Available Online at EScience Press
Plant Protection
ISSN: 2617-1287 (Online), 2617-1279 (Print)
http://esciencepress.net/journals/PP

IMPACT OF CROP ROTATION ON CERCOSPORA LEAF SPOT OF PEANUT

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ARTICLE INFO

Article history
Received: 29th January, 2019
Revised: 26 March, 2019
Accepted: 4th April, 2019

Keywords
Arachis hypogaea L.
Cercospora Leaf spot
Crop rotation
Peanut
Tikka disease

ABSTRACT

Among various diseases of peanut (*Arachis hypogaea* L.), Cercospora leaf spot (CLS) is the most detrimental leading to reduced yield in peanut crop. CLS builds up in the soil when the same crop is cultivated in the same plot year after year. Rotation with non-host crops is a cultural practice used as disease management strategy in soil borne diseases. A field experiment was conducted to study the impact of duration of crop rotation to control CLS. Sowing of peanut crop in fallow land or in land with one- or two-years rotation of non-host crop of Cercospora leaf spot delayed disease initiation from 58 to 108 days and gave better yields than plots with left over seed of previous year. Lesser % infection rates in field with one-year rotation (13.91%) and two years (11.72%) were observed. Among the yield parameters, 100 pods (unshelled) weight remained significantly higher in plots in fallow land during both the years. Hundred pods weight in one- and two-year rotations were at par with each other. Results of experiment supported the hypothesis that rotation with non-host crop is a practical approach leading to decreased inoculum pressure which eventually control disease in next year.

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INTRODUCTION

The cultivated peanut (*Arachis hypogaea* L.), is one of the largest leguminous oilseed crops grown in rainfed conditions (Anonymous, 2016). Cercospora leaf spot (CLS) commonly known as Tikka disease of peanut in Indo-Pak subcontinent, is recorded frequently. Damage from CLS is 50 to 70% depending upon degree of resistance of peanut varieties cultivated (Zongo et al., 2019). Crop rotation is considered one of the important cultural methods aiming at eradicating or reducing the amount of soil-borne pathogens from a field and ultimately reducing yield losses (Larkin and Lynch, 2018) as it does not particularly prevent loss of fertility because it is a sanitary measure (Gangopadhyay, 1998).

Soilborne diseases are hard to control since they are caused by pathogens which can endure for extended ages in the absence of the normal crop host. Chemotherapy frequently does not work well as evolution of resistant genotypes of plants is not an easy job. Host range of this pathogen is very limited to only peanut crop. Amount of disease inoculum in soil may decrease if peanut crop is rotated with any other crop for one to three years (Boudreau et al., 2016). Rotating land out of susceptible crops can be an effective and relatively cheap practice for controlling various diseases, but the known life cycle of the pathogen is obligatory for crop rotation in disease management. However, the cultivation of non-host crops is crucial until the pathogen in the soil is eliminated or its inoculum decreased to a degree that leads to insignificant yield losses. To manage a disease successfully with rotation, one must be familiar with the information described viz. survival of pathogen in the soil, plant species (including weeds and cover crops) it can survive on, other ways it can survive between susceptible crops, disease cycle and methods for managing other pathogen sources. For example, a pathogen that can survive in the soil but can also disperse by wind may not be successfully managed by rotation if an infected planting occurs nearby or the spores can disperse long distances.

The current trial was carried out to investigate the influence of duration of crop rotation on initiation and progression of Cercospora leaf spot disease of peanut when it is rotated with any of the non-host crop under rainfed conditions. Findings of the work conducted has been discussed as under along with the methodology used.

MATERIALS AND METHODS

The present study was conducted at Barani Agricultural Research Institute (BARI), Chakwal. Experimental layout was designed in complete randomized design (CRD) having plot size measuring 180 m length and 100 m width. Cropping systems were tested where peanut was rotated with sorghum [*Sorghum bicolor* (L.) Moench], pearl millets [*Pennisetum americannum* (Linn.) K. Schum], black gram [*Phaseolus mungo* L.]/ green gram [*Phaseolus aureus* Roxb.], gwar (*Cyamopsis tetragonolobus* (Linn.) Tabu., sesame [*Sesamum orientale* L.], cowpea [*Vigna unguiculate* (L.) Walp.] and by keeping fallow in summer *Brassica* spp., gram (*Cicer arietinum* Linn.) and lentil [(*Lens esculenta* Moench).]. A piece of land at the western end had a long row of [*Eucalyptus* spp L. Herit.] trees so it was kept under non-leguminous crops since long. It was first time cultivated with peanut during 2014 and 2015 by bifurcating into northern and southern plots after removal of *Eucalyptus* spp. plantation.

All field plots were prepared for next summer crop after harvesting of Kharif crop or in case of fallow fields deep ploughed for moisture conservation of winter rains. At the end of winter season before seedbed preparation two ploughings and plankings were done to conserve moisture for sowing. Two to four ploughings and one planking was applied after spreading fertilizers 24 hours before sowingof crop. Green gram, black gram and millets were sown in first week of July at the advent of summer rainfall. Harvesting of green gram, black gram, millets and peanut coincide with each other during month of October to November.

