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Studies on sequence crops in management of chickpea wilt

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ABSTRACT

Present investigation was carried out at Pulses Research Unit, Dr.PDKV, Akola (M.S.) during *kharif* and *rabi* season in wilt sick plot, in which fungi population was observed more in rhizosphere of sunflower, soybean, and groundnut as compared with sorghum, mung and udid.There was a gradual increase in the propagules of *Fusarium oxysporum* f.sp. *ciceri* from sowing to harvesting of chickpea. In correlation study the inoculum range of 10.11 to 14.00 per cent was recorded and there was positive but non-significant correlation between the inoculum available and the wilt incidence in chickpea.

Key words : *Fusarium oxysporum ciceri*, Wilt, Sequence crops, Ccorrelation, Chickpea wilt.

INTRODUCTION

Among the pulses, chickpea (*Cicer arietinum* L.) is one of the most important legume crop of India. More than seventy pathogens have been reported on chickpea. *Fusarium oxysporum* f.sp. *ciceri* and *Rhizoctonia bataticola* are impotant (Zote and Dhutraj, 1996). The disease also causes the enormous losses in yield (Mathur *et al.,* 1960; Singh and Dahiya,1973; Jani *et al.,* 1999; Singh *et al.,* 1974; Nene *et al.,* 1996), and can be devasting, as it is soil borne as well as seed borne and survives on stubbles in the form of chlamydospores for over 8-20 years in soil. If the crop grown year after year, the inoculum of the pathogen built in the soil. It is very difficult to manage the disease either by way of adoption of prophylactic or curative measures. It is preferred to manage soil borne pathogens by using cultural practices rather than the cultural means. Hence, sequence cropping is a good example of a farm management practice carried out for diverse reason that results in an effective mechanism for diminishing the risks of losses due to plant diseases. Plant density affects the disease incidence. Thus raising crop in sequence is effective in lowering populations of soil borne diseases. Hence, the present study was undertaken to found suitable crop rotation sequence for management of wilt disease of chickpea.

MATERIALS AND METHODS

Field trial was laid out in Randomised Block Design (RBD) with three replications and seven treatments that is crops in rotations at Pulses Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *kharif* and *rabi* season. During *kharif* season six crops were sown in chickpea wilt sick plot and one plot was kept fallow as control. After harvesting of *kharif* crops chickpea was sown in *rabi* season. The plot size was 4.00 x 2.70 sq.m. The varieties used were Mung – AKM-8802, Udid – TAU-1, Soybean – JS-335, Groundnut – TAG-24, Sorghum – CSH-9, Sunflower – Modern, Chickpea – Chaffa-816.

Soil samples were collected from rhizosphere of different crops from sick plot. Isolation of rhizosphere mycoflora or pathogen from soil was done by using the dilution method of Dhingra and Sinclair (1995). After four days of incubation, number of distinct colonies were counted using colony counter. The fungal colonies were calculated per gram of soil by using the formula of Mc.Kinny (1923):

$$\frac{\text{Colonies average of three replication}}{\text{Amount plated (ml.) x dilution}}$$

Distinguished colonies were picked up and subcultured on an appropriate medium. Fungi were identified on the basis of morphological characters *i.e.* type of spores and spore attachment.

At the start of *rabi* season, after germination, chickpea plant population was counted. During study period wilted plants were counted periodically at 30 days interval. The per cent disease incidence was calculated by using the formula:

$$\text{Per cent wilt incidence} = \frac{\text{Number of wilted plants x 100}}{\text{Total no. of plants}}$$

RESULTS AND DISCUSSION

The data presented in Table 1(A) and 1(B) represent mycoflora (x 10^4) observed in rhizosphere of different crops grown during *kharif* season in wilt sick plot before chickpea.*Fusarium oxysporum* f. sp. *ciceri*

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Table 1(A) : Rhizosphere mycoflora (x 10^4) of different crops grown in wilt sick plot during *kharif* season

