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Influence of Weather Parameters on the Incidence of Sorghum Shoot Fly (Atherigona Soccata, Rondani)

KEYWORDS
Sorghum, shoot fly incidence, weather parameters

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ABSTRACT *Field trials were conducted at Mahatma Phule Krishi Vidyapeeth, Rahuri for fourteen years from 1996-2010 to evaluate influence of weather parameters on the incidence of sorghum shootfly (Atherigona soccata, Rondani) in kharif and rabi seasons. It was concluded that peak incidence (dead hearts) of shoot fly in kharif season was in the month of August while in rabi season it was in the month of October – November. Minimum temperature, RH morning and evening showed significant and positive effect while maximum temperature had significant and negative effect on the incidence of shoot fly. The regression equation for weather parameters three weeks prior to observations showed that there was significant and positive effect of minimum temperature, RH morning on the incidence of shoot fly. It may be predicted that one unit increase in minimum temperature and morning humidity would increase the incidence of shoot fly from 0.60 to 28% and 0.8 to 7%, respectively. The regression equation of the data of weather parameters recorded three weeks prior to observation is useful for early prediction of shoot fly for adopting control measures.*

INTRODUCTION

Sorghum shoot fly (*Atherigona soccata* Rondani) is an important seedling pest (Sherwill *et al.* 1999) attacks sorghum crop upto 30 days from sowing which cause nearly 32% loss of actual produce (Borad and Mittal,1983). However, the infestations at times may be over 90 % (Rao and Gowda, 1967). The shoot fly females lay eggs singly on the adaxial surface of the leaves, parallel to the midrib. After egg hatching, the larvae crawl to the plant whorl and move downward between the folds of the young leaves until they reach the growing point. When they feed, they cut the growing tip resulting in the dryness of central leaf called dead heart. It is estimated that

an increase in 1 % of dead hearts would result in loss of 143 kg grain yield per hectare (Chundurwar and Karanjkar, 1979).

Forewarning refers to prediction of forthcoming infestation of pest in numbers which would cause economic damage to the crop. It is of foremost importance in integrated pest management programme as it serves as tool to remain in preparedness to face the exigencies. Weather based pest forecast models are used in crop protection. For the purpose of development and use of these models, both metrological and biological data are required as input, while the output in the anticipated outbreak of the pests and diseases. Various weather based forewarning models for pests and diseases have been reported earlier (Lingappa *et al*, 2005, Nimbalkar *et al.*, 2005 and Padmaja *et al.*, 2005). With the view of this weekly data on weather parameters and shoot fly incidence for last 14 years for Mahatma Phule Krishi Vidyapeeth, Rahuri region have been used to find out influence of weather parameters on the incidence of sorghum shoot fly and to forecast its occurrence during kharif and rabi season.

Climate of the region is very dry with high evaporative demands. *Rabi* sorghum tract is characterized by low rainfall (500-700 mm) which is inadequate, ill distribution and erratic and thus soil moisture becoming the most important constraint in production of *rabi* sorghum . Though the rainfall start in middle of June, the quantity of rainfall during June to August is less significant in scarcity zone which includes entire area of Solapur and Ahmednagar districts, eastern parts of Pune, Satara, Sangali, Dhule, Nandurbar, Nashik and Jalgaon. Bimodal distribution pattern is noticed with peaks in June-July and September. Dry spells of 2 to 6 and sometimes even of 8 weeks are commonly experienced. The maximum temperature ranges from 24°C to 46°C reaching its peak in April-May and minimum temperature from 5°C to 24°C with lowest in December-January. Extreme high day temperature and low night temperatures results in poor seed set.

MATERIALS AND METHODS

Field trials were conducted at All India co-ordinated sorghum Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri for fourteen years from 1996-2010 to study the effect of different weather variables on shoot fly incidence (dead hearts). The sowing of sorghum variety Phule Amruta (kharif) and Phule Vasudha (Rabi) was done every week in a plot of 1.80 x 1.50 m. with three replications. The data on shoot fly dead hearts were recorded 28 days after emergence of seedling (DAE). The analysis comprised correlation between the dead hears caused by shoot fly and the prevailing weekly meteorological parameters during one week, two week and three week prior to the date of observation of shoot fly under kharif and rabi sown conditions. A critical analysis of correlation coefficients between weather parameters and dead hearts due to shoot fly was carried out as per procedure given by Panse and Sukhatme (1985). Based on the above interferences, regression equations for individual year were also analyzed to see the effect of weather parameters on the incidence of sorghum shoot fly during kharif and rabi season.

