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REGULAR ARTICLE

EVALUATION OF DIFFERENT GERMPLASM OF *BRASSICA JUNCEA* AGAINST *OROBANCHE AEGYPTIACA*

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ABSTRACT

Among the major weed groups that cause huge economic losses to important cropping systems, *Orobanche* species are greatly devastating. Egyptian broomrape (*Orobanche aegyptiaca*) is a parasitic weed causing major yield loss in many field and vegetable crops and is a serious threat to Indian mustard. In this study, severalgenotypes of Indian mustard were screened in order to identify resistant genotypes against *O. aegyptiaca*. In the greenhouse conditions, genotypes were different in the degree of susceptibility to Broomrape. Attachment number, emergence number, and dry matter of parasitic broomrape were affected by biomass of genotype. A significant impact of the parasitism onto the dry weight of all infected mustard genotype with variable degree was observed. Broomrape attachment was observed in all the cultivated genotypes with Pusa mustard 24 being the most susceptible with the greatest number of emerged Orobanche shoots. In contrast, no emergence shoots were observed in four out of the fifteen genotype viz., Pusa Jaikisan, Pusa bold, Pusa Vijay and Pusa mustard 26 which have less attachment number and emergence number. These genotype appear to be interesting for our objectives.

Keywords: *Orobanche aegyptiaca;* Parasitic weed; Resistance and susceptibility

INTRODUCTION

Among the major weed groups that cause huge economic losses to important cropping systems, *Orobanche* species are greatly devastating [1]. They cause severe damage to a wide array of dicotyledonous families such as Brassicaceae, Solanaceae, Apiaceae, Asteraceae [1]. In India, this noxious weed is a major threat to Indian Mustard [*Brassica juncea*(L.), Czenand cross)]. Due to the high parasitic seed bank in agricultural soils of Haryana, Punjab, Northern Rajasthan, Western U. P. and Northeast Madhya Pradesh [2, 3], the biotic potential of these mustard growing states has declined greatly below the optimal levels. Broomrapes are plant root parasites devoid of chlorophyll and therefore autotrophic potential. The modus operandi of these highly competitive plant parasites are to attach themselves with the crop root and divert minerals, water and even nutrients (mainly carbohydrates and amino acids) [4]. The beginning of host-parasite interactions is marked by the release of germination stimulants in the host root exudates. The qualitative analysis of some of these has revealed their chemical nature; the first one being strigol, a sesquiterpene [5] found on cotton root exudates. Sorghum [6], Red clover [7] have also been found to produce such stimulants but their chemical nature is still unknown.

O. aegyptiaca (syn. *Phelipanche aegyptiaca)* or egyptian broomrape has various vernacular names such as Margoja, Mukhri, Kumbhi Or Gulli [8]. It is a frequent, harmful and obligate holoparasite of the *Orobanche* genera. *O. aegyptiaca* with their haustorial cells penetrate crop roots and cause great damage to crops across the world. A significant reduction of around 15-49 % has been recorded in the yield of mustard, which is one of the most important oil seeds [9]. For the control of parasitic weeds, several methods are available with more or less efficiency such as preventive, crop rotation, cover crop, tillage, irrigation, mulching, solarization, flaming, steaming, chemical fertilizer and biological methods. These have been evaluated by the various worker such as [10-18]. But the most reliable method for the control is using the resistant host against parasite. In view of the aforementioned, the core objective of this study was to evaluate the response of different genotypes of mustard to *O. aegyptiaca*.

MATERIALS AND METHODS

Seeds of fifteen varieties/germplasm of oilseed rape (Pusa Bold, Pusa Agrani Pusa Jagannath, Pusa Mahak, Pusa Karishma, Pusa Mustard 21, Pusa Mustard 24, Pusa Vijay, Pusa Mustard 22, Pusa Mustard 25, Pusa Tarak, Pusa Mustard 26, Pusa Mustard 27, Pusa Mustard 28 and Pusa Jaikisan) were obtained from IARI, New Delhi. Collection of *O. aegyptiaca* seeds was done during a preliminary field survey in Banda District of Uttar Pradesh 2014-15. To break the dormancy and initiate seed germination, *O.*

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aegyptiaca seeds were exposed to Gibberellic Acid (30 mg L^{-1}) for one week at 18 °C in darkness. Followed by preconditioning as described by the method of Plakhine *et al.* [19]. After the conditioning, approximately 100 *Orobanche* seeds per kg soil were mixed in pot containing two weeks old mustard seedling. Pots were arranged in two complete randomized block designs with three replicates, each for the control and the inoculated set (genotype containining *O. aegyptiaca* seeds). After 10 w of sowing, host plants were uprooted and roots were observed under a binocular microscope, after gentle washing in water to determine the number and developmental stage of broomrape attachments. Moreover, percentage reduction in dry weight of inoculated genotype over control; total number of *Orobanche* attached and total *Orobanche* dry weight (g) were recorded for statistical studies.

Statistical analysis

Pearson correlation coefficients were calculated to assess relationships between percentage reduction in dry weight of inoculated genotype over control and *Orobanche* dry weight (g). For the relationships with the highest Pearson correlation coefficient (percentage reduction in dry weight of inoculated genotype over control), regression analysis was conducted using PROC REG to obtain slope.

RESULTS AND DISCUSSION

The interpretation of statistical analysis of results found that none of the genotype appeared immune to broomrape since, at 10 w after infestation, all had at least one broomrape attachment on their roots (fig. 1). Broomrape attachment was observed in all the cultivated genotypes with Pusa mustard 24 being the most susceptible with the greatest number of emerged Orobanche shoots (fig. 2). In contrast, no emergence shoots were observed in four out of the fifteen genotype viz., Pusa Jaikisan, Pusa bold, Pusa Vijay and Pusa mustard 26. Our results are accord with Shukla [20] who screened two hundred fifty genotype of mustard against broomrape and he found out of these thirty-three accession were severely affected.