Sr. No.	Crops	Months	Mycoflora								
			Fusarium oxysporum f. sp. *ciceri*	*Tricho-derma* sp.	*A. niger*	*A. flavus*	*Penicillium* sp.	*Rhizopus sp.*	*Rhizoctonia bataticola*	*Curvularia lunata*	*Sclerotium rolfsii*
1.	Sorghum	July	0.66	-	6.00	14.00	4.00	-	-	-	-
		August	1.33	-	3.00	12.00	2.00	-	-	0.66	-
		September	2.00	0.66	4.66	4.33	1.33	-	-	1.33	-
		October	0.66	-	3.00	6.33	0.66	-	0.66	2.00	-
2.	Groundnut	July	2.00	-	4.66	14.66	2.00	-	4.66	-	-
		August	1.33	-	3.00	12.00	2.00	-	-	0.66	-
		September	2.66	-	4.66	13.66	2.00	-	-	1.33	2.00
		October	0.66	-	1.33	8.00	-	0.66	0.66	0.66	1.66
3.	Soybean	July	2.30	-	6.66	24.00	-	-	-	-	-
		August	0.66	-	-	14.00	4.33	-	1.33	4.00	-
		September	2.00	-	2.66	14.00	2.66	-	-	1.33	-
		October	1.33	-	5.33	8.00	1.33	-	2.00	2.00	0.33
4.	Sunflower	July	2.00	-	4.66	6.66	5.33	-	4.66	-	-
		August	2.66	-	1.33	24.00	3.33	-	1.33	3.33	-
		September	3.33	0.66	2.66	14.66	2.00	-	-	2.00	1.33
		October	1.33	-	5.33	8.00	1.33	-	2.00	2.00	0.33
5.	Mung	July	4.00	1.33	10.00	20.66	-	-	1.33	2.00	-
		August	1.33	0.33	2.00	2.66	0.66	-	-	-	-
		September	x	x	x	x	x	x	x	x	x
		October	x	x	x	x	x	x	x	x	x
6.	Udid	July	4.00	1.33	11.33	1600	-	-	1.33	2.00	-
		August	2.00	-	4.66	2.66	-	-	-	-	-
		September	x	x	x	x	x	x	x	x	x
		October	x	x	x	x	x	x	x	x	x

x :- Mung and Udid crops were harvested in the month of August

Table 1(B) : Mycoflora (x 10^4) observed in rhizosphere of different crops grown during *kharif* season before chickpea in wilt sick plot of chickpea

Sr. No.	Crops	July		August		September		October		Mean	
		Fusarium oxysporum f. sp. *ciceri*	Other fungi	*Fusarium oxysporum* f. sp. *ciceri*	Other fungi	*Fusarium oxysporum* f. sp. *ciceri*	Other fungi	*Fusarium oxysporum* f. sp. *ciceri*	Other fungi	*Fusarium oxysporum* f. sp. *ciceri*	Other fungi
1.	Sorghum	0.66	24.00	1.33	17.66	2.00	12.31	0.66	12.65	1.16	16.66
2.	Groundnut	2.00	25.98	2.00	27.64	2.66	23.65	0.66	12.97	1.83	22.56
3.	Soybean	2.00	30.66	0.66	23.66	2.00	20.65	1.33	18.99	1.50	23.49
4.	Sunflower	2.00	21.31	2.66	33.32	3.33	23.31	0.66	16.65	2.16	23.65
5.	Mung	4.00	35.32	1.33	5.65	x	x	x	x	2.67	20.49
6.	Udid	4.00	31.99	2.00	12.98	x	x	x	x	3.00	22.49

Other fungi observed : *Trichoderma* sp., *A. niger, A. flavus, Penicillium* sp. *Rhizopus* sp., *Rhizoctonia bataticola, Curvularia lunata, Sclerotium rolfsii.*

x :Crops were harvested

propagules observed in sorghum rhizosphere ranging between 0.66 - 2.00 x 10^4, whereas the other fungi propagules were 12.31 - 24.00 x 10^4 cfu/g during *kharif* season. The mean of *F. oxysporum* f. sp. *ciceri* was 1.16 x 10^4 whereas the mean of other fungi was 16.66 x 10^4. The other fungi were *Trichoderma* sp., *Aspergillus niger, A. flavus, Penicillium* sp., *Rhizopus* sp., *Rhizoctonia bataticola, Curvularia lunata* and *Sclerotium rolfsii*.Groundnut rhizosphere exhibited *Fusarium oxysporum* f. sp. *ciceri* and propagules were 1.83 x 10^4 and mean of other fungi were 22.56 x 10^4. The maximum mycoflora exhibited in the month of

August as compared to July, September and October. Soybean rhizosphere exhibited *F. oxysporum* f. sp. *ciceri* propagules in the range of 0.66 - 2.00 x 10^4 during *kharif* season. The maximum cfu exhibited in the month of July whereas the minimum cfu count observed in the month of October.