The trial composed following treatments

T1: Left over seeds of previous year;

T2: One-year rotation with non-host crop viz. (Millets, Wheat, Green Gram, Sorghum);

T3: Two-year rotation with non-host crop viz. (Sesame, Chickpea, Black);

T4: Fallow since long

Experiment was performed with three replications for each treatment in. For fallow land treatment, a field of half hectare reserved for the purpose, was sub divided into three sub plots across the slop. Data on disease initiation in all plots were recorded two times in a week till initial symptom was noted and rests of data for disease development were recorded at 45 days interval during first year and 30 days interval during second year of trial. Last data were recorded at first fortnight of September and additional data on defoliation were recorded just before harvesting of crop. Data were computed for infection percentage following the method described by Davis et al. (1993). Areas under disease progress curve were calculated by using equation developed by Shaner and Finney (1977). The experimental data were subjected to statistical analysis according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

Field experiments on the influence of crop rotation with non-host crop of CLS of peanut were conducted during 2014 and 2015. Better yield was recorded in two-year rotation of peanut with non-host crops. AUDPC in plots with fallow land were less than in plots with two-year crop rotations during 2014 and 2015. Minimum AUDPC and maximum yields in fallow plots (Figure 1, 2; Table 1). Higher yields were recorded in two years rotation plots than fallow land during 2014 and 2015.

Table 1. Yield (Kg/ha) and Days to CLS Initiation influenced by different crop rotation systems.

Treatments	Yield (Kg/ha)			Days to disease initiation		
	2014	2015	Mean	2014	2015	Mean
Left over crop	920	1290	1105	25	34	30
1 Year	2104a	1914a	2009	79a	87a	83
2 Year	3431b	2328a	2906	61a	58b	60
Fallow	3754b	1840a	2797	108b	89a	98

 DOI: 10.33804/pp.003.01.0111

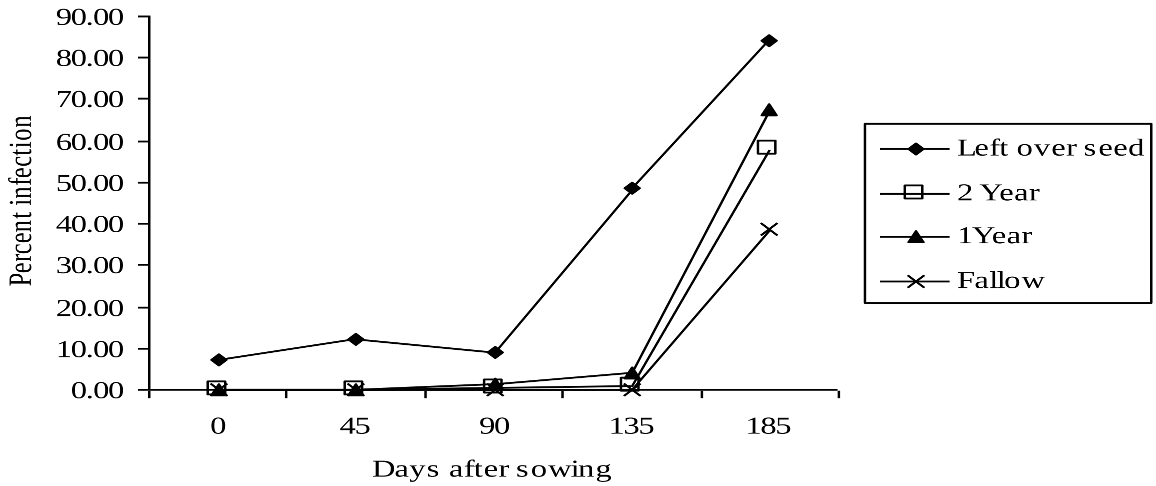

Figure 1. Area Under Disease Progress curves of CLS influenced by rotation systems with non-host crop (2014).

