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EFFECT OF DIFFERENT DATES OF SOWING ON THE INCIDENCE OF WHEAT SHOOT FLY ATHERIGONA ORYZAE MALLOCH IN NORTHERN KARNATAKA

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Abstract:
The effect of sowing dates on infestation of wheat shoot fly, *Atherigona oryzae* Mollach was investigated with the growing seasons of II FN of October, I-FN of November, II-Fort Night of November and I-Fort Night of December at University of Agricultural Science, Dharwad. Four sowing dates, using eight wheat genotypes were evaluated for their effect of infestation. Infestation due to shoot fly was significantly varied among the four different dates of sowings. II-FN of October resulted in very minimum mean dead heart damage 7.67 per cent with the eight wheat genotypes followed by 9.88, 17.77 and 19.57 per cent in I-FN of November, II-FN of November and I-FN of December respectively. The dead heart damage followed an increasing trend as the date of sowing delayed. Among all the eight wheat genotypes, UAS-304 recorded highest per cent dead heart 23.42 in I-FN of December sowing and GW-322 recorded lowest 8.30 per cent dead heart at same date of sowing. From the investigation it is concluded that delayed in wheat sowing results in higher per cent dead heart due to shoot fly and therefore early sowing at II-FN of October is the best time period for the wheat crop and that results minimum shoot fly damage.

Keywords: Wheat, Shoot fly, dates of sowing, Management and Wheat Insects

1.0 Introduction

Wheat (*Triticum estivum*.) is a food that is necessary every day and is considered a "food containing many nutrients'' (Duveiller *et al.,* 2007). It has been known as the "King of Cereals" for centuries. It maintains this exciting position, with its roots deep in human culture and its evolutionary history stretching back to human civilization (Schirrmann *et al.*, 2016: Anonymous, 2013 and Borlaug E, 1968). Wheat occupies second position (next to rice) in production among all the cultivated crops in world due to its feeding boon to mankind (Gahukar1994). It is cultivated across a wide range of environments around the world and has the broadest adaptations of all the crop species, more land is devoted worldwide to the production of wheat than to any other crops (Jose et al., 2008). It is the number one food grain consumed directly by human beings and is estimated that more than 35 per cent of the world's population depends on wheat as it supplies more nutrients particularly, essential amino acids than any other single crop (Borlaug 1968: Kalappanavar *et al*., 2010).

Major wheat growing countries include China, India, USA, Russia, Canada and Mexico. The world acreage under the wheat crop cultivation is 223.56 million ha. Wheat cultivation in India started

5000 years ago. Today, India ranks second in wheat production with 31.2 M ha as under cultivation and production of 95.9 million tons with an average productivity of 30q/ha (Anonymous 2013). The major wheat growing states in India are Uttar Pradesh, Madhya Pradesh and Punjab during 2013 -14 seasons (Biradar *et al*., 2011). To meet out the increasing demand of wheat production without increasing area, there is need to incorporate new physiological tools (Bhagwat et al., 2011: Swaminathan, 2013). These tools will help for the improvement of breeding program under abiotic stress environment. If specific physiological trait associated with yield could be identified under stress environment, selection efficiency could be increased. These traits will contribute to more objective screening of yield for selection in early generations, when grain yield may not be properly assessed (Balikai 2012: Anonymous 2010: Gahukar 1994).

Wheat cultivation in Karnataka is unique where in all the three cultivated species are grown in typical hot tropical climate, characterized by the high temperature during the crop growth. Wheat is the one of the important *Rabi* crop grown mainly in Northern Karnataka both under the rainfed and irrigated conditions covering an area of 2.14 lakh hectares with an annual production of 2.3 lakh tones (Singh, 2014). Much of this area is concentrated in North parts of Karnataka comprising twelve revenue districts *viz*., Belagavi, Bellary, Bidar, Vijayapura, Bagalkot, Dharwad, Gadag, Haveri, Gulbarga, Yadagir, Raichur and Koppal districts.

The productivity of wheat is very low (988 kg/ha) in Karnataka as compared to the national average of 2900 kg/ha (Anonymous, 2013). This is mainly due to the fact that large area of wheat (60%) is grown under rain fed condition, non-adaptability of improved technologies and attack of many insect pests. Although damage caused by most of these insects is either insignificant or limited to isolated areas, other pests inflict serious yield and forage losses. Some of these pest problems are directly linked to the unique farming system employed in a particular area, while other pests are opportunistic or generalist herbivores that do not specifically target wheat as a host (Miller and Pike, 2002).

