayed. Stock solutions and serial dilutions of extracts and fractions were prepared in dimethylsulphoxide (DMSO) following (Ambrozin et al., 2004).

Criteria used to assess various treatments was the germination of grains. Twenty-five seeds were used in each treatment with five seeds per moist chamber. These treated seeds were placed in humid chamber (three blotting papers in each glass chamber) under hygienic conditions. These moist chambers were incubated under 12-hour light/darkness at 25^o C. Trial was conducted in early March. Data of following parameters were recorded at 48-hour interval.

1- Germination
2- Plumule length (mm),
3- Radical length (mm)
4- Seminal root (number)

Evaluation of wheat advance lines against black point incidence under different agro-ecological conditions: Wheat advance lines were evaluated against black point under different agro-ecological conditions with collaboration of Wheat Botanist BARI, Chakwal. Field experiments were sown at five locations at BARI Chakwal, ARS Karor, CRS Multan, AARI Faisalabad and RRI Kala Shah Kaku. Disease incidence data were recorded after threshing by taking ≈ 1500 grains per entry per location (Table 1).

Table 1. Geographic coordinates of Locations surveyed.

	Geographic coordinates of Locations				
	Chakwal	Faisalabad	Kala Shah Kaku	Karor	Multan
Latitude	32.93°	34.33°	31.74°	34.46°	30.2°
Longitude	72.85	72.28°	74.25°	72.8°	71.4°
Altitude	523 m	365m	207 m	764m	123 m

RESULTS AND DISCUSSION

Data of Wheat advanced material screened against the disease indicated test material showed susceptible response however diversity in response was noted against the disease (Figure 1). Based on the samples collected from different locations the results indicate that black point infestation was maximum in Chakwal. Karor, Multan and Faisalabad were found free from black point. Infestation (%) of Black point on all wheat advance lines was recorded in all genotypes in Chakwal but only three entries showed infestation (%) under the conditions of Kala Shah Kakoo. Data recorded is presented in graph below (Figure 2). Thiophanate Methyl performed best followed by Neem Leaf extract among the chemicals tested (Figure 3).

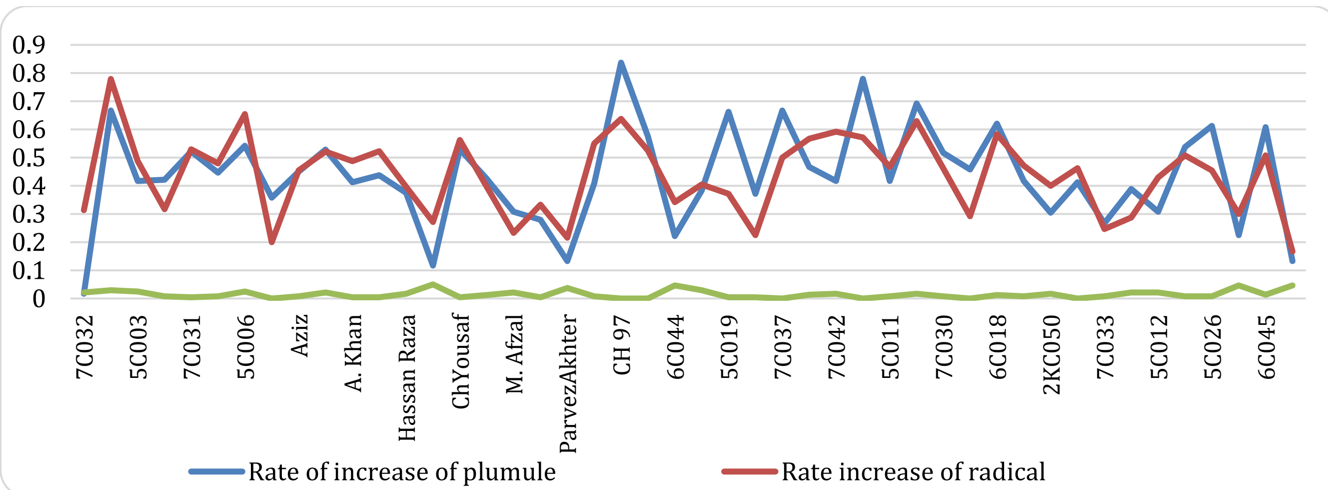

Figure 1. Screening of wheat genotypes against black point.