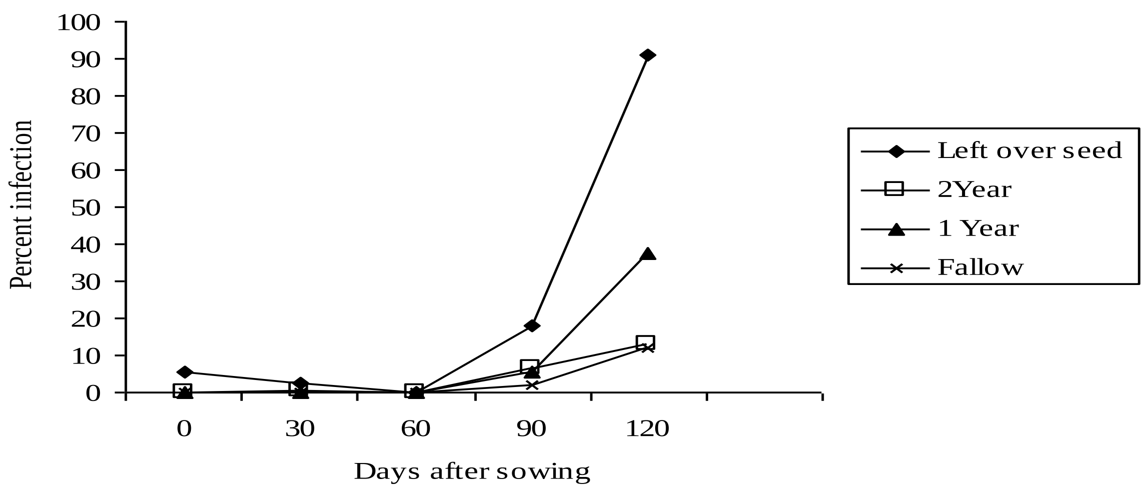

Figure 2. Area under disease progress curves of CLS influenced by rotation systems with non-host crop (2015).

In 2014, CLS disease initiated in plots with left over seeds in first week of March, 25 days before the sowing of normal peanut crop at onset of spring season rains. It initiated in plots with fallow land 108 days after seed sowing in month of June on onset of monsoon. In 2015 CLS disease in plots with left over treatment initiated in last week of April while in plots with one-year rotation disease initiated in first week of May. In 2015 minimum days to disease initiation (DDI) (34 days) were recorded in left over plots and maximum 89 days in fallow land (Table 2).

DDI were significant, while other disease parameters remained statistically at par in all treatments. Minimum infection percentage at final stage was observed in plots with fallow land (Table 2) and minimum defoliation just before harvesting was recorded in two-year crop rotation treatment although it was statistically at par with fallow plots during both the years. Less number of spots/leaves were recorded in two year and fallow treatments.

Minimum disease was recorded in fallow land followed by two-year rotation (Figure 1, 2) throughout crop season. CLS disease progressed at minimum rate in fallow and two-year rotations while maximum rates were computed in left over treatment (Table 2).

Among the yield parameters, 100 pods (unshelled) weight remained significantly higher in plots in fallow land during both years (Data not presented in tabulated form). Hundred pods weight in one- and two-year rotations were at par with each other. During 2014, 100 seed (shelled pods) weight was more in plots in fallow land but during 2015, maximum 100 seed weight was recorded in one-year rotations treatments. Twenty pods lengths another important yield parameter of peanut was significantly higher in fallow and one-year rotations treatments during 2014 but during 2015 difference was statistically not considerable.

Table 2. CLS infection (%) at initial and final stages influenced by crop rotation systems.

Treatments	Initial infection (%)			Final Infection (%)		
	2014	2015	Mean	2014	2015	Mean
Left over crop	7.34 b	5.55 a	6.45 a	84.06 a	91.02 a	87.54 a
1Year	0.67 d	4.80 a	2.74 c	67.47 b	37.47 b	52.47 b
2Year	2.31 c	5.60 a	3.96 b	58.19 c	12.88 c	35.53 c
Fallow	10.08 a	1.22 b	5.65 a	38.48 d	12.17 c	25.36 d

Generally, soilborne pathogens survive in the soil and plant debris up to numerous years. Crop rotation will be helpful to control the soilborne inoculum because if the host is not present for particular number of years then the amount of inoculum will be decreased. Satisfactory control through crop rotation is possible with pathogens that are soil invaders i.e. survive only on living plants or only as long as the host residue persists as a substrate for their saprophytic existence.

The phytosanitary measures for example removal of straw debris in monoculture, ploughed sowing and crop rotation can mitigate horizontal and vertical dissemination of the pathogen in debris borne diseases like Cercospora of peanut. Occasionally reimbursements of phytosanitary measures are curtailed by the advent of wind-borne conidia and conducive situation being decisive. Early leaf spot of peanut (*Cercospora arachidicola* H) infection percentage was lesser throughout the crop season when peanut was sown after rotation of three years with Bahia grass (Brenneman et al., 1995). The cropping sequence, though not in limits of these studies Late leaf spot of peanut (*Cercosporidium personatum* H) remained severe when peanut was sown after peanut than in plots rotation with maize. It has been concluded at Alabama that CLS in plots where peanut grown for consecutive two years had significantly lower ratings, compared to plots with continuous peanut production (Hagan et al., 2003).

Groundnuts benefit from fertilizers applied to preceding crops (Table 1). High seed yields are frequently obtained when nutrients are applied to a previous, not necessarily the preceding crop (Weiss, 2000). Our results are in concord with previous studies and revealed the importance of suitable crop rotations in initiation of disease and significant yields.

CONCLUSION

One-year rotation with non-host crop which is less exhaustive may be best option to mitigate the impact of disease. Keeping in view a planned cropping system may effectively mitigate the losses attributed to soilborne diseases. Further studies may be suggested on sequence of crops according to ecological conditions.

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