So far more than twenty six (26) insect pests have been recorded on this crop under Indian conditions (Lutfallah 2014: David, 2011). In the past fifty years there has been an increase in wheat productivity and have also been marked by considerable changes in the pest complex. Introduction of high yielding wheat varieties has changed the wheat ecosystem and the changes in the crop environment have become conducive for the development and multiplication of certain insect pest species and have accelerated the incidence of older but innocuous pests and also have led to emergence of new ones (Hein et al.,2005). Consequently over the years, various regions of the country have witnessed limited epidemics of pests like army worm; ghujiya weevil etc., while pests like shoot fly, pink stem borers, brown wheat mite, foliar aphids, termites, have become common and of almost regular occurrence and some new emerging threats to wheat i.e., pink stem borer with the regular involvement of the entomologist in the All India Wheat and Barley Improvement Project (Chavan and Nikam 1990: Chapin *et al*., 2001: Duveiller, 2007).

According to Duveiller *et al.*, (2007) chewing and feeding insects usually do not cause major direct damages in wheat, unless populations reach very high levels. Infestation by several aphids feeding on wheat, such as *Sitobion avenae* or *Rhopalosiphum padi*, result in higher BYDV incidence (Swaminathan, 2013). In some areas, green bug (*Shizaphis graminum*) and Russian wheat aphids (*Diuraphis noxia*) cause damage by injecting a toxin when they feed on leaves. Pink Stem borer (*Sesamia inferens* Walker), Shoot fly (*Atherigona soccata* Malloch) Termites, (*Microtermus obesus* Holmgren) and (*Odontotermus obesus* Rambur) and Cut worms (*Agrotis ipsilon* Hufnagel) Wheat thrips, *(Anaphothrips sudanensis* Trybom) Aphid, (*Macrosiphum miscanthi* Takahashi) are the insects presently occurring on wheat (Shekharappa, 2001).

In the last five years shoot fly, stem borer and aphids are causing more damage in the various district of northern Karnataka. Shoot fly is causing more than 26 per cent dead heart, pink stem borer causing 10 per cent dead heart at seedling stage and white ear heads at later crop growth stage, followed by Aphids (Rajagopal and Channabasavanna 1975: Sithole,1987: Sharma, 1997: Parker *et* *al*., 2001: Chapin et al., 2001: Reddy et al., 2003: Shrinivas M., 2006: Krusteva *et al*., 2011 Singh B, 2012 and Anonymous, 2013).

However, the information available on pests of wheat is very scanty under north Karnataka conditions. There is need to document important pest of wheat, so as to generate information related economics of insect pest incidence in wheat, particularly at Dharwad. Hence the present study was undertaken with the following objective i.e. effect of different dates of sowing on the incidence of wheat shoot fly *Atherigona soccata* malloch at Main Agricultural Research Station, University of Agricultural Sciences Dharwad, Karnataka.

2.0 Materials and Methods

The investigations was carried out at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad on medium black soil which is located at 15^0 26' N latitude, 75^0 07' E longitudes and at an altitude of 678 m above mean sea level. The field experiment was conducted in D block plot no 108. The research station comes under Northern Transition Zone (Zone-8) of Karnataka which lies between the Western Hilly Zone (Zone 9) and Northern Dry Zone (Zone-3).The field was unprotected with a plot size of 2m X 6m.

Treatments were as follows:

The experiment was conducted as main plots with four different dates of sowing and sub plots with eight different wheat varieties and were listed as follows.

Main plots: Four different dates of sowings (1st Fortnight October, 2nd Fortnight of October, 1st Fortnight of November and 2nd Fortnight of November, 2012)

Sub plots: Eight wheat varities

Replications: Each treatment replicated three times

Totally four main plots with four dates of sowing, eight sub plots with eight varieties and three replications were chosen and sowings were done on first fortnight of October to second fortnight of November 2012 at an interval of fifteen days (first fortnight and second fortnight of October and first fortnight and second fortnight of November). Each sowing date was considered as individual treatment. The observations on per cent dead heart were taken at 10, 35 and 70 days after sowing (DAS), and yield data was recorded. The experiment was laid out in split plot design with four treatments and three replications with plot size of 2mx 6m, spacing of 22.5 cm. The data was pooled and subjected to statistical analysis and DMRT. The wheat varieties used were as follows.