F. oxysporum f. sp. *ciceri* propagules observed in sunflower rhizosphere ranging between 0.66 - 3.33 x 10^4 whereas the other fungi propagules were 16.65 - 33.32 x 10^4. As the crops *viz*; mung and udid were

Table 2 (A) : Rhizosphere mycoflora (x 10^4) of chickpea grown in wilt sick plot during *rabi* season

Sr. No.	Crops	Months	Mycoflora								
			Fusarium oxyspor-um f. sp. *ciceri*	*Tricho-derma* sp.	*A. niger*	*A. flavus*	*Penicillium* sp.	*Rhizopus sp.*	*Rhizoctonia bataticola*	*Curvul-aria lunata*	*Sclerotium rolfsii*
1.	Sorghum-	November	1.33	1.33	3.00	6.66	4.00	-	-	2.00	-
	Chickpea	December	1.33	0.66	4.66	2.66	0.66	-	-	4.00	-
		January	2.00	3.33	4.66	4.33	2.66	-	-	1.33	-
		February	4.00	0.66	3.00	8.00	0.66	-	0.66	2.00	-
2.	Groundnut-	November	1.33	2.00	-	6.66	2.00	-	-	-	-
	Chickpea	December	1.33	4.33	5.33	14.00	2.00	-	-	0.66	-
		January	4.00	-	2.66	-	-	-	-	1.33	2.00
		February	6.66	-	1.33	8.00	-	-	0.66	0.66	1.66
3.	Soybean-	November	2.00	4.33	5.33	2.66	-	-	-	-	-
	Chickpea	December	2.66	3.33	5.33	14.00	2.00	-	-	0.66	-
		January	2.66	0.66	2.66	14.00	1.33	-	-	2.66	-
		February	4.00	3.33	5.33	6.33	1.33	-	2.00	-	-
4.	Sunflower-	November	1.33	3.33	1.33	-	5.33	-	-	-	-
	Chickpea	December	2.00	-	6.66	2.66	4.33	-	-	-	1.66
		January	4.00	-	4.66	13.66	2.00	-	-	0.66	-
		February	4.66	0.66	4.66	11.33	0.66	-	-	2.00	0.33
5.	Mung-	November	0.66	0.66	2.00	-	-	-	4.66	-	-
	Chickpea	December	2.00	-	10.00	24.00	-	-	1.33	-	-
		January	4.66	-	-	14.66	2.00	-	-	-	-
		February	6.66	-	1.33	1.33	-	0.66	-	0.66	0.33
6.	Udid-	November	0.66	-	2.00	2.66	-	-	1.33	-	-
	Chickpea	December	2.00	-	10.00	24.00	-	-	1.33	-	-
		January	4.66	-	-	4.33	2.66	-	-	2.00	1.33
		February	6.66	-	1.33	1.33	-	-	-	-	1.66
7.	Fallow -	November	2.66	-	2.00	2.66	2.00	-	-	-	-
	Chickpea	December	2.00	-	6.66	2.66	1.33	-	1.33	-	-
		January	4.66	-	2.66	4.33	1.33	-	-	0.66	-
		February	6.66	-	5.33	1.33	1.33	-	-	0.66	0.33

Table 2 (B) : Mycoflora (x 10^4) in rhizosphere of chickpea crop grown during *rabi* season in wilt sickplot of chickpea

Sr. No.	Crops	November		December		January		February		Mean	
		Fusarium oxysporum f. sp. *ciceri*	Other fungi	*Fusarium oxysporum* f. sp. *ciceri*	Other fungi	*Fusarium oxysporum* f. sp. *ciceri*	Other fungi	*Fusarium oxysporum* f. sp. *ciceri*	Other fungi	*Fusarium oxysporum* f. sp. *ciceri*	Other fungi
1.	Sorghum-Chickpea	1.33	16.99	1.33	12.64	2.00	16.31	4.00	14.98	2.17	15.33
2.	Groundnut-Chickpea	1.33	10.66	1.33	16.32	4.00	5.99	6.66	12.31	3.33	11.32
3.	Soybean-Chickpea	2.00	12.32	2.66	25.32	2.66	21.31	4.00	18.32	2.83	19.32
4.	Sunflower-Chickpea	1.33	9.99	2.00	15.31	4.00	20.98	4.66	19.64	3.00	16.48
5.	Mung-Chickpea	0.66	7.32	2.00	35.33	4.66	16.66	6.66	4.31	3.50	15.91
6.	Udid-Chickpea	0.66	5.99	2.00	13.33	4.66	10.32	6.66	4.32	3.50	4.49
7.	Fallow-Chickpea	2.66	6.66	2.00	11.98	4.66	8.98	6.66	8.98	4.00	9.15

Other fungi observed : *Trichoderma* sp., *A. niger, A. flavus, Penicillium sp. Rhizopus* sp., *Rhizoctonia bataticola, Curvularia lunata, Sclerotium rolfsii*

harvested at the end of month August since the cfu was not counted for the months September and October. The mean *F. oxysporum* f. sp. *ciceri* propagules were 2.67 x 10^4 and 3.00 x 10^4 in mung and udid, respectively.