RESULTS AND DISCUSSION

It is seen from data of incidence i.e. dead hearts due to shootfly in kharif and rabi season that peak incidence during kharif season was in the month August while during rabi season it was in the month of October – November

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(Kandalkar *et al*, 2003). The correlation coefficient (r) of shoot fly incidence and weather parameters recorded one week, two week and three week prior to the observation showed that the data of weather parameters (Table 3) three weeks prior to observation showed more effect on the incidence (dead hearts) of shoot fly. This is in support of Anonymous, 2004. Minimum temperature, RH morning and evening showed significant and positive effect, while maximum temperature had significant and negative effect on the incidence of shoot fly (Karibasavaraj *et al*, 2005). The regression equation of the data of weather parameters recorded three weeks prior to observation (i.e. 28 DAE) for fourteen years (Table 4) showed that the significance of minimum temperature and RH morning and evening was observed for both rabi and kharif season. However, the positive significance was observed in 8 years data of rabi season. While negative significance was observed in 5 years data of kharif season. As the area under sorghum in Maharashtra is maximum during rabi season, the regression equations for rabi season were considered for prediction of shoot fly. Thus, (Table 4) it is predicted that one unit increase in minimum temperature and morning humidity would increase the incidence of shoot fly from 0.60 to 28% and 0.8 to 7%, respectively. The effect of minimum temperature on shoot fly incidence was positive in rabi season while in kharif season it was negative.

From the above data, it is also revealed that, the crop sown during June (Kharif) and September (Rabi) was least affected by shoot fly, and the same is identified as the most appropriate time for sowing in order to avoid the shoot fly menace. A critical analysis of correlation and regression coefficient between shootfly dead hearts and weather parameters showed that maximum and minimum temperatures, morning and evening relative humidity have profound effect (R^2 ranging from 0.42 to 0.98 during rabi season) on development of shootfly incidence. The weather parameters three week prior to shoot fly incidence should be considered for prediction of shoot fly. The regression equation of data of most influencing weather parameters (maximum temperature, minimum temperature, RH morning and evening) recorded three weeks prior to observation i.e. 28 days after emergence (DAE) is useful for early prediction and preparation for control measures if any. An attempt has been made to use operational shootfly management scheme which not only reduce shootfly incidence lower than economic injury levels but also minimize use of noxious chemicals through proper application of right chemicals at right time using weather based information.

Table 1 : Correlation coefficient (r) of shoot fly incidence and weather parameters (three weeks prior to incidence) (Kharif)

Sr. No.	Year	Max. Temp	Min. Temp	RH Morn.	RH Eve.	Rainfall	Sun shine
1	1996 -97	-0.7062*	-0.3617	0.2019	0.5317*	0.1480	-0.0778
2	1997 -98	-0.0333	-0.4274	-0.2734	-0.0005	-0.2526	-0.4378
3	1998 -99	-0.5493*	-0.7429*	0.4456	0.3730	0.4518	-0.2614
4	1999 -2000	-0.4764	-0.5003*	-0.2811	-0.5295*	-0.3311	-0.2145
5	2000-01	-0.1149	-0.7514*	-0.0994	-0.2202	-0.6240*	-0.0166
6	2001-02	-0.3035	-0.4205	0.6632*	0.3042	0.4053	0.0851
7	2002-03	-0.5754*	0.0041	-0.0083	0.6753*	-0.2019	-0.4152
8	2003-04	0.4133	0.6213*	-0.2073	-0.1368	-0.4978	0.6079*
9	2004-05	0.1701	-0.1002	0.0001	-0.0617	-0.2062	0.0372
10	2005-06	-0.7490*	-0.8579*	0.5545*	0.4219	-0.2537	-0.4481
11	2006-07	-0.4582	-0.6181*	-0.1951	0.1826	-0.0014	-0.7331*
12	2007-08	-0.5288*	-0.3239	-0.2451	-0.4438	0.3187	-0.3345
13	2008-09	-0.0673	0.0601	0.5033*	0.2684	0.5327*	0.4748
14	2009-10	-0.8209*	-0.5757*	0.1706	0.8019*	-0.2325	0.4948

* Significant at 5% level

Table 2 : Correlation coefficient (r) of shoot fly incidence and weather parameters (three weeks prior to incidence) (Rabi)