Experimental Plot Design

	D1								D2								D3								D4							
R3	S3	S2	S1	S8	S7	S5	S4	S6	S3	S2	S1	S4	S5	S6	S7	S7	S5	S2	S4	S8	S7	S6	S8	S3	S6	S5	S4	S1	S7	S8	S2	S3
R2	S8	S7	S6	S5	S4	S3	S2	S1	S4	S5	S6	S7	S8	S1	S2	S3	S8	S7	S6	S1	S3	S2	S5	S4	S8	S7	S6	S5	S4	S3	S2	S1
R1	S1	S2	S3	S4	S5	S6	S7	S8	S6	S2	S5	S4	S3	S8	S7	S1	S3	S2	S1	S4	S5	S6	S7	S8	S5	S4	S3	S2	S1	S8	S7	S6

D=Main Plots S=Sub Plots

D=Dates of sowing As Main Plots, S=Wheat varieties as Sub Plots and R=Replications

Varieties used for dates of sowing.

Sl. No.	Varieties
1	DWR-162
2	UAS-304
3	MACS-6222
4	RAJ-4037
5	GW-322
6	DWR-225
7	NIAW-34
8	NIAW-917

Statistical analysis

All the data collected in each experiment was subjected to the suitable transformations to analyse. The analysis was done using RBD excel design and values were analysed finally in M-STAT software.

3.0 Results

The results of the investigations on the effect of different dates of sowing on the incidence of wheat shoot fly *Atherigona soccata* malloch at Main Agricultural Research Station, University of Agricultural Sciences Dharwad, Karnataka revealed that. The dead heart incidence due to shoot fly in wheat sown during second fortnight of October, 2012 ranged from 3.5 to 13.48. Highest infestation was recorded in UAS-304 (13.48%) followed by DWR-162 (8.64%), RAJ-4037 (7.98%), DWR-225 (7.63%), MACS-6222 (6.85%), NAIW-917 (6.80%), NAIW-34 (6.54%) and least was recorded in GW-322 (3.50%). Irrespective of the variety, average infestation during first date of sowing was 7.67 per cent.

During second date of sowing per cent dead heart varied from 5.38 to 19.63. Highest infestation was recorded in UAS-304 (19.63%) followed by DWR-162 (10.73%), RAJ-4037 (9.17%), DWR-225 (8.92%), NAIW-917 (8.83%), MACS-6222 (8.41%), NAIW-34 (8.04%) and least was in GW-322 (5.38%). Irrespective of the variety, average infestation during second date of sowing was 9.88 per cent.

In the third date of sowing the per cent dead heart infestation ranged from 11.18 to 26.35. Highest infestation was recorded in UAS-304 (26.35%) followed by DWR-162 (22%), MACS-6222 (17.80%), DWR-225 (17.76%), RAJ-4037 (16.93%), NAIW-34 (14.53%), NAIW-917 (15.60) and least infestation was recorded in GW-322 (11.18 %). Irrespective of the variety, average infestation during third date of sowing was 17.77 per cent.

In the fourth date of sowing the per cent dead heart infestation ranged between 13.12 to 34.21 per cent. Highest infestation was recorded in UAS-304 (34.21%) followed by DWR-162 (24.87%), MACS-6222 (17.91%), DWR-225 (17.88%), RAJ-4037 (17.03%), NAIW-917 (16.90), NAIW-34 (14.53%) and least infestation was recorded in GW-322 (13.12 %). Irrespective of the variety, average infestation during fourth date of sowing was 19.57 per cent.

Among the different dates of sowing the average per cent dead heart infestation ranged between 8.30 to 23.42 respectively. Highest infestation was recorded in UAS-304 (23.42%) followed by DWR-162 (16.56%), DWR-225 (13.05%), RAJ-4037 (12.77%), MACS-6222(12.74%), NAIW-917 (12.03%), NAIW-34(10.93%) and least infestation was recorded in GW-322 (8.30%).

Among the four different dates of sowing fourth date of sowing recorded maximum incidence of dead heart (34.21%) in UAS-304 followed by 24.87 per cent in DWR-162 and least incidence was recorded in GW-322 with 13.12 per cent. While first date of sowing recorded incidence of only 13.48 per cent in UAS-304 and 3.50 per cent in GW 322.

Table 1: Effect of different dates of sowing on the incidence of wheat shoot fly *Atherigona soccata* malloch.