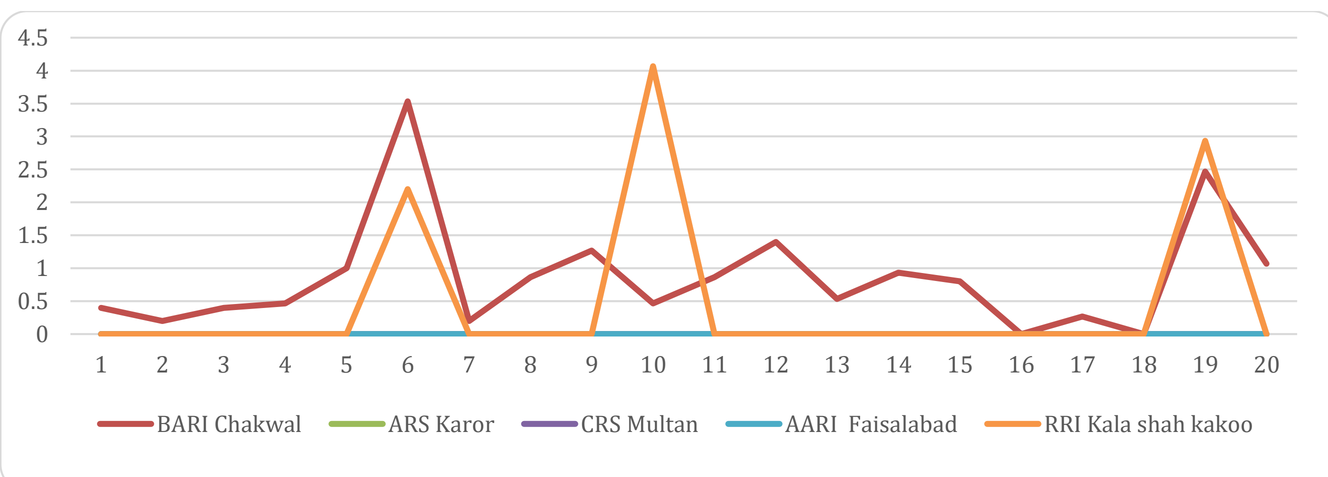

Figure 2. Response of wheat genotypes under various environmental conditions.

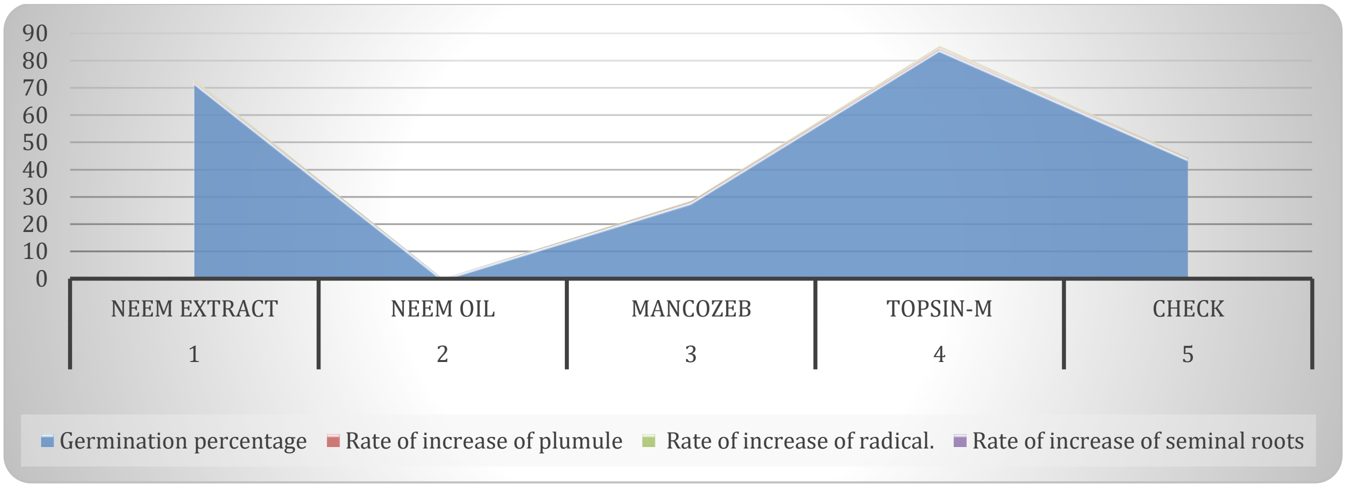

Figure 3. Efficacy of fungicides (Herbal and systemic) against black point.

Climatic conditions during grain ripening, almost three weeks after flowering is the most vulnerable growth stage for black point. High humidity or frequent rainfall from milk to soft dough stage, late season irrigation and lodging initiate infection by these seed-inhabiting fungi. Liability against disease appears to alleviate at lower grain moisture content hence late precipitation are likely to decrease injury caused by black point. Genotypes which flower late appears to decrease the possibility of black point due to the fact the crop has a better opportunity of escaping persistent rainy periods, which are associated with high humidity (Fernandez and Conner, 2011). The development of black point or smudge is very weather dependent. Little can be done to prevent this problem especially in rain fed areas.

Existing cultivars lack resistance against the disease, however the response of genotypes is diverse against infection and in severity. Under the situation disease did not appear is attributed to environment and not resistance. If the incidence of black point is not high, the seed can be planted, following proper chemotherapy. In the study conducted it has been revealed that Chakwal and Kala Shah Kaku have been identified hot spot of disease. It is hereby suggested to adopt precautionary measures against disease in these regions (Cultivation of resistant varieties and seed treatment). Moreover, multilocational trials in the regions may be conducted which have not been addressed in this study to pinpoint hot spots of disease. The results provided information on status of disease resistance in germplasm as well as a reference for identifying locations where disease is prevalent and impact of seed treatment.

Pakistan is among the list of wheat exporting countries. Disease effects the quality of crop severely therefore effects marketing of produce. So, it is need of hour to address the quality along with the quantity to compete in the global market of wheat. Therefore, it has become need of hour to address not only foliar diseases of wheat like rusts and powdery mildew affecting yield but smuts and black point as well responsible for reduced commercial grade of wheat causing economic losses to producers.

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