Expressing resistance by total dry weight of *O. aegyptiaca* (tubercles and *Orobanche* shoot) showed considerable variation among the mustard genotype from 4.80 g to more than 15.67 g per mustard plant. Among the genotype, Pusa bold resistant reaction with 4.80 g broomrape dry weight. Moreover, genotype Pusa mustard 24 was the most susceptible in term of parasite 15.67 g dry weight.

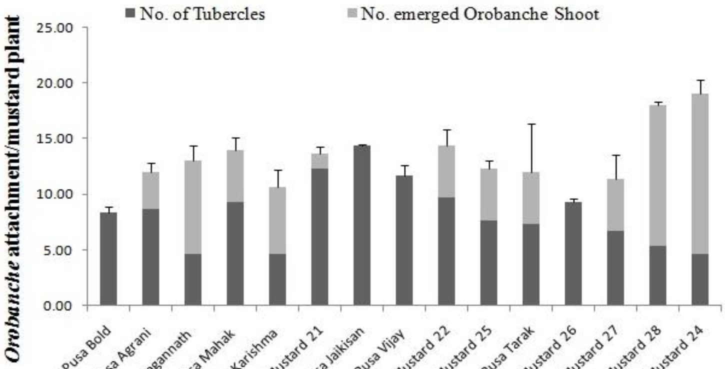

Fig. 1: Tubercle and emerged orobanche shoots grown on mustard genotype. Results represent mean numbers of three replicates

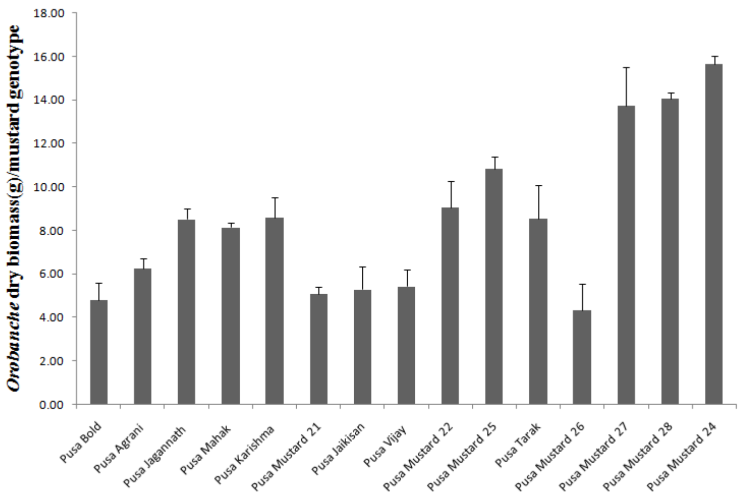

Fig. 2: Total dry weight of *Orobanche* (tubercle and emerged Shoot) grown on mustard genotype, results represent mean numbers of three replicates

The broomrape dry weight was positively correlated with mustard growth parameters. The highest Pearson correlation coefficients were observed between total mustard dry weight and Egyptian broomrape total dry weight (0.880). Regression analysis demonstrated that each 1 g increase in *Orobanche* dry weight corresponded to a 4.85 % decrease in dry weight in inoculated genotype in comparison to control (fig. 3).

In other words, mustard with high biomass generally supported greater growth of *O. aegyptiaca viz.,* the Pusa Jaikisan genotypes had the highest biomass (27.76 g) and supported the highest broomrape dry weight (14.80 g). Conversely, genotypes with low root dry weight (e. g. Pusa Jagannath) generally had correspondingly low Egyptian broomrape dry weight. However, there were some deviations from this relationship. For example, the Pusa Vijay and Pusa mustard 22 genotypes had almost equal biomass, 15.02 and 15.09g respectively, but they showed high levels of deviation in Egyptian broomrape dry weight in correspondence their host genotype. In our literature analysis revealed that only one study was conducted by Zehhar *et al.* [21] they found that all the fifteen screened varieties were susceptible to *O. ramosa*. However, the variation in susceptibility of varieties was also noticed.

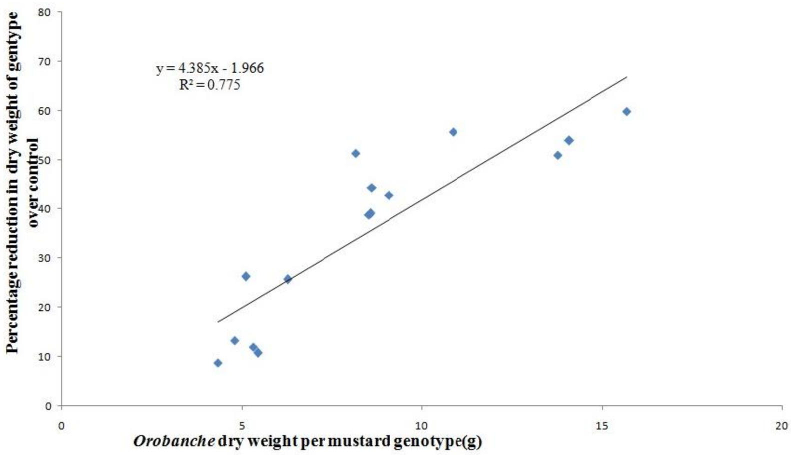

Fig. 3: Correlation between mustard biomass and *Orobanche* total dry weight

A range in susceptibility exists within the fifteen oilseed rape genotype when the three parameters were used to measure the resistance of mustard species to *O. aegyptiaca*: the total number of tubercles, of emerged Orobanche shoots and broomrape dry weight per mustard plant ten weeks after sowing, in all the varieties screened.

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