Sl. No	**Genotypes (SP)**	**Shoot fly (*Atherigona soccata*) (dead heart %)**				
		MP1-II-FN (Oct-2012)	**MP2- I-FN (Nov-2012)**	**MP3 II-FN (Nov-2012)**	**MP4 I-FN (Dec-2012)**	**Mean**
1	**S1**-(GW 322)	3.50 (10.71)[a]	5.38 (13.33)[a]	11.18 (19.49)[a]	13.12 (21.25)[a]	8.30 (16.19)[a]
2	**S2**-(NAIW917)	6.80 (15.11)[b]	8.83 (14.80)[ab]	15.60 (23.21)[b]	16.90 (24.26)[b]	12.03 (19.34)[b]
3	**S3**-(MACS6222)	6.85 (15.17)[b]	8.41 (16.84)[bc]	17.80 (24.94)[b]	17.91 (25.02)[b]	12.74 (20.49)[b]
4	**S4**-(DWR 162)	8.64 (17.15)[b]	10.73 (19.12)[c]	22.00 (28.02)[c]	24.87 (29.99)[c]	16.56 (23.57)[c]
5	**S5**- (RAJ 4037)	7.98 (16.40)[b]	9.14 (17.58)[bc]	16.93 (24.29)[b]	17.03 (24.36)[b]	12.77 (20.65)[bc]
6	**S6**-(DWR 225)	7.63 (16.02)[b]	8.92 (17.37)[bc]	17.76 (24.91)[b]	17.88 (25.00)[b]	13.05 (20.82)[bc]
7	**S7**-(UAS-304)	13.48 (21.65)[c]	19.63 (26.37)[d]	26.35 (30.85)[c]	34.21 (35.87)[d]	23.42 (28.68)[d]
8	**S8**-(NAIW34)	6.54 (14.80)[b]	8.04 (16.46)[bc]	14.53 (22.40)[b]	14.61 (22.51)[ab]	10.93 (19.04)[ab]
Mean		7.67 (15.88)[a]	9.88 (17.73)[b]	17.77 (24.76)[c]	19.57 (26.03)[d]	13.72 (21.10)

	SE.m±	**C.D. (0.05)**	-
DOS (MP)	0.23	0.72	-
Genotypes (SP)	0.88	2.58	-
Two SP means @ same level of MP	1.77	5.16	-
Two MP means @ same or different levels of SP	0.86	2.50	-

4.0 Discussions

The investigations data on incidence of shoot fly at different dates of sowing have been presented in Table 1. The per cent dead heart due to shoot fly was recorded an increasing trend as the dates of sowing delayed i.e. from II-Fort Night of October to I-Fort Night of December. The mean per cent dead heart recorded 7.67, 9.88, 17.77 and 19.57 with II-Fort Night-October, I-Fort Night-November, II-Fort Night-November and I-Fort Night of December respectively in all four main plots. However, in eight different sub plots of wheat varieties UAS-304 recorded highest per cent dead heart (23.42%) due to shoot fly infestation and followed by DWR-162 (16.56%), DWR-225 (13.05%), Raj-4037 (12.77%), MACS-6222 (12.74%), NAIW-917 (12.03%), NAIW-34 (10.93%) and GW-322 (8.03%) respectively.

Among all the four dates of sowing highest incidence (19.57%) due to shoot fly was recorded in fourth date of sowing I-Fort Night of December. Among the varieties UAS-304 recorded highest 34.21 per cent and GW-322 had least incidence (13.12%) dead heart respectively.

Present findings are in line with Krusteva and Kandjova (2011) from Bulgaria, who studied the effect of three sowing dates of triticale in the autumn of 2008 (September 30, October 10 and October 22) and 2009 (September 25, October 9 and October 26) on insect pest abundance and degree of damage to the crop by the main pest species. Twenty-four insect species belonging to the orders Hemiptera (18 species), Coleoptera (1 species) and Diptera (5 species) were found to damage triticale shoots. Cereal flies have a major share in damaging triticale stems. The autumn wheat-shoot fly (*Phorbia fumigata* Meigen), and the frit flies *Oscinella frit* (Linnaeus) and *Oscinella pusilla* (Meigen) were the most damaging pests during the autumn vegetation period and *P. fumigata* was the dominant pest in both years of the study and this incidence of shoot fly increased from first date of sowing (16.88%) to (18.45%) in second date of sowing. This is mainly due to the intensity of flight activity of adults depending on weather conditions, sowing time and emergence of plants. But in the third date of sowing shoot fly activity decreased because of precipitation in the third date that decreased the population from (18.45%) to (17.79%) whereas in the present findings shoot fly incidence increased and reached maximum (19.57%) per cent during fourth date of sowing.