The data presented in Table 2(A) and (B) represent mycoflora (x10^4) in rhizosphere of chickpea crop grown during *rabi* season .*Fusarium oxysporum* f. sp. *ciceri* propagules observed in chickpea rhizosphere after sorghum ranged between 1.33 - 4.00 x 10^4 during *rabi* season the other fungi propagules observed were 12.64 - 16.99 x 10^4.In the chickpea rhizosphere grown after groundnut, the mean of *F. oxysporum* f. sp. *ciceri* were 3.33 x 10^4 and mean of other fungi was 11.32 x 10^4. The maximum cfu exhibited in the month of December whereas the minimum cfu count observed in January.In the chickpea rhizosphere taken after soybean exhibited *F. oxysporum* f. sp. *ciceri* propagules in the range of 2.00 - 4.00 x 10^4/g during *rabi* season. The maximum cfu of total mycoflora exhibited in the month of December whereas the minimum cfu count observed in the month of November.*Fusarium oxysporum* f. sp. *ciceri* propagules observed in chickpea after sunflower, rhizosphere ranged between 1.33 - 4.66 x 10^4 whereas the other fungi propagules observed between the range of 9.99 - 20.98 x 10^4.Chickpea rhizosphere rotated after mung and udid exhibited similar *F. oxysporum* f. sp. *ciceri* propagules (0.66 - 6.66 x 10^4). The mean of other fungi propagules were 15.91 x 10^4 and 8.49 x 10^4 in mung and udid, respectively.Chickpea raised in fallow plot exhibited average 4.00 x 10^4 cfu/g soil of *F. oxysporum* f. sp. *ciceri* and other fungi were 9.15 x 10^4. It indicates the higher inoculum was available in fallow sick plot compare to others as some of the population of *Fusarium oxysporum* f. sp. *ciceri* was affected by the *kharif* crop cultivated before *rabi* chickpea.

A. niger, A. flavus and *Penicillium* sp. propagules were frequent in each crop and almost in all months like *kharif* season. These findings confirm the results of various workers like Atique *et al.* (1982) who recorded the variation in fungal flora during crop growth, certain fungi *viz*; *Penicillium* sp. *Curvularia* sp. could be isolated up to 45 days of plant growth and *Fusarium* sp. were recorded only at flowering and *Aspergillus* sp.throughout the chickpea plant growth.Lenka and Shrivastava (1997) reported that *A. niger and Penicillium* sp. were found in all samples, whereas *Fusarium and Trichoderma* sp. were found in some of the samples. Bobade (2001) isolated *Fusarium oxysporum* f. sp. *ciceri* in the rhizoplane of diseased chickpea plant alongwith *A. niger, A. flavus, Penicillium* sp. and *Rhizopus* sp. etc.

The correlation of available propagules of *Fusarium oxysporum* f. sp. *ciceri* in the plots rotated with different crops and its relation with the expression of chickpea wilt was recorded. *kharif* sorghum crop exhibited minimum propagules of *F. oxysporum* f. sp. *ciceri i.e.* 11.00 x 10^4 cfu/ g soil and causes 10.11 per cent wilt followed by soybean 11.32 x 10^4 cfu/ g and 11.01 per cent wilt, Haware *et al.* (1996) also reported the similar influence of sorghum crop rotation on wilt incidence in chickpea. Maximum propagules were recorded in fallow *i.e.* 15.31 x 10^4 cfu/ g. Sunflower crop also reflected the reduction of propagules of pathogen.(Table 3).In general inoculum potential has an ability to introduce wilting in the range of 10.11 to 12.94 per cent and there was positive but non-significant correlation between the inoculum available and the wilt incidence in chickpea. These findings confirm the results of Anonymous (2003a) who reported that the residual effect of all the test crops grown in previous season were reducing the chickpea wilt under sick plot condition.(Table 3).

Table 3 : Correlation of *Fusarium oxysporum* f. sp. *ciceri* propagules and wilt incidence in chickpea affected by different crops

Treatments	*F. oxysporum* f. sp. *ciceri* (propagules) x cfu/ 10^4 /g	Wilt percentage	Correlation coefficient (r) values
T_1 - Soybean	11.32	11.01	0.921
T_2 -Sunflower	11.99	12.10	0.908
T_3 - Udid	13.98	12.94	0.903
T_4 -Sorghum	11.00	10.11	0.930
T_5 - Groundnut	13.32	11.34	0.818
T_6- Mung	14.08	12.71	0.913
T_7 - Fallow	15.31	11.49	0.907

* and ** indicates significance of values at P=0.05 and 0.01 is 0.950 + and 0.990 ++, respectively

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