Sr. No.	Year	Max. Temp	Min. Temp	RH Morn.	RH Eve.	Rainfall	Sun shine
1	1996 -97	0.4162	0.08541	-0.3221	-0.2544	0.0691	-0.3426
2	1997 -98	-0.1680	0.7778*	-0.2378	0.2815	0.5373*	0.8860*
3	1998 -99	-0.1059	0.5506*	-0.6752*	0.4857	-0.2424	0.5823*
4	1999 -2000	0.6025*	-0.2962	-0.2311	-0.4473	-0.3397	-0.3592
5	2000-01	0.2634	-0.2094	0.0678	-0.3564	-0.2398	0.0791
6	2001-02	-0.1349	0.9419*	0.9380*	0.9018*	0.7317*	0.6281*
7	2002-03	0.7084*	0.9248*	0.6012*	0.7158*	0.2354	0.8143*
8	2003-04	-0.0175	0.9465*	0.7335*	0.8008*	0.4490	0.5530*
9	2004-05	0.7697*	0.9392*	0.5092*	0.8191*	0.3987	0.3483
10	2005-06	-0.0746	0.8485*	0.5522*	0.8222*	0.6143*	0.6095*
11	2006-07	-0.0579	0.5993*	0.3990	0.6245*	0.5444*	0.6932*
12	2007-08	-0.3958	0.3993	-0.0831	0.4959	0.4417	0.5465*
13	2008-09	-0.4229	0.7985*	0.7878*	0.6266*	0.6216*	0.5589*
14	2009-10	-0.6009*	0.5117*	0.4337	0.7849*	0.0972	0.5492*

* Significant at 5% level

Table 3 : Regression equation of shoot fly incidence and weather parameters (Three weeks prior to incidence) (Kharif)

Sr. No.	Year	R^2	Constant	Max. Temp	Min. Temp	RH Morn.	RH Eve.
1	1996 -97	0.463	476.97	-6.50	3.32*	0.02	-4.59
3	1997 -98	0.670	156.02	5.54	-9.44*	-1.80*	1.90
5	1998 -99	0.851	1272.88	2.96	-40.82*	-5.72*	1.73
7	1999 -2000	0.690	597.31	-7.38	-13.57*	-0.40	0.22
9	2000-01	0.884	99.11	-2.47	-7.99*	2.67	-0.10
11	2001-02	0.525	7.33	0.002	0.70	0.96	-0.20
13	2002-03	0.795	-16.97	4.45	0.51	-2.38	2.27*
15	2003-04	0.863	-1498.14	41.98	-4.35	0.06	6.06*
17	2004-05	0.469	58.24	3.51	-1.55	0.03	0.68
19	2005-06	0.918	595.75	-9.28	-9.76	1.15	-2.35*
21	2006-07	0.601	579.76	-21.64	-11.49	7.37	-4.75
23	2007-08	0.308	-1388.99	17.13	-1.35	10.58	-0.47
25	2008-09	0.434	-396.81	4.92	-2.29	3.11	0.79
27	2009-10	0.879	92.59	-5.54	-1.89	2.60	-0.79

Table 4 : Regression equation of shoot fly incidence and weather parameters (Three weeks prior to incidence) (Rabi)

Sr. No.	Year	R^2	Constant	Max. Temp	Min. Temp	RH Morn.	RH Eve.
2	1996 -97	0.863	1613.42	-27.68	28.03*	8.23*	-9.20*
4	1997 -98	0.734	117.49	-3.32	3.05*	-0.56	-0.09
6	1998 -99	0.858	149.11	-1.88	0.81	1.11*	0.17
8	1999 -2000	0.779	-375.09	21.88	-13.64	-2.08	3.41
10	2000-01	0.425	-255.25	5.89	-3.85	1.69	0.31
12	2001-02	0.979	-268.53	4.89	0.67	1.41*	0.41
14	2002-03	0.985	95.26	2.05	10.82*	0.80*	-2.40*
16	2003-04	0.945	-102.05	3.17	4.97*	-0.35	-0.03
18	2004-05	0.946	10.78	0.49	4.26*	0.06	-0.97
20	2005-06	0.858	174.84	-3.89	2.27	-0.84	-0.006
22	2006-07	0.878	-85.28	12.03	7.94*	3.91*	-0.10
24	2007-08	0.926	-429.71	26.53	-14.13	3.97*	5.32*
26	2008-09	0.910	-91.23	7.28*	3.85*	3.54*	-1.01
28	2009-10	0.909	328.41	11.49	8.60*	7.21*	3.23

*t value more than 2.0

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