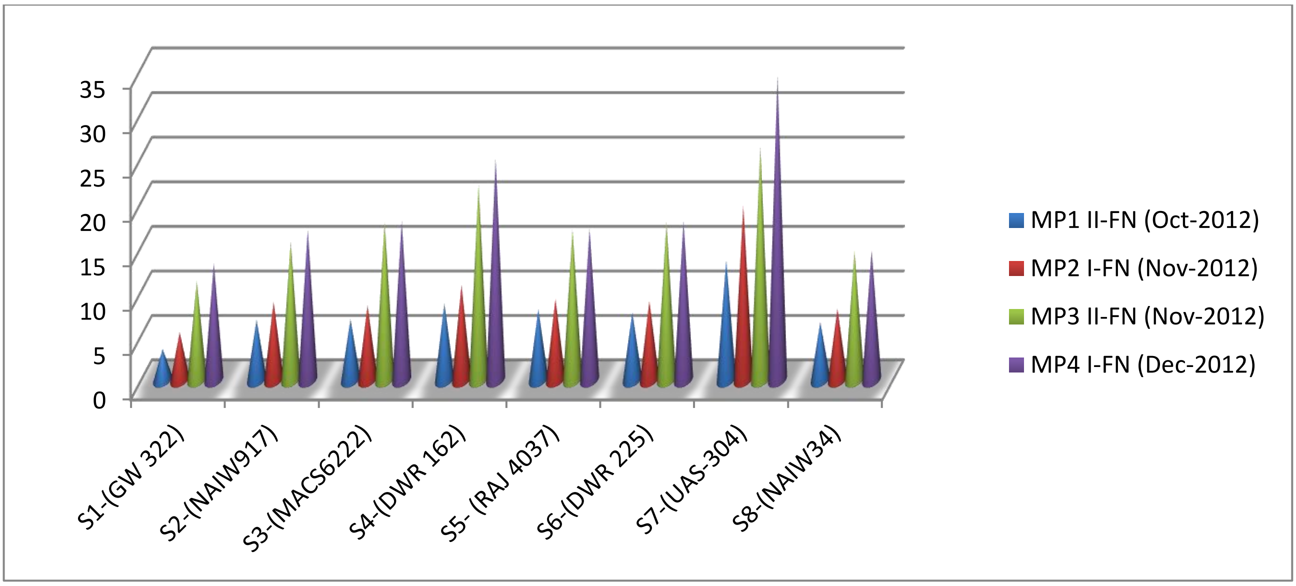

Fig.1: Effect of different dates of sowing on the incidence of wheat shoot fly *Atherigona soccata* malloch.

MP- Main Plots, SP- Sub Plots. The figures in the parenthesis are arc sign transferred. Means followed by same alphabet in a column do not differ significantly (P= 0.05) by DMRT .II-FN-2nd Fort Night, I-FN- 1st Fort Night Further, Sithole (1987) who studied the effect of dates of sowing on shoot flies and stem borer infestations in sorghum were reported to be highest (32 and 31% respectively) for the last sowing date (mid March) and was lowest for the first sowing date (late January). This may be because of smaller supplementary broods of adult flies emerging and infesting on later sown crop and is in line with the present study though the host studied is wheat. Jobie T and Goftisu M (2007) reported from their research investigation that the barley sown in early sowing significantly minimized infestation and resulted in higher yield than late sowing and the present findings were in support with the investigated results with late sown wheat crop resulted in 19.57 per cent dead heart due to Shoot fly in the wheat field. Fully delayed sowing in the Ist- Fort Night of December is totally not good for the wheat crop. As the delayed sowing of wheat crop beyond 1st December or I-FN of December during of Rabi season in the Northern Karnataka of India leads to non-congenial temperature throughout its crop growth. As we know that wheat requires colder temperature during its flowering but crop sown in after the 1st FN of December led to increased temperature during its anthesis that results in bad opening of the flower and less grain set with stunted crop growth. Wheat crop susceptible to increased insect pests damage as insects takes active part as the temperature increases and consumes double the as earlier period.

5.0 Conclusion

The results from the experiment/investigations concluded that sowing of wheat in the early season i.e. II-Fort Night of October is the standard and best time period for wheat crop that results in the lowest insect pest of shoot fly infestation but sowing after the II-Fort Night of November and I-Fort Night of December results in drastic yield as because of the non-congenial temperature throughout its flowering period and increased damage due to shoot fly. Best time for the sowing of *rabi* wheat is the II-Fort Night of October and I Fort Night of November in the Northern Karnataka